SUSE

How to Tune Systems with `saptune`

Tuning for SAP workloads such as SAP HANA, SAP S/4HANA and SAP NetWeaver is managed with **`saptune`**. The tool automates OS parameter management by grouping recommended SAP Notes into workload-specific Solutions. This simplifies system configuration, eliminates manual tuning errors and ensures consistent system performance across reboots.

Prerequisites

- A system running designated for SAP workloads with an active subscription
- Knowledge of the target SAP workload

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1 About **saptune**

saptune is a tool designed for tuning the operating system for running SAP workloads. The tool simplifies the mandatory system tuning as described in many SAP Notes. All the required tuning parameters are added to **saptune** notes. These notes are grouped into solutions representing SAP workloads. This ensures that no parameter is missed, while the **saptune** service applies all notes and solutions after each system reboot, thus keeping the system reliably tuned at all times.



Important

saptune is used exclusively for tuning the system for SAP workloads, and not the SAP workloads themselves. **saptune** does not make any changes to SAP configuration files.

2 Installing and enabling **saptune**

Learn how to install, enable and update **saptune**.

2.1 Requirements

- A system on which you plan to run SAP workloads. The system must have an active SUSE subscription.

2.2 Installing and enabling **saptune**

Before you install **saptune**, check if it is already installed on your system. To do this, run the **which saptune** command. Proceed with installing **saptune** if the command returns empty output.

To install and enable **saptune**, proceed as follows:

1. To install **saptune**, run the following command:

```
# zypper install saptune
```

2. Enable and start the `saptune` service using the following command:

```
# saptune service enable
```

2.3 Troubleshooting

When installing and updating **saptune**, pay attention to the **zypper** output to ensure that installation and updates are performed correctly. The output is also saved in `/var/log/zypp/history`.

Because **saptune** is installed as a regular RPM package, refer to the Zypper troubleshooting documentation if the **saptune** installation or update fails.

3 Configuring **saptune**

Learn how to configure **saptune** after it has been installed.

3.1 Requirements

- A system with **saptune** installed.

3.2 Configuring **saptune**

Keep in mind that the **configure** command manages the **saptune** configuration and not the tuning itself. The command exposes only user-defined changes, and it helps avoid misconfiguration. Configurable options include the color scheme, skipped **sysctl** files, etc. (refer to **man 8** for more information). The command can be used as follows:

```
saptune configure PARAMETER VALUE
```

For example:

```
saptune configure COLOR_SCHEME red-noncmpl
```

To view the **saptune** configuration file, use the **saptune configure show** command.

The following command reverts the **saptune** configuration to its defaults:

```
saptune configure reset
```



Important

Do not edit `/etc/sysconfig/saptune` directly. Use **saptune configure** instead.

4 Configuring **saptune** tuning

Learn how to configure **saptune** tuning.

4.1 Requirements

- A system with **saptune** installed, configured and enabled.

4.2 Configuring **saptune** tuning

After installation, **saptune** starts tuning your system with a minimal base tuning (SAP_Base Solution) as described in the SAP Note 1275776 - Linux: Preparing SLES for SAP environments (https://me.sap.com/notes/1275776/E). However, you should choose the tuning solution that best suits your specific **saptune** workload.

The easiest way to tune a system is to apply an SAP Solution that matches your installed SAP software. SAP Solutions are a group of SAP Notes that perform the actual tuning. To display all available Solutions and their Notes, run the following command:

```
# saptune solution list
```

saptune recognizes the following tuning SAP Solutions:

- BOBJ Solution for running SAP BusinessObjects.
- HANA Solution for running an SAP HANA database.
- MAXDB Solution for running an SAP MaxDB database.
- NETWEAVER Solution for running SAP NetWeaver application servers.
- S4HANA-APPSERVER Solution for running SAP S/4HANA Application Servers.
- S4HANA-APP+DB Solution for running both SAP S/4HANA Application Servers and SAP HANA on the same host.
- S4HANA-DBSERVER Solution for running the SAP HANA database of an SAP S/4HANA installation.
- SAP-ASE Solution for running an SAP Adaptive Server Enterprise database.

Note: SAP-ASE Solution deprecation

The SAP-ASE Solution and the associated SAP Notes 1805750 and 1680803 are deprecated and removed from **saptune** 3.2 on SLE 16. The default settings are sufficient for ASE, so no additional tuning is required.

- NETWEAVER+HANA Solution for running both SAP application servers and SAP HANA on the same host.
- NETWEAVER+MAXDB Solution for running both SAP application servers and MAXDB on the same host.

To apply a Solution, run the following command:

```
# saptune solution apply SOLUTION
```

Keep in mind that only one Solution can be applied at a time.

To disable a Solution, run the following command:

```
# saptune solution revert SOLUTION
```

To switch to a different Solution, run the following command:

```
# saptune solution change SOLUTION
```

Alternatively, you can tune the computer according to recommendations from specific SAP Notes. Use the **saptune note list** to view a list of notes that you can tune for.

To apply a Note, run the following command:

```
# saptune note apply NOTE
```

To revert a Note, run the following command:

```
# saptune note revert NOTE
```

Note: Combining optimizations

It is possible to combine Solutions and Notes by reverting Notes from an applied Solution or applying additional ones. However, only one solution can be active at a time. The `saptune` service restores the combination of Solution and Notes after a service restart or reboot.

In rare cases, Notes can have conflicting options or parameters. Arrange your Notes carefully to avoid conflicts. The last Note always takes priority over conflicting options or parameters of previous notes. In this situation, create your own Solution (see *Section 6.2.2, "Creating a new SAP Solution"*) or customize the applied Solution (see *Section 6.2.1, "Customizing an SAP Solution"*).

5 Managing SAP Notes

Learn how to manage SAP Notes.

5.1 Requirements

- A system with **saptune** installed, configured and enabled.

5.2 Managing SAP Notes

The following sections provide information on working with SAP Notes.

An SAP Note configuration contains the OS-specific part of the original SAP Note as completely as possible. A parameter is disabled (it is present in the configuration but has no value) if it does not have a value recommendation, or if **saptune** cannot safely detect the conditions required to set the correct value. To set a suitable value, read the corresponding SAP Note and customize the Note (see *Section 5.2.1, "Customizing an SAP Note"*).

5.2.1 Customizing an SAP Note

Any SAP Note can be configured using the following command:

```
# saptune note customise NOTE
```

The command opens the default editor with a copy of the Note configuration. Remove everything except the parameters you want to change or disable, as well as the header of the section the parameter belongs to.

You can change or add the value of the parameter. To disable a parameter, remove the value, but leave the parameter and the = character. **saptune** lists parameters, but it does not change or check them for the compliance status. For more information, refer to the `saptune-note(5)` man page.

This creates a `/etc/saptune/override/NOTE` file. You can create the file elsewhere and place it in `/etc/saptune/override/`.

Configuration sections can be conditional. This is called tagging. Refer to the `saptune-note(5)` for further information.

When you are done customizing a Note, restart the `saptune` service to apply the changes:

```
# saptune service restart
```

Below is an example of an override file for SAP Note 2382421:

```
# Always:
#  - Changing net.ipv4.tcp_max_syn_backlog from 8192 to 65536
#  - Disable net.ipv4.tcp_slow_start_after_idle, because the parameter is tuned elsewhere
#
# On virtual machines additionally:
#  - Change net.ipv4.tcp_syn_retries from 8 to 16

[sysctl]
net.ipv4.tcp_max_syn_backlog = 65536
net.ipv4.tcp_slow_start_after_idle =

[sysctl:virt=vm]
net.ipv4.tcp_max_syn_backlog = 65536
net.ipv4.tcp_slow_start_after_idle =
net.ipv4.tcp_syn_retries = 16
```

Run the **`saptune note verify 2382421`** command. If the changes have been applied correctly, the output on a virtual machine should be as follows:

```
SAPNote, ... | Parameter                          | Expected | Override  | Actual | Compliant
---------------+-----------------------------------+----------+-----------+--------+-----------
   ...
   2382421, 47  | net.ipv4.tcp_max_syn_backlog       | 65536    | 65536     | 65536  | yes
   ...
   2382421, 47  | net.ipv4.tcp_slow_start_after_idle | 0        | untouched | 0      | yes
   2382421, 47  | net.ipv4.tcp_syn_retries           | 16       | 16        | 16     | yes
   ...
```

On a bare-metal system, the output should be as follows:

```
SAPNote, ... | Parameter                          | Expected  | Override  | Actual | Compliant
---------------+-----------------------------------+-----------+-----------+--------+-----------
   ...
   2382421, 47  | net.ipv4.tcp_max_syn_backlog       | 65536     | 65536     | 65536  | yes
   ...
   2382421, 47  | net.ipv4.tcp_slow_start_after_idle | 0         | untouched | 0      | yes
   2382421, 47  | net.ipv4.tcp_syn_retries           | 8         |           | 8      | yes
```

```
...
```

If changes have not been applied correctly, and you do not see any errors because of the incorrect config file, the `Compliant` field in the table will display `no`, and the values in the `Actual` and `Expected` fields will differ.

5.2.2 Creating a new SAP Note

A new SAP Note can be created using the following command:

```
# saptune note create NOTE
```

The command opens the default editor with a Note configuration template. All the features of **`saptune`** are available here. For more information, refer to the `saptune-note(5)` man page.

This creates a configuration file at `/etc/saptune/extra/NOTE.conf`. You can also create the file elsewhere and place it in `/etc/saptune/extra/`.

Configuration sections can be conditional. This is called tagging. Refer to the `saptune-note(5)` for further information.

5.2.3 Editing a custom SAP Note

To edit a custom Note, use the following command:

```
# saptune note edit NOTE
```

The command opens the default editor with the Note configuration. When you are done editing a Note, restart the `saptune` service to apply the changes. Custom Notes can be customized like shipped Notes.

5.2.4 Deleting an SAP Note or a customization

When deleting a note, keep in mind the following:

- The note can be deleted only if it has not been applied.
- A confirmation is needed to finish the action.
- Internal SAP Notes applied by **`saptune`** cannot be deleted. Instead, the override file is removed when available.
- If the Note is already applied, the command is terminated with the message that the note first needs to be reverted before it can be deleted.

The following command deletes a note, including the corresponding override file, if available:

```
# saptune note delete test

Note to delete is a customer/vendor specific Note.
```

5.2.5 Renaming an SAP Note

Keep in mind the following points:

- The note can be renamed only if it has not been applied.
- A confirmation is needed to finish the action.
- Internal SAP Notes applied by **saptune** cannot be renamed.
- If the Note is already applied, the command is terminated with the information that the Note first needs to be reverted before it can be renamed.

The following command allows renaming a created Note to a new name. If a corresponding override file is available, this file is renamed as well:

```
# saptune note rename test test2
```

5.2.6 Showing the configuration of an SAP Note

The configuration of a Note can be listed using the following command:

```
# saptune note show NOTE
```

5.2.7 Verifying an SAP Note

To verify the tuning of a Note, use the following command:

```
# saptune note verify NOTE
```

For information about the output of the command and verifying the entire tuning instead of a single Note, refer to *Section 7, "Verification and troubleshooting"*.

5.2.8 Reverting an SAP Note

To revert an SAP Note, run the following command:

```
# saptune note revert NOTE
```

This restores all parameters of the SAP Note to their values at the time of application.

To revert everything, run the following command:

```
# saptune note revert all
```

5.2.9 Listing all enabled or applied SAP Notes

To list all enabled SAP Notes, run the following command:

```
# saptune note enabled
```

To list all applied SAP Notes, run the following command:

```
# saptune note applied
```

Both commands are primarily meant for use in scripts.

6 Managing SAP Solutions

Learn how to manage SAP Solutions.

6.1 Requirements

- A system with **saptune** installed, configured and enabled.

6.2 Managing SAP Solutions

This chapter explains how to work with SAP Solutions.

An SAP Solution is a combination of SAP Note configurations grouped logically. It generally represents an SAP product or combination. Applying an SAP Solution effectively applies all SAP Note configurations listed in it. Instructions for listing and setting a solution are provided in *Section 4.2, "Configuring* **saptune** *tuning"*.

6.2.1 Customizing an SAP Solution

An SAP Solution can be customized using the following command:

```
# saptune solution customise SOLUTION
```

The command opens the default editor (defined in the environment variable `EDITOR`) with a copy of the Solution configuration. Change the Note list for the architecture to your liking. For more information, refer to the `saptune-note(5)` man page.

This creates an override file `/etc/saptune/override/SOLUTION.sol`. It is possible to create the file elsewhere and place it in `/etc/saptune/override/`.

When you are done customizing an SAP Solution, restart the `saptune` service to apply the changes.

6.2.2 Creating a new SAP Solution

To create a new SAP Solution, run the following command:

```
# saptune solution create SOLUTION
```

The command opens the default editor (defined in the environment variable `EDITOR`) with a Solution configuration template. Fill in the template.

This creates a Solution configuration file `/etc/saptune/extra/SOLUTION.sol`. You can create the file elsewhere and place it in `/etc/saptune/extra/`.

6.2.3 Editing a custom SAP Solution

To edit a custom SAP Solution, run the following command:

```
# saptune solution edit SOLUTION
```

The command opens the default editor (defined in the environment variable `EDITOR`) with the Solution configuration.

When you are done editing an SAP Solution, restart the `saptune` service to apply the changes.

Custom Solutions can be customized like shipped Solutions.

6.2.4 Deleting an SAP Solution

The following command deletes a created Solution (in this example, myHANA), including the corresponding override file or the override file of a shipped Solution, if available:

```
# saptune solution delete myHANA

Solution to delete is a customer/vendor specific Solution.
Do you really want to delete this Solution 'myHANA'? [y/n]: y
```

The SAP Solution may not be applied at the time of deletion. Keep in mind the following:

- A confirmation is required to finish the action.
- SAP Solutions shipped with **saptune** cannot be deleted. Only the override file is removed, if available.
- If the SAP Solution is already applied, the command is terminated with the information that the SAP Solution first needs to be reverted before it can be deleted.

6.2.5 Renaming an SAP Solution

To rename an SAP Solution, run the following command:

```
# saptune solution rename myHANA myHANA2

Solution to rename is a customer/vendor specific Solution.
Do you really want to rename this Solution 'myHANA' to the new name 'myHANA2'? [y/n]:
```

The SAP Solution may not be applied at this time. Keep in mind the following points:

- A confirmation is needed to finish the action.
- SAP Solutions shipped by **saptune** cannot be renamed.
- If the SAP Solution is already applied, the command will be terminated with the information that the SAP Solution first needs to be reverted before it can be renamed.

6.2.6 Showing the configuration of an SAP Solution

To list the configuration of an SAP Solution, run the following command:

```
# saptune solution show SOLUTION
```

6.2.7 Switching to another SAP Solution

You can switch to a different solution using the **`saptune solution change`** *`SOLUTION`* command.

Keep in mind that internally the current solution is reverted first, and then the new solution is applied. If you have additional notes configured, the order is not preserved.

If the same solution is already applied, no action is taken. Otherwise the current solution gets reverted and the new one applied. The command prompts for confirmation before making the change. This can be disabled by adding the `--force` option.

6.2.8 Verifying an SAP Solution

To verify the tuning of a Solution, run the following command:

```
# saptune solution verify SOLUTION
```

For information about the output of the **`verify`** command and how to verify the entire tuning instead of a single Solution, refer to *Section 7, "Verification and troubleshooting"*.

6.2.9 Reverting an SAP Solution

To revert an SAP Solution, run the following command:

```
# saptune solution revert SOLUTION
```

The SAP Solution must be applied. This reverts all SAP Notes that are part of the SAP Solution and are still applied.

6.2.10 Editing a custom SAP Solution

To edit a custom SAP Solution, run the following command:

```
# saptune solution edit SOLUTION
```

6.2.11 Listing an enabled or applied SAP Solution

To list an enabled SAP Solution, run the following command:

```
# saptune solution enabled
```

To list an applied SAP Solution, run the following command:

```
# saptune solution applied
```

If you revert SAP Notes from an applied SAP Solution, the string `(partial)` appears in the solution name.

Both commands are primarily meant for use in scripts.

7 Verification and troubleshooting

This chapter explains how to verify SAP Notes and troubleshoot **saptune**.

7.1 Requirements

- A system with **saptune** installed, configured and enabled.

7.2 Verification and troubleshooting

To see the current status of **saptune**, run the following command:

```
# saptune status
```

The output contains the following:

- Status of the **saptune**, `sapconf` and `tuned` services.
- Version of the package and running **saptune**.
- Details about configured SAP Solutions and SAP Notes.
- Details about staging.
- Status of the `systemd` system state.
- Virtualization environment (new in **saptune** version 3.1).
- Tuning compliance (new in **saptune** version 3.1).

To analyze your **saptune** installation, run the following command:

```
# saptune check
```

This command performs the following checks:

- Check for mandatory or obsolete configuration files.
- Check for RPM leftovers.
- Check if the `systemd` system state is degraded and lists failed units.
- Check the status of the `sapconf`, **`saptune`** and `tuned` services.



Note

If **`saptune check`** warns about a degraded `systemd` system status, in most cases it has no impact on **`saptune`**. However, failed services require troubleshooting.

The command does not check the tuning itself. To check the tuning, run the following command:

```
# saptune note verify
```



Note

If **`saptune note verify`** is called without specifying a Note, it verifies all enabled Notes. To verify the currently applied Notes, use the **`saptune note verify applied`** or **`saptune verify applied`** commands. Normally, enabled Notes are also applied, except when the system has been rebooted without an enabled `saptune.service`.

The **`saptune note verify`** command prints a table with all applied Notes, including the following:

- SAP Note and version
- The parameter
- The expected value of the parameter
- The value from an override if one exists
- The current system value
- The compliance status of the parameter

The last line contains the overall compliance status of the entire tuning.



Note

Certain parameters of shipped Notes are disabled, meaning they have empty values in the *Expected* column. In such cases, the SAP Note does not contain a concrete recommendation or **saptune** cannot detect the conditions for a recommendation. Read the SAP Note and set the value manually by customizing the Note (See *Section 5.2.1, "Customizing an SAP Note"*).

If the parameters are not compliant, read the footnote if it exists. For certain tunings, equivalent parameters exist, for example:

- `grub:intel_idle.max_cstate` covered by `force_latency`
- `grub:processor.max_cstate` covered by `force_latency`
- `grub:numa_balancing` covered by `kernel.numa_balancing`
- `grub:transparent_hugepage` covered by `THP`

A restart of the `saptune` service fixes the problems, except for non-compliant packages (parameter starts with `rpm:`) or GRUB entries (parameter starts with `grub:`). **saptune** does not install, uninstall or upgrade packages, and it never changes the boot loader.

A typical problem is the **sysctl** parameters that are handled by **saptune** and **sysctl**. A footnote in the parameter's compliance column indicates if it is also present in one of the **sysctl** configuration files. Remove the parameter from the **sysctl** configuration or disable the parameter in **saptune** to fix the problem.

Always investigate the cause of the changed tuning and fix it. If **saptune** does not tune certain parameters, you can revert the Note or disable parameters via an Override.

8 **saptune** machine-readable output

Overview of **saptune**'s machine-readable output in the JSON format.

8.1 Machine-readable output

saptune supports machine-readable output (JSON) for the following commands:

- **saptune [service] status**
- **saptune note list|verify|enabled|applied**
- **saptune solution list|verify|enabled|applied**
- **saptune status**
- **saptune version**
- **saptune check**

The machine-readable output makes it possible to integrate **saptune** into scripts and configuration management solutions.

To generate JSON output, add `--format json` as the first option, for example:

```
> saptune --format json note applied | jq
{
"$schema": "file:///usr/share/saptune/schemas/1.0/saptune_note_applied.schema.json",
"publish time": "2023-08-29 17:05:45.627",
"argv": "saptune --format json note applied",
"pid": 1538,
"command": "note applied",
"exit code": 0,
"result": {
    "Notes applied": [
    "941735",
    "1771258",
    "1980196",
    "2578899",
    "2684254",
    "2382421",
    "2534844",
    "2993054",
    "1656250"
    ]
},
"messages": []
}
```

If a command does not yet support JSON output, the command fails with the `result` block set to `"implemented": false`:

```
[+]
> saptune --format json staging status | jq
{
"$schema": "file:///usr/share/saptune/schemas/1.0/saptune_staging_status.schema.json",
"publish time": "2023-08-29 17:08:16.708",
"argv": "saptune --format json staging status",
"pid": 1653,
"command": "staging status",
"exit code": 1,
"result": {
    "implemented": false
},
"messages": []
}
```

9 **saptune** staging

Learn how to use staging with **saptune**.

9.1 Requirements

- A system with **saptune** installed, configured and enabled.

9.2 Staging

It is possible that a new **saptune** package can contain both binary changes (for example, bug fixes) and new or altered SAP Notes and SAP Solutions. In certain situations, it is preferable to deploy bug fixes and new features while leaving modifications to the system configuration out.

With staging enabled, SAP Note and SAP Solution changes in a package update are *not* activated immediately. They are placed in a staging area, which can be reviewed and released later.

Important

With the current implementation, a package update overwrites the staging if staging is enabled.

Staging is disabled by default, and it can be enabled with the following command:

```
# saptune staging enable
```

From that point, SAP Note and SAP Solution changes shipped by a **saptune** package are put in the staging area. To view the staging area, run:

```
# saptune staging list
```

You can print a tabular overview of the differences between the SAP Note and SAP Solution in the staging and working area with the following command:

```
# saptune staging diff [NOTE...|SOLUTION...|all]
```

After reviewing the differences, you can perform an analysis to see if a release has potential issues or requires additional steps. To do this, run the following command:

```
# saptune staging analysis [NOTE...|SOLUTION...|all]
```

To release an SAP Note or an SAP Solution from the staging area, use the command as follows:

```
# saptune staging [--force|--dry-run] [NOTE..|SOLUTION...|all]
```

The command presents an analysis (see **saptune staging analysis**) and carries out the release after asking for confirmation.

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