SUSE

Setting up a `systemd` service

WHAT?

`systemd` is used to manage system settings and services. `systemd` organizes tasks into components called *units* and groups of units into *targets*.

WHY?

Learn about the basics of setting up a `systemd` service; the types of services, how to edit a service, debug a failed `systemd` service and get email notifications on a failed `systemd` service.

EFFORT

20 minutes of reading time.

REQUIREMENTS

- Basic understanding of Linux commands
- Basic understanding of Linux processes, daemons, and control groups

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Contents

1 What is systemd?

`systemd` is a system and service manager for Linux operating systems. It is the default initialization system for major Linux distributions. `systemd` is not directly initiated by the user, but installed through the `/sbin/init` and started during the early boot. `systemd` acts as the init system that brings up and maintains user space services when run as the first process on boot (PID 1). PID 1 is known as *init* and is the first Linux user-mode process created. It runs until the system shutdown.

`systemd` owns PID 1, and is started directly by the kernel. All other processes are started directly by `systemd` or one of its child processes. `systemd` mounts the host's file system and manages temporary files. It is backward compatible with the SysV init scripts. SysV is an initialization system that predates `systemd`.

In `systemd`, a unit is a resource that the system knows how to operate on and manage. This is the primary object that the `systemd` tools use. These resources are defined with configuration files called unit files.

`systemctl` is the central management tool for controlling the init system. It is used to examine and control the state of the `systemd` system and service manager.

Targets in `systemd` are groups of related units that act as synchronization points during a system boot. Target unit files have a `.target` file extension. Target units group together various `systemd` units through a chain of dependencies.

For troubleshooting, you can use **`journalctl`**, which is used to query and display log messages from the `systemd` journal.

For more information on `systemd`, you can refer to https://systemd.io and **`man 1 systemd`**.

2 Structure of a unit file

In `systemd`, a unit refers to any resource that the system knows how to operate on and manage. This is the primary object that the `systemd` tools use. These resources are defined using configuration files called unit files. Administration is easier when you understand unit files when working with `systemd`. Unit files use a simple declarative syntax that allows you to see easily the purpose and effects of a unit upon activation. Unit files have sections with directives, for example:

```
[Section]
```

```
        Directive1=value
        Directive2=value
        . . .
```

Unit file types include the following sections:

`[Unit]`
: The first section found in most unit files is the `[Unit]` section. This section is used to define the metadata of the unit file and configure the relationship of the unit file to other unit files. This section is usually placed at the top because it provides an overview of the unit file.

`[Automount] / [Mount] / [Path] / [Service] / [Slice] / [Socket] /[Swap] / [Timer]`
: Sections containing directives that are specific to the respective type. See *Section 3, "Unit file types"* for a list of available types. Note that the types `device`, `target`, `snapshot` and `scope` do not have a type-specific section.

`[Install]`
: This is often the last section in the unit file and is optional. This section is used to define the behavior of a unit file when it is enabled or disabled. When you enable a unit file, it automatically starts at boot. Based on the specific unit, there could be a dependency on other related units to work properly. For example, `chrony` requires the directives `After`, `Wants`, and `Before`, which are all dependencies for `chrony` to work with.

EXAMPLE 1: A `systemd` SERVICE FILE

```
[Unit]
Description=usbguard ❶

[Service]
ExecStart=/usr/sbin/usb-daemon ❷

[Install]
WantedBy=multi-user.target ❸
```

❶ A brief and meaningful description explaining the service file's purpose.

❷ Specifies the program to be executed when the service is started.

❸ Starts a multi-user system with networking, and no graphical environment. This directive allows you to specify a dependency relationship.

3 Unit file types

You can determine the type of unit by its file extension. `systemd` categorizes units according to the type of resource they describe.

Types of unit files available for `systemd`:

`.service`
: Describes how to manage a service or application. This includes how to start or stop the service, reload its configuration file (if applicable), under what conditions the service starts automatically, and the dependency or the hierarchy information for related unit files.

`.scope`
: This unit file is automatically created by `systemd` from the information received from the D-Bus interface and is used to manage sets of system processes that are created externally.

`.path`
: Defines a path for path-based activation. By default, a `.service` unit file of the same base name is activated. `inotify` is a kernel API that is used by programs that want to be notified about changes to files.

`.snapshot`
: The **`systemctl snapshot`** command automatically creates a `.snapshot` unit file. This command creates temporary snapshots of the current state of the system. You can modify the current state of the system after making changes. Snapshots are used for rolling back temporary states.

`.timer`
: Defines a timer that is managed by `systemd`. This is similar to a cron job for delayed or scheduled activation. A unit file with the same name, but with file extension `.service` is started when the timer is reached.

`.slice`
: Associate Linux Control Group nodes, which allow resources to be assigned or restricted to any processes associated with the slice. The name indicates the hierarchy within the control group tree. Units are placed in slices by default depending on their type.

`.target`
: Provides synchronization for other units during a boot up or a change in state, or brings the system to a new state. Other units specify their relation to targets in order to sync with the target's operations.

`.socket`

Describes a network, an IPC socket, or a FIFO buffer that `systemd` uses for socket-based activation. There is an associated `.service` file that starts when an activity is seen on the socket that this unit defines.

`.device`

Defines a device that has been designated for `systemd` management by `udev` or `sysfs` file system. Not all devices have the `.device` file. This unit file is required when ordering, mounting, or accessing a device.

`.swap`

Defines the swap space on the system. The name of the unit file must reflect the device or file path of the space.

`.mount`

Defines a mount point on the system to be managed by `systemd`. This file is named after the mount path, with the slashes changed to dashes. Entries within `/etc/fstab` can have units created automatically.

`.automount`

Defines a mount point that is automatically mounted. Name the file after the mount point that it refers to. A matching `.mount` unit file is required to define the specifics of the mount.

4 Unit dependencies and order

`systemd` has two types of dependencies: requirement and order dependencies. Requirement dependencies specify which other units must be either started or stopped when activating a unit. Order dependencies specify the order in which units must be started.

Unit dependencies

Unit files have the dependencies feature. A unit may want or require one or more other units before it can run. These dependencies are set in unit files with the directives `Wants` and `Requires`.

`Wants`

For example, if unit A has `Wants=unit B`, when unit A is run, unit B runs as well. But if unit B starts successfully or not, does not have an influence on unit A running successfully.

`Requires`

If unit A has `Requires=unit B`, both units run but if unit B does not run successfully, unit A is deactivated. It does not matter if the processes of unit A would have run successfully.

Unit order

Without proper instructions, `systemd` can run a group of units at the same time. Starting services in the right order is important for a good functioning of the Linux system. You can arrange the order with the unit file directives `Before` and `After`.

`Before`

For example, if unit A has `Before=unit B`, when both units are run, unit A is executed fully before unit B.

`After`

If unit A has `After=unit B`, when both units are run, unit B is executed fully before unit A.

5 Creating a Linux service with `systemd`

You can create an auto-start task or program that executes every time that you boot or reboot your system by creating a Linux service with `systemd`.

To create a custom `systemd` service, involves creating a service unit file, which defines the service and its behavior.

1. Create a new script at the specified location, that is used by the `systemd` service:

   ```
   vi /usr/local/bin/FILE_NAME.sh
   ```

   The `/usr/local/bin` is the standard location for installing custom scripts and executables specific to the system. When you place the script in this location,you make is accessible to all system users without a need to specify the full path.

2. Paste the following in the file:

   ```
   #!/bin/bash
        echo "Hello, Everyone!"
   ```

3. Make the script executable:

   ```
   > sudo  chmod +x /usr/local/bin/FILE_NAME.sh
   ```

4. Create a `systemd` unit file at the specified location:

```
vi /etc/systemd/system/FILE_NAME.service
```

5. Paste the following in the file:

```
[Unit]
Description= Name service

[Service]
ExecStart=/usr/local/bin/FILE_NAME.sh

[Install]
WantedBy=multi-user.target
```

   The `Unit` section gives you a description of the service. The `Service` section defines the service and its behavior. The `ExecStart` directive specifies the command to start the service. The `Install` section specifies when the service should start.

6. Save and exit the file.

7. To make `systemd` aware of the new service, run:

```
> sudo  systemctl SERVICE_NAME
```

8. Start,enable, and check the status of the service:

```
systemctl start SERVICE_NAME
```

```
systemctl enable SERVICE_NAME
```

```
systemctl status SERVICE_NAME
```

6 Editing a `systemd` unit file

You can use the **`systemctl`** command to edit and modify an existing service file.

There are three main directories where unit files are stored on the system:

`/usr/lib/systemd/system/`
: When the package is installed, `systemd` unit files reside here.

`/run/systemd/system/`

: `systemd` unit files created at run time.

`/etc/systemd/system/`

: `systemd` unit files that are created by the **`systemctl enable`** command and also unit files added for extending a service.

The **`sysctemctl edit`** command by default opens a unit file snippet, for example:

```
> sudo  systemctl edit testhttp.service
```

This creates a blank file that is used to override or add directives to the unit file definition. A directory is created in `/etc/systemd/system` which contains the name of the unit file with `.d` appended. For example, a directory called `testhttp.service.d` is created.

Within the directory, a snippet called `override.conf` is created. `systemd` merges the override snippet with the full unit file, when the unit is loaded. This snippet's directives take precedence over those directives in the original unit file.

You can edit the full unit file instead of creating a snippet with the `--full` flag. For example:

```
> sudo  systemctl edit --full testhttp.service
```

This loads the current unit file into the editor, where you can modify. When you save and exit the editor,the modified file is written to `/etc/systemd/system`, which takes precedence over the system's unit definition usually located in `/lib/systemd/system`.

To remove any additions you have made, you can either delete the unit's `.d` configuration directory or the the modified service file from `/etc/systemd/system`. After deleting the file or directory, reload the `systemd` process so that it reverts back to the initial system process.

7 Debugging a systemd service

Use the **`systemctl`** and **`journalctl`** commands to investigate the reasons for a failed system service.

When `systemd` fails to start a service, a generic error message is displayed, for example:

```
# systemctl start apache2
Job for apache2.service failed because the control process exited with error code.
See "systemctl status apache2.service" and "journalctl -xe" for details.
```

- List all available services and their current status:

```
# systemctl list-units -t service --all
```

For example:

```
# systemctl list-units -t service --all
  UNIT                                LOAD      ACTIVE   SUB     DESCRIPTION>
  accounts-daemon.service             loaded    active   running Accounts Se>
  apache2.service                     loaded    failed   failed  The Apache HTTP
 server>
\u25cf acpid.service                  not-found inactive dead    acpid.servi>
  after-local.service                 loaded    inactive dead    /etc/init.d>
  alsa-restore.service                loaded    active   exited  Save/Restor>
  alsa-state.service                  loaded    inactive dead    Manage Soun>
\u25cf amavis.service                 not-found inactive dead    amavis.serv>
  apparmor.service                    loaded    active   exited  Load AppArm>
  appstream-sync-cache.service        loaded    inactive dead    Synchronize>
  auditd.service                      loaded    active   running Security Au>
  augenrules.service                  loaded    active   exited  auditd rule>
```

- If you think a specific service has failed, you can use the `is-failed` option:

```
# systemctl is-failed apache2.service
              failed
```

- Check the status of the failed service to find the specific error message:

```
# systemctl status --full --lines=50 apache2
  ● apache2.service - Apache HTTP Server
  Loaded: loaded (/usr/lib/systemd/system/apache2.service; enabled; vendor preset:
 disabled)
  Active: failed (Result: exit-code) since Fri 2021-08-20 10:24:15 CEST; 2min 24s
 ago
    Docs: https://httpd.apache.org/docs
 Process: 2491 ExecStart=/usr/bin/apache2 --add-runtime oci=/usr/sbin/apache-runc
 $DOCKER_NETWORK_OPTIONS $DOCKER_OPTS >
Main PID: 2491 (code=exited, status=1/FAILURE)
```

In the above example, the service ran as process ID 2491, but failed. Error messages give you a hint on what to do.

- You can also use the **`journalctl`** command to check the log of the failed service:

```
#  journalctl --catalog --pager-end --unit=apache2
[...]
```

```
Aug 20 10:24:15 localhost.localdomain dockerd[2479]: unable to configure the Docker
 daemon with file /etc/apache2/daemon.json:
cannot unmarshal string into Go value of type map[string]interface {}
```

The option `--unit` limits the log entries only to the failed Apache2 service. The error message suggests looking into the file `/etc/docker/daemon.json`. In this scenario, the error was caused by a wrong syntax. You can fix this and restart the Apache2 service.

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