SUSE

Managing `systemd` Services

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 how to manage your system services by using `systemd` to start,stop, enable and disable a service, send termination signals, use the **systemctl** command and manage `systemd` targets. The article also includes troubleshooting and best practices.

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 Starting and stopping `systemd` services

You can start and stop `systemd` services by using units which are resources. The target units are service units, which have a `.service` suffix. For service management tasks, you do not have to add the `.service` because `systemd` knows that you want to execute a service.

To start and stop `systemd` services, use the following commands:

- To start a `systemd` service:

  ```
  > sudo  systemctl start SERVICE
  ```

- To check the status of a `systemd` service:

  ```
  > sudo  systemctl status  SERVICE
  ```

- To stop a currently running `systemd` service:

  ```
  > sudo  systemctl stop SERVICE
  ```

You can also use the following **systemctl** commands:

- Stops the service and then starts it. If the service is not running, it is started.

  ```
  > sudo  systemctl restart SERVICE
  ```

- Reloads the `systemd` service's configuration file without interrupting operations.

  ```
  >   systemctl reload SERVICE
  ```

- Reloads the service if it supports reloading, otherwise it restarts the service. If the service is not running, it is started.

  ```
  > sudo  systemctl reload-or-restart SERVICE
  ```

3   Enabling and disabling `systemd` services

You can enable and disable `systemd` services by using `units` which are resources.

To enable and disable `systemd` services, follow:

1. To enable a service at boot:

   ```
   > sudo  systemctl enable SERVICE
   ```

   A symbolic link is created usually in `/lib/systemd/system` or `etc/systemd/system` pointing into the location on disk where `systemd`looks for autostart files. This is either in `/lib/systemd/system` or `/etc/systemd/system`, which is usually `/etc/systemd/system/EXAMPLE_TARGET.target`.

For example:

```
> sudo  systemctl enable firewalld.service
     Created symlink /etc/systemd/system/dbus-org.fedoraproject.FirewallD1.service
 \u2192 /usr/lib/systemd/system/firewalld.service.
     Created symlink /etc/systemd/system/multi-user.target.wants/firewalld.service
 \u2192 /usr/lib/systemd/system/firewalld.service.
```

2. To disable a service from starting automatically:

```
> sudo  systemctl disable SERVICE
```

This removes the symbolic link that indicates that the service should be started automatically.

For example:

```
> sudo  systemctl disable firewalld.service
     Removed /etc/systemd/system/multi-user.target.wants/firewalld.service.
     Removed /etc/systemd/system/dbus-org.fedoraproject.FirewallD1.service.
```

3. To check the status of a service:

```
> sudo  systemctl status SERVICE
```

For example:

```
> sudo  systemctl status firewalld.service
     \u25cf firewalld.service - firewalld - dynamic firewall daemon
     Loaded: loaded (/usr/lib/systemd/system/firewalld.service; enabled; vendor p>
     Active: active (running) since Wed 2024-01-31 01:36:36 EST; 1h 5min ago
     Docs: man:firewalld(1)
     Main PID: 965 (firewalld)
     Tasks: 2
     CGroup: /system.slice/firewalld.service
     \u2514\u2500965 /usr/bin/python3 -Es /usr/sbin/firewalld --nofork --nopid
```

Enabling or disabling a service does not start it in the current session. You can use **start** or **stop** to start or stop the service and enable or disable it at boot.

4 Sending termination signals to `systemd` services

Each service in `systemd` is categorized into a control group which makes it easy to identify all parent and child processes of a service. This enables you to send a signal to each of these processes. You can send a signal to a `systemd` service or to the individual processes that belong to a service.

✋ Warning: Do not cancel the D-Bus service in a running system

The D-Bus service is the message bus for communication between `systemd` clients and the `systemd` manager that is running as PID 1. D-Bus is a stand-alone daemon and an integral part of the init infrastructure.

Terminating or restarting the D-Bus service is neither recommended nor supported. This breaks the `systemd` client and server communication and makes most of the `systemd` functions unusable.

The **`systemd-cgls`** command displays all processes that belong to a `systemd` service. It recursively shows the contents of the specific Linux control group hierarchy in a tree.

- Lists all control groups and their processes:

  ```
  > systemd-cgls
  ```

- Displays all processes that belong to a particular service, for example: the `libvirtd.service` service:

  ```
  > systemd-cgls -u libvirtd.service
  ```

- Sends a termination signal to the service:

  ```
  > sudo systemctl kill SERVICE
  ```

- By default, the **`kill`** command sends the signal to `all` processes of the specified control group. You can restrict it to the `control` or the `main` process. The latter is, for example, useful to force a service to reload its configuration by sending `SIGHUP`:

  ```
  > sudo systemctl kill -s SIGHUP --kill-who=main SERVICE
  ```

- Sends a different signal to a service with the `-s` option, such as `SIGKILL` (9):

  ```
  > sudo systemctl kill -s 9 SERVICE
  ```

5 Managing `systemd` targets with the **`systemctl`** command

`systemd` targets are special unit files that describe a system or synchronization state. They are used to group units together in order or bring the system to a certain state, just like other init systems use runlevels. You can use the **`systemctl`** command to manage `systemd` targets.

Getting and setting the default target

`systemd` has a default target that is used when booting the system. To find the default target for your system:

```
> sudo systemctl get-default
  multi-user.target
```

You can also change the default target:

```
> sudo systemctl set-default graphical.target
```

Listing the available targets

To get the available targets on your system:

```
> sudo systemctl list-unit-files --type=target
        STATE                   VENDOR PRESET
    basic.target                static   -
    blockdev@.target            static   -
    bluetooth.target            static   -
    boot-complete.target        static   -
    cryptsetup-pre.target       static   -
    cryptsetup.target           static   -
    ctrl-alt-del.target         alias    -
    cvs.target                  static   -
    default.target              alias    -
    emergency.target            static   -
    exit.target                 disabled disabled
    final.target                static   -
    first-boot-complete.target  static   -
    getty-pre.target            static   -
    getty.target                static   -
    .....
```

Multiple targets can be active at the same time. An active target is when `systemd` attempts to start all the units in a specific target. To see a list of the active targets:

```
> sudo systemctl list-units --type=target
      UNIT              LOAD   ACTIE SUB    DESCRIPTION                        >
  basic.target          loaded active active Basic System
  bluetooth.target      loaded active active Bluetooth Support
  cryptsetup.target     loaded active active Local Encrypted Volumes
  getty.target          loaded active active Login Prompts
  graphical.target      loaded active active Graphical Interface
  local-fs-pre.target   loaded active active Preparation for Local File Syste>
  local-fs.target       loaded active active Local File Systems
  multi-user.target     loaded active active Multi-User System
  network-online.target loaded active active Network is Online
  network-pre.target    loaded active active Preparation for Network
  network.target        loaded active active Network
  nss-lookup.target     loaded active active Host and Network Name Lookups
  nss-user-lookup.target loaded active active User and Group Name Lookups
  paths.target          loaded active active Path Units
  remote-fs.target      loaded active active Remote File Systems
  slices.target         loaded active active Slice Units
  snapd.mounts-pre.target loaded active active Mounting snaps
  .....
```

Isolating targets

You can start all the units associated with a target and stop all units that are not part of the dependency tree. For example, if you are using a graphical environment with an active `graphical.target` target, you can stop the graphical system and enable a multiuser command-line system by isolating the `multi-user.target` target. Since the `graphical.target` target depends on the `multi-user.target` target, all the graphical units are stopped. To take a look at the dependencies of the target you are isolating:

```
> sudo systemctl list-dependencies multi-user.target
```

Output:

```
multi-user.target
  o ├─after-local.service
  ● ├─apparmor.service
  o ├─appstream-sync-cache.service
  ● ├─auditd.service
  ● ├─avahi-daemon.service
  ● ├─btrfsmaintenance-refresh.path
  ● ├─chronyd.service
  ● ├─cron.service
```

- ├─cups.path
- ├─dbus.service
- ├─fail2ban.service
- ├─firewalld.service
- ├─irqbalance.service
- ├─kbdsettings.service
- ├─libvirtd.service
- ├─mcelog.service
- ├─ModemManager.service
- ├─NetworkManager.service
- ├─nscd.service
- ├─plymouth-quit-wait.service
- ○ ├─plymouth-quit.service
- ├─postfix.service

You can isolate the specific target:

```
> sudo sudo systemctl isolate multi-user.target
```

6 Troubleshooting `systemd` management

If you are experiencing problems with `systemd`, try the following troubleshooting tips to identify and resolve issues:

Check the runtime status of a service

To find out the current runtime status of a service:

```
> sudo systemctl status SERVICE
```

Display all processes that belong to a particular service, for example: the `libvirtd.service` service:

```
> systemd-cgls -u libvirtd.service
```

Check the logs for your service with the `journalctl -u` SERVICE command

If you experience any issue with a `systemd` service, check the service's log. For example:

```
> sudo  journalctl -u my-custom-service.service
```

The command displays logs for the specified service, including any error messages, warnings or other relevant information. You can use these logs to identify and fix issues with the service.

7 Best practices for `systemd` management

To manage `systemd` services, try certain best practices that are equipped to handle different situations:

Check the runtime status of a service

To find out the current runtime status of a service:

```
> sudo systemctl status SERVICE
```

Use absolute path in your `systemd` unit file

Use an absolute path for executable files and required files, such as configuration files or scripts in your `systemd` unit file. `systemd` does not rely on the user's environment variables like $PATH to locate files. Use the *ExecSearchPath* directive in the `[SERVICE]` section.

```
[Service]
            ExecSearchPath=ABSOLUTE_PATH
```

Use the ExecReload directive

Use the *ExecReload* directive in the `[SERVICE]` section when you want to define a specific command that should be executed when you reload a service with the **systemctl reload** command. This is useful for services that can dynamically reload their configuration without a restart.

```
[Service]
ExecStart=PATH_TO_EXECUTABLE
ExecReload=PATH_TO_RELOAD_SCRIPT
```

Use the RestartSec directive

Use the *RestartSec* directive in the `[SERVICE]` section when you want to define a delay (in seconds) before the service is restarted after a failure. This is useful for services that require a specified time to release resources or prevent rapid restart loops that can cause high system load.

```
[Service]
ExecStart=PATH_TO_EXECUTABLE
Restart=on-failure
RestartSec=5
```

Disable emergency mode on a remote machine

You can disable emergency mode on a remote machine, for example, a virtual machine hosted on Google Cloud. If this mode is enabled, the machine is blocked from connecting to the network. For example:

```
> sudo systemctl mask emergency.service
```

```
> sudo systemctl mask emergency.target
```

8 **systemctl** commands overview

The **systemctl** command is used to examine and control the state of systemd and service manager.

You can use the following common **systemctl** commands and refer to the *man systemctl* page.

8.1 Viewing systemd information

To view information about systemd components, you can use the following commands:

systemctl list-units

Lists the systemd units. You can use the optional arguments: **--state=running** to show the active units and **--type=service** to show the exited and active units.

systemctl list-unit-files

Lists the systemd units and the status, such as static, generated, disabled, alias, masked, and enabled.

systemctl list-dependencies

Lists the dependency tree.

systemctl list-dependencies *UNIT_FILE*

Lists the dependencies of a unit file.

8.2 Managing systemd services

The **systemctl** command enables you to perform the following tasks with services.

systemctl status *SERVICE*

    Checks the status of the specific service.

systemctl show *SERVICE*

    Displays the service information.

systemctl start *SERVICE*

    Instead of manually starting the service, use the `start` command. When a change is made to the configuration file, the related service must be started again.

systemctl stop *SERVICE*

    Stops a specific running service.

systemctl restart *SERVICE*

    Instead of manually restarting the service, use the `restart` command. When a change is made to the configuration file, the related service must be restarted again.

systemctl enable *SERVICE*

    Enables the service on boot.

systemctl disable *SERVICE*

    Disables the service on boot.

systemctl reload-or-restart *SERVICE*

    Reload the service if it supports reloading, otherwise it restarts the service. If the service is not running, it is restarted.

systemctl mask *SERVICE*

    When a service is masked, this means the unit file is symlinked to `/dev/null`. A symlink for a masked service is created from `/etc/systemd/system` to point to `/dev/null`. This makes it impossible to load the service even if another enabled service requires it. It must be stopped manually, or it continues to run in the background. You can use `--runtime` option to only mask temporarily until the next reboot of the system.

```
Created symlink /etc/systemd/system/FOSSLinux.service → /dev/null.
```

systemctl unmask *SERVICE*

    Unmasks the service. It is effective when the system is started or restarted manually.

8.3 Managing system states

The `systemctl` command enables you to perform power management processes on your system, like restarting, shutting down and so on, as described below.

systemctl reboot

Reboots the system `reboot.target`.

systemctl poweroff

Powers off the system `poweroff.target`.

systemctl emergency

Goes into the emergency mode `emergency.target`.

systemctl default

Goes back to default target `multi-user.target`.

9 More information

- Man 1 systemd

- Man 1 journalctl

- Man 1 systemd-cgls

- Man 1 systemctl

- Man 5 systemd.service

- Man 5 systemd.kill

- Man 7 systemd.boot

- Introduction to `systemd` basics https://documentation.suse.com/smart/systems-management/html/systemd-basics/index.html ↗

- System and Service Manager https://systemd.io/ ↗

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