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RH12412 - Service and Daemon Management

Contents

Systemd

The boot systems prior to Systemd, **SysVinit** and **Upstart**, were **sequential** boot systems.

Systemd, on the other hand, tries to start as many services in parallel as possible. This is possible because most modern hardware architectures are multi-core. If a service depends on another that has not yet been started, the former is put on hold in a buffer. What's more, services that are not

needed to start at boot time, such as cups, are only started later if necessary. During startup, partitions are mounted in parallel. Recently, **Systemd** has replaced traditional boot scripts with compiled binaries, which are much faster than their predecessors.

Instead of talking about boot scripts and execution levels, **Systemd** uses the terminology **Units** and **Targets**. A Unit can be :

- **.automount** - enables the automount feature.
- **.device** - exposes a device in systemd.
- **.mount** - controls when and how file systems are mounted.
- **.path** - activates a service when there is access to a file or directory monitored by the system.
- **.service** - starts, stops, restarts or reloads a service.
- **scope** - manages services.
- **.slice** - groups Units in a tree to limit resources using CGroups.
- **.snapshot** - a saved state of the Systemd manager.
- **.socket** - allows Units to use sockets for inter-process communication.
- **swap** - encapsulates a device or swap file.
- **.timer** - triggers the activation of other Units using Systemd timers.
- **.target** - groups multiple Units together so that they can be started at the same time. For example **network.target** groups together all the Units needed to start all the network interfaces at the same time.

A Target is a sort of **large step** in booting the system:

- **halt.target** - stops the system.
- **poweroff.target** - stops the system and cuts the power.
- **shutdown.target** - shuts down the system.
- **rescue.target** - starts the system in single-user mode (only root can connect). All file systems are mounted but the network is not booted.
- **emergency.target** - boots the system in single-user mode (only root can connect). Only the root file system is mounted in read-only mode. The network is not started.
- **multi-user.target** - starts the system in multi-user mode with all file systems mounted and the network service started.
- **graphic.target** - starts the system in multi-user.target then starts the graphical interface.
- **hibernate.target** - saves the current state to disk and stops the system. When the system is rebooted, the state is restored.
- **reboot.target** - restarts the system.

Systemd uses Targets in a similar way to how **SysVinit** uses runlevels. To make the transition easier, there are **Targets** which ‘simulate’ the run levels of **SysVinit** :

```
[root@redhat9 ~]# ls -l /usr/lib/systemd/system/runlevel*
lrwxrwxrwx. 1 root root 15 Jul 18 13:00 /usr/lib/systemd/system/runlevel0.target -> poweroff.target
lrwxrwxrwx. 1 root root 13 Jul 18 13:00 /usr/lib/systemd/system/runlevel1.target -> rescue.target
lrwxrwxrwx. 1 root root 17 Jul 18 13:00 /usr/lib/systemd/system/runlevel2.target -> multi-user.target
lrwxrwxrwx. 1 root root 17 Jul 18 13:00 /usr/lib/systemd/system/runlevel3.target -> multi-user.target
lrwxrwxrwx. 1 root root 17 Jul 18 13:00 /usr/lib/systemd/system/runlevel4.target -> multi-user.target
lrwxrwxrwx. 1 root root 16 Jul 18 13:00 /usr/lib/systemd/system/runlevel5.target -> graphical.target
lrwxrwxrwx. 1 root root 13 Jul 18 13:00 /usr/lib/systemd/system/runlevel6.target -> reboot.target

/usr/lib/systemd/system/runlevel1.target.wants:
total 0

/usr/lib/systemd/system/runlevel2.target.wants:
total 0

/usr/lib/systemd/system/runlevel3.target.wants:
total 0

/usr/lib/systemd/system/runlevel4.target.wants:
total 0

/usr/lib/systemd/system/runlevel5.target.wants:
total 0
```

LAB #1 - The systemctl command

To view the list of Units, use the **systemctl** command with the **list-units** option:

```
[root@redhat9 ~]# systemctl list-units
  UNIT                                                                                       LOAD
ACTIVE SUB       DESCRIPTION                                >
  proc-sys-fs-binfmt_misc.automount                                                          loaded
```

```
active running   Arbitrary Executable File Formats File Syst>
  sys-devices-pci0000:00-0000:00:01.1-ata2-host2-target2:0:0-2:0:0:0-block-sr0.device                    loaded
active plugged   QEMU_DVD-ROM
  sys-devices-pci0000:00-0000:00:05.0-0000:01:01.0-virtio2-host0-target0:0:0-0:0:0:0-block-sda-sda1.device loaded
active plugged   QEMU_HARDDISK 1
  sys-devices-pci0000:00-0000:00:05.0-0000:01:01.0-virtio2-host0-target0:0:0-0:0:0:0-block-sda-sda2.device loaded
active plugged   QEMU_HARDDISK 2
  sys-devices-pci0000:00-0000:00:05.0-0000:01:01.0-virtio2-host0-target0:0:0-0:0:0:0-block-sda.device     loaded
active plugged   QEMU_HARDDISK
  sys-devices-pci0000:00-0000:00:12.0-virtio1-net-ens18.device                                           loaded
active plugged   Virtio network device
  sys-devices-platform-serial8250-tty-ttyS0.device                                                       loaded
active plugged   /sys/devices/platform/serial8250/tty/ttyS0
  sys-devices-platform-serial8250-tty-ttyS1.device                                                       loaded
active plugged   /sys/devices/platform/serial8250/tty/ttyS1
  sys-devices-platform-serial8250-tty-ttyS2.device                                                       loaded
active plugged   /sys/devices/platform/serial8250/tty/ttyS2
  sys-devices-platform-serial8250-tty-ttyS3.device                                                       loaded
active plugged   /sys/devices/platform/serial8250/tty/ttyS3
  sys-devices-virtual-block-dm\x2d0.device                                                               loaded
active plugged   /sys/devices/virtual/block/dm-0
  sys-devices-virtual-block-dm\x2d1.device                                                               loaded
active plugged   /sys/devices/virtual/block/dm-1
  sys-devices-virtual-misc-rfkill.device                                                                 loaded
active plugged   /sys/devices/virtual/misc/rfkill
  sys-module-configfs.device                                                                             loaded
active plugged   /sys/module/configfs
  sys-module-fuse.device                                                                                 loaded
active plugged   /sys/module/fuse
  sys-subsystem-net-devices-ens18.device                                                                 loaded
active plugged   Virtio network device                      >
  -.mount                                                                                                loaded
active mounted   Root Mount
  boot.mount                                                                                             loaded
```

```
active mounted   /boot
  dev-hugepages.mount                                                                                  loaded
active mounted   Huge Pages File System
  dev-mqueue.mount                                                                                     loaded
active mounted   POSIX Message Queue File System
  proc-sys-fs-binfmt_misc.mount                                                                        loaded
active mounted   Arbitrary Executable File Formats File Syst>
  run-credentials-systemd\x2dsysctl.service.mount                                                      loaded
active mounted   /run/credentials/systemd-sysctl.service
  run-credentials-systemd\x2dtmpfiles\x2dsetup.service.mount                                           loaded
active mounted   /run/credentials/systemd-tmpfiles-setup.ser>
  run-credentials-systemd\x2dtmpfiles\x2dsetup\x2ddev.service.mount                                    loaded
active mounted   /run/credentials/systemd-tmpfiles-setup-dev>
  run-user-1000.mount                                                                                  loaded
active mounted   /run/user/1000
  run-user-42.mount                                                                                    loaded
active mounted   /run/user/42
  sys-fs-fuse-connections.mount                                                                        loaded
active mounted   FUSE Control File System
  sys-kernel-config.mount                                                                              loaded
active mounted   Kernel Configuration File System
  sys-kernel-debug-tracing.mount                                                                       loaded
active mounted   /sys/kernel/debug/tracing
  sys-kernel-debug.mount                                                                               loaded
active mounted   Kernel Debug File System
  sys-kernel-tracing.mount                                                                             loaded
active mounted   Kernel Trace File System                  >
  cups.path                                                                                            loaded
active running   CUPS Scheduler
  systemd-ask-password-plymouth.path                                                                   loaded
active waiting   Forward Password Requests to Plymouth Direc>
  systemd-ask-password-wall.path                                                                       loaded
active waiting   Forward Password Requests to Wall Directory>
  init.scope                                                                                           loaded
```

```
active running   System and Service Manager
  session-4.scope                                                                                                    loaded
active running   Session 4 of User trainee
lines 1-37...skipping...
  UNIT                                                                                                               LOAD
ACTIVE SUB       DESCRIPTION
  proc-sys-fs-binfmt_misc.automount                                                                                  loaded
active running   Arbitrary Executable File Formats File System Automount Point
  sys-devices-pci0000:00-0000:00:01.1-ata2-host2-target2:0:0-2:0:0:0-block-sr0.device                                loaded
active plugged   QEMU_DVD-ROM
  sys-devices-pci0000:00-0000:00:05.0-0000:01:01.0-virtio2-host0-target0:0:0-0:0:0:0-block-sda-sda1.device loaded
active plugged   QEMU_HARDDISK 1
  sys-devices-pci0000:00-0000:00:05.0-0000:01:01.0-virtio2-host0-target0:0:0-0:0:0:0-block-sda-sda2.device loaded
active plugged   QEMU_HARDDISK 2
  sys-devices-pci0000:00-0000:00:05.0-0000:01:01.0-virtio2-host0-target0:0:0-0:0:0:0-block-sda.device      loaded
active plugged   QEMU_HARDDISK
  sys-devices-pci0000:00-0000:00:12.0-virtio1-net-ens18.device                                                       loaded
active plugged   Virtio network device
  sys-devices-platform-serial8250-tty-ttyS0.device                                                                   loaded
active plugged   /sys/devices/platform/serial8250/tty/ttyS0
  sys-devices-platform-serial8250-tty-ttyS1.device                                                                   loaded
active plugged   /sys/devices/platform/serial8250/tty/ttyS1
  sys-devices-platform-serial8250-tty-ttyS2.device                                                                   loaded
active plugged   /sys/devices/platform/serial8250/tty/ttyS2
  sys-devices-platform-serial8250-tty-ttyS3.device                                                                   loaded
active plugged   /sys/devices/platform/serial8250/tty/ttyS3
  sys-devices-virtual-block-dm\x2d0.device                                                                           loaded
active plugged   /sys/devices/virtual/block/dm-0
  sys-devices-virtual-block-dm\x2d1.device                                                                           loaded
active plugged   /sys/devices/virtual/block/dm-1
  sys-devices-virtual-misc-rfkill.device                                                                             loaded
active plugged   /sys/devices/virtual/misc/rfkill
  sys-module-configfs.device                                                                                         loaded
active plugged   /sys/module/configfs
```

```
  sys-module-fuse.device                                                                                      loaded
active plugged   /sys/module/fuse
  sys-subsystem-net-devices-ens18.device                                                                      loaded
active plugged   Virtio network device
  -.mount                                                                                                     loaded
active mounted   Root Mount
  boot.mount                                                                                                  loaded
active mounted   /boot
  dev-hugepages.mount                                                                                         loaded
active mounted   Huge Pages File System
  dev-mqueue.mount                                                                                            loaded
active mounted   POSIX Message Queue File System
  proc-sys-fs-binfmt_misc.mount                                                                               loaded
active mounted   Arbitrary Executable File Formats File System
  run-credentials-systemd\x2dsysctl.service.mount                                                             loaded
active mounted   /run/credentials/systemd-sysctl.service
  run-credentials-systemd\x2dtmpfiles\x2dsetup.service.mount                                                  loaded
active mounted   /run/credentials/systemd-tmpfiles-setup.service
  run-credentials-systemd\x2dtmpfiles\x2dsetup\x2ddev.service.mount                                           loaded
active mounted   /run/credentials/systemd-tmpfiles-setup-dev.service
  run-user-1000.mount                                                                                         loaded
active mounted   /run/user/1000
  run-user-42.mount                                                                                           loaded
active mounted   /run/user/42
  sys-fs-fuse-connections.mount                                                                               loaded
active mounted   FUSE Control File System
  sys-kernel-config.mount                                                                                     loaded
active mounted   Kernel Configuration File System
  sys-kernel-debug-tracing.mount                                                                              loaded
active mounted   /sys/kernel/debug/tracing
  sys-kernel-debug.mount                                                                                      loaded
active mounted   Kernel Debug File System
  sys-kernel-tracing.mount                                                                                    loaded
active mounted   Kernel Trace File System
```

```
  cups.path                                                                                         loaded
active running   CUPS Scheduler
  systemd-ask-password-plymouth.path                                                                loaded
active waiting   Forward Password Requests to Plymouth Directory Watch
  systemd-ask-password-wall.path                                                                    loaded
active waiting   Forward Password Requests to Wall Directory Watch
  init.scope                                                                                        loaded
active running   System and Service Manager
  session-4.scope                                                                                   loaded
active running   Session 4 of User trainee
  session-c1.scope                                                                                  loaded
active running   Session c1 of User gdm
  accounts-daemon.service                                                                           loaded
active running   Accounts Service
  atd.service                                                                                       loaded
active running   Deferred execution scheduler
  auditd.service                                                                                    loaded
active running   Security Auditing Service
  avahi-daemon.service                                                                              loaded
active running   Avahi mDNS/DNS-SD Stack
  colord.service                                                                                    loaded
active running   Manage, Install and Generate Color Profiles
  crond.service                                                                                     loaded
active running   Command Scheduler
  cups.service                                                                                      loaded
active running   CUPS Scheduler
  dbus-broker.service                                                                               loaded
active running   D-Bus System Message Bus
  dracut-shutdown.service                                                                           loaded
active exited    Restore /run/initramfs on shutdown
  firewalld.service                                                                                 loaded
active running   firewalld - dynamic firewall daemon
  gdm.service                                                                                       loaded
active running   GNOME Display Manager
```

```
  irqbalance.service                                                                                  loaded
active running   irqbalance daemon
  iscsi.service                                                                                       loaded
active exited    Login and scanning of iSCSI devices
  kdump.service                                                                                       loaded
active exited    Crash recovery kernel arming
  kmod-static-nodes.service                                                                           loaded
active exited    Create List of Static Device Nodes
  libstoragemgmt.service                                                                              loaded
active running   libstoragemgmt plug-in server daemon
  lvm2-monitor.service                                                                                loaded
active exited    Monitoring of LVM2 mirrors, snapshots etc. using dmeventd or progress polling
lines 1-55
```

To view the list of inactive units, use the following command:

```
[root@redhat9 ~]# systemctl list-units --all | grep inactive | more
● boot.automount
not-found inactive dead      boot.automount
● home.mount
not-found inactive dead      home.mount
● sysroot.mount
not-found inactive dead      sysroot.mount
  tmp.mount
loaded    inactive dead      Temporary Directory /tmp
● var.mount
not-found inactive dead      var.mount
  systemd-ask-password-console.path
loaded    inactive dead      Dispatch Password Requests to Console Directory Watch
  alsa-restore.service
loaded    inactive dead      Save/Restore Sound Card State
  alsa-state.service
loaded    inactive dead      Manage Sound Card State (restore and store)
● auto-cpufreq.service
```

```
not-found inactive dead      auto-cpufreq.service
● autofs.service
not-found inactive dead      autofs.service
  blk-availability.service
loaded    inactive dead      Availability of block devices
  cpupower.service
loaded    inactive dead      Configure CPU power related settings
  dm-event.service
loaded    inactive dead      Device-mapper event daemon
  dnf-makecache.service
loaded    inactive dead      dnf makecache
  dracut-cmdline.service
loaded    inactive dead      dracut cmdline hook
  dracut-initqueue.service
loaded    inactive dead      dracut initqueue hook
  dracut-mount.service
loaded    inactive dead      dracut mount hook
  dracut-pre-mount.service
loaded    inactive dead      dracut pre-mount hook
  dracut-pre-pivot.service
loaded    inactive dead      dracut pre-pivot and cleanup hook
  dracut-pre-trigger.service
loaded    inactive dead      dracut pre-trigger hook
  dracut-pre-udev.service
loaded    inactive dead      dracut pre-udev hook
  dracut-shutdown-onfailure.service
loaded    inactive dead      Service executing upon dracut-shutdown failure to perform cleanup
● ebtables.service
not-found inactive dead      ebtables.service
  emergency.service
loaded    inactive dead      Emergency Shell
● fcoe.service
not-found inactive dead      fcoe.service
  getty@tty1.service
```

```
loaded    inactive dead      Getty on tty1
  initrd-cleanup.service
loaded    inactive dead      Cleaning Up and Shutting Down Daemons
  initrd-parse-etc.service
loaded    inactive dead      Mountpoints Configured in the Real Root
  initrd-switch-root.service
loaded    inactive dead      Switch Root
  initrd-udevadm-cleanup-db.service
loaded    inactive dead      Cleanup udev Database
  insights-client-boot.service
loaded    inactive dead      Run Insights Client at boot
● ip6tables.service
not-found inactive dead      ip6tables.service
● ipset.service
not-found inactive dead      ipset.service
● iptables.service
not-found inactive dead      iptables.service
  iscsi-init.service
loaded    inactive dead      One time configuration for iscsi.service
  iscsi-onboot.service
loaded    inactive dead      Special handling of early boot iSCSI sessions
  iscsi-shutdown.service
loaded    inactive dead      Logout off all iSCSI sessions on shutdown
  iscsi-starter.service
loaded    inactive dead      iscsi-starter.service
  iscsid.service
loaded    inactive dead      Open-iSCSI
  iscsiuio.service
loaded    inactive dead      iSCSI UserSpace I/O driver
  ldconfig.service
loaded    inactive dead      Rebuild Dynamic Linker Cache
  logrotate.service
loaded    inactive dead      Rotate log files
  low-memory-monitor.service
```

```
loaded    inactive dead      Low Memory Monitor
● lvm2-activation-early.service
not-found inactive dead      lvm2-activation-early.service
  lvm2-lvmpolld.service
loaded    inactive dead      LVM2 poll daemon
  mdmonitor.service
loaded    inactive dead      Software RAID monitoring and management
  microcode.service
loaded    inactive dead      Load CPU microcode update
  mlocate-updatedb.service
loaded    inactive dead      Update a database for mlocate
  modprobe@configfs.service
loaded    inactive dead      Load Kernel Module configfs
  modprobe@drm.service
loaded    inactive dead      Load Kernel Module drm
  modprobe@fuse.service
loaded    inactive dead      Load Kernel Module fuse
  multipathd.service
loaded    inactive dead      Device-Mapper Multipath Device Controller
● network.service
not-found inactive dead      network.service
  nftables.service
loaded    inactive dead      Netfilter Tables
● nslcd.service
not-found inactive dead      nslcd.service
--More--
[q]
```

The black dots at the beginning of some lines in the output above are actually white dots on the screen. These dots imply that the specified service, target or unit has not been found on the system. For example :

```
[root@redhat9 ~]# systemctl status network
Unit network.service could not be found.
```

To view the list of Units and their status, use the following command:

```
[root@redhat9 ~]# systemctl list-unit-files | more
UNIT FILE                                  STATE           PRESET
proc-sys-fs-binfmt_misc.automount          static          -
-.mount                                    generated       -
boot.mount                                 generated       -
dev-hugepages.mount                        static          -
dev-mqueue.mount                           static          -
proc-sys-fs-binfmt_misc.mount              disabled        disabled
run-vmblock\x2dfuse.mount                  disabled        disabled
sys-fs-fuse-connections.mount              static          -
sys-kernel-config.mount                    static          -
sys-kernel-debug.mount                     static          -
sys-kernel-tracing.mount                   static          -
tmp.mount                                  disabled        disabled
cups.path                                  enabled         enabled
insights-client-results.path               disabled        disabled
ostree-finalize-staged.path                disabled        disabled
systemd-ask-password-console.path          static          -
systemd-ask-password-plymouth.path         static          -
systemd-ask-password-wall.path             static          -
session-4.scope                            transient       -
session-c1.scope                           transient       -
accounts-daemon.service                    enabled         enabled
alsa-restore.service                       static          -
alsa-state.service                         static          -
arp-ethers.service                         disabled        disabled
atd.service                                enabled         enabled
auditd.service                             enabled         enabled
autovt@.service                            alias           -
avahi-daemon.service                       enabled         enabled
blk-availability.service                   disabled        disabled
bluetooth.service                          enabled         enabled
```

```
bolt.service                                static          -
brltty.service                              disabled        disabled
canberra-system-bootup.service              disabled        disabled
canberra-system-shutdown-reboot.service     disabled        disabled
canberra-system-shutdown.service            disabled        disabled
chrony-wait.service                         disabled        disabled
chronyd-restricted.service                  disabled        disabled
chronyd.service                             disabled        enabled
cni-dhcp.service                            disabled        disabled
cockpit-motd.service                        static          -
cockpit-wsinstance-http.service             static          -
cockpit-wsinstance-https-factory@.service   static          -
cockpit-wsinstance-https@.service           static          -
cockpit.service                             static          -
colord.service                              static          -
configure-printer@.service                  static          -
console-getty.service                       disabled        disabled
container-getty@.service                    static          -
cpupower.service                            disabled        disabled
crond.service                               enabled         enabled
cups-browsed.service                        disabled        disabled
cups.service                                enabled         enabled
dbus-broker.service                         enabled         enabled
dbus-daemon.service                         disabled        disabled
--More--
[q]
```

To view Units of a specific type, use the **-t** option:

```
[root@redhat9 ~]# systemctl list-unit-files -t mount
UNIT FILE                     STATE     PRESET
-.mount                       generated -
boot.mount                    generated -
dev-hugepages.mount           static    -
```

```
dev-mqueue.mount              static    -
proc-sys-fs-binfmt_misc.mount disabled  disabled
run-vmblock\x2dfuse.mount     disabled  disabled
sys-fs-fuse-connections.mount static    -
sys-kernel-config.mount       static    -
sys-kernel-debug.mount        static    -
sys-kernel-tracing.mount      static    -
tmp.mount                     disabled  disabled

11 unit files listed.
```

In the STATE column we see the words **static** and **generated**.

- STATE = **static**
  - This means that the Unit cannot be started or stopped by the administrator. Starting and stopping such a Unit is done by the system. As a general rule, Units with STATE = static are dependencies of other Units.
- STATE = **generated**
  - This implies that the file was generated automatically using the information in the **/etc/fstab** file when the system was started. In the case of a mount point, the executable responsible for generating the file is **/lib/systemd/system-generators/systemd-fstab-generator** :

```
[root@redhat9 ~]# ls -l /lib/systemd/system-generators/systemd-fstab-generator
-rwxr-xr-x. 1 root root 57696 Jul 18 13:01 /lib/systemd/system-generators/systemd-fstab-generator
```

There are also other executables responsible for generating other files:

```
[root@redhat9 ~]# ls -l /lib/systemd/system-generators
total 396
-rwxr-xr-x. 1 root root   541 Jul 24 06:08 kdump-dep-generator.sh
-rwxr-xr-x. 1 root root 15832 May 17 18:27 ostree-system-generator
lrwxrwxrwx. 1 root root    31 Aug  8 10:54 podman-system-generator -> ../../../libexec/podman/quadlet
-rwxr-xr-x. 1 root root  1005 Feb 19  2024 selinux-autorelabel-generator.sh
-rwxr-xr-x. 1 root root 15624 Jul 18 13:01 systemd-bless-boot-generator
-rwxr-xr-x. 1 root root 40920 Jul 18 13:01 systemd-cryptsetup-generator
-rwxr-xr-x. 1 root root 24312 Jul 18 13:01 systemd-debug-generator
```

```
-rwxr-xr-x. 1 root root 57696 Jul 18 13:01 systemd-fstab-generator
-rwxr-xr-x. 1 root root 24096 Jul 18 13:01 systemd-getty-generator
-rwxr-xr-x. 1 root root 36496 Jul 18 13:01 systemd-gpt-auto-generator
-rwxr-xr-x. 1 root root 16096 Jul 18 13:01 systemd-hibernate-resume-generator
-rwxr-xr-x. 1 root root 24240 Jul 18 13:01 systemd-integritysetup-generator
-rwxr-xr-x. 1 root root 15632 Jul 18 13:01 systemd-rc-local-generator
-rwxr-xr-x. 1 root root 24296 Jul 18 13:01 systemd-run-generator
-rwxr-xr-x. 1 root root 15824 Jul 18 13:01 systemd-system-update-generator
-rwxr-xr-x. 1 root root 36424 Jul 18 13:01 systemd-sysv-generator
-rwxr-xr-x. 1 root root 36872 Jul 18 13:01 systemd-veritysetup-generator
```

The command line switches for the **systemctl** command are :

```
[root@redhat9 ~]# systemctl --help
systemctl [OPTIONS...] COMMAND ...

Query or send control commands to the system manager.

Unit Commands:
  list-units [PATTERN...]             List units currently in memory
  list-automounts [PATTERN...]        List automount units currently in memory,
                                      ordered by path
  list-sockets [PATTERN...]           List socket units currently in memory,
                                      ordered by address
  list-timers [PATTERN...]            List timer units currently in memory,
                                      ordered by next elapse
  is-active PATTERN...                Check whether units are active
  is-failed PATTERN...                Check whether units are failed
  status [PATTERN...|PID...]          Show runtime status of one or more units
  show [PATTERN...|JOB...]            Show properties of one or more
                                      units/jobs or the manager
  cat PATTERN...                      Show files and drop-ins of specified units
  help PATTERN...|PID...              Show manual for one or more units
  list-dependencies [UNIT...]         Recursively show units which are required
```

```
                                    or wanted by the units or by which those
                                    units are required or wanted
  start UNIT...                     Start (activate) one or more units
  stop UNIT...                      Stop (deactivate) one or more units
  reload UNIT...                    Reload one or more units
  restart UNIT...                   Start or restart one or more units
  try-restart UNIT...               Restart one or more units if active
  reload-or-restart UNIT...         Reload one or more units if possible,
                                    otherwise start or restart
  try-reload-or-restart UNIT...     If active, reload one or more units,
                                    if supported, otherwise restart
  isolate UNIT                      Start one unit and stop all others
  kill UNIT...                      Send signal to processes of a unit
  clean UNIT...                     Clean runtime, cache, state, logs or
                                    configuration of unit
  freeze PATTERN...                 Freeze execution of unit processes
  thaw PATTERN...                   Resume execution of a frozen unit
  set-property UNIT PROPERTY=VALUE... Sets one or more properties of a unit
  bind UNIT PATH [PATH]             Bind-mount a path from the host into a
                                    unit's namespace
  mount-image UNIT PATH [PATH [OPTS]] Mount an image from the host into a
                                    unit's namespace
  service-log-level SERVICE [LEVEL]   Get/set logging threshold for service
  service-log-target SERVICE [TARGET] Get/set logging target for service
  reset-failed [PATTERN...]         Reset failed state for all, one, or more
                                    units
Unit File Commands:
  list-unit-files [PATTERN...]      List installed unit files
  enable [UNIT...|PATH...]          Enable one or more unit files
  disable UNIT...                   Disable one or more unit files
  reenable UNIT...                  Reenable one or more unit files
  preset UNIT...                    Enable/disable one or more unit files
                                    based on preset configuration
  preset-all                        Enable/disable all unit files based on
```

```
                                     preset configuration
lines 1-55
```

LAB #2 - Configuration files

2.1 - Default Configuration Files

Target configuration files and Unit configuration files installed by packages are located in the **/usr/lib/systemd/system** directory:

```
[root@redhat9 ~]# pkg-config systemd --variable=systemdsystemunitdir
/usr/lib/systemd/system
```

```
[root@redhat9 ~]# ls -l /usr/lib/systemd/system | more
total 1584
-rw-r--r--. 1 root root  729 Feb 24  2022 accounts-daemon.service
-rw-r--r--. 1 root root  480 Jan 16  2024 alsa-restore.service
-rw-r--r--. 1 root root  465 Jan 16  2024 alsa-state.service
-rw-r--r--. 1 root root  275 Aug 10  2021 arp-ethers.service
-rw-r--r--. 1 root root  274 Apr  4  2022 atd.service
-rw-r--r--. 1 root root 1771 Nov  8  2023 auditd.service
lrwxrwxrwx. 1 root root   14 Jul 18 13:00 autovt@.service -> getty@.service
-rw-r--r--. 1 root root 1044 Nov  8  2023 avahi-daemon.service
-rw-r--r--. 1 root root  870 Nov  8  2023 avahi-daemon.socket
-rw-r--r--. 1 root root  964 Jul 18 13:00 basic.target
drwxr-xr-x. 2 root root    6 Jul 18 13:00 basic.target.wants
-r--r--r--. 1 root root  384 Feb  3  2024 blk-availability.service
-rw-r--r--. 1 root root  449 Oct 31  2022 blockdev@.target
-rw-r--r--. 1 root root  707 Jun 14  2022 bluetooth.service
-rw-r--r--. 1 root root  435 Oct 31  2022 bluetooth.target
-rw-r--r--. 1 root root  642 Jan 16  2023 bolt.service
-rw-r--r--. 1 root root  463 Oct 31  2022 boot-complete.target
-rw-r--r--. 1 root root  217 Aug  9  2021 brltty.service
```

```
-rw-r--r--. 1 root root  491 Jul 13  2023 canberra-system-bootup.service
-rw-r--r--. 1 root root  509 Jul 13  2023 canberra-system-shutdown-reboot.service
-rw-r--r--. 1 root root  466 Jul 13  2023 canberra-system-shutdown.service
-rw-r--r--. 1 root root 1811 Jan 23  2024 chronyd-restricted.service
-rw-r--r--. 1 root root 1468 Jan 23  2024 chronyd.service
-rw-r--r--. 1 root root 1082 Jan 23  2024 chrony-wait.service
-rw-r--r--. 1 root root  277 Jul 23 09:37 cni-dhcp.service
-rw-r--r--. 1 root root  302 Dec  4  2023 cni-dhcp.socket
-rw-r--r--. 1 root root  222 Apr  2 05:45 cockpit-motd.service
-rw-r--r--. 1 root root  720 Apr  2 05:45 cockpit.service
-rw-r--r--. 1 root root  349 Apr  2 05:45 cockpit.socket
-rw-r--r--. 1 root root  221 Apr  2 05:45 cockpit-wsinstance-http.service
-rw-r--r--. 1 root root  165 Apr  2 05:45 cockpit-wsinstance-https-factory@.service
-rw-r--r--. 1 root root  244 Apr  2 05:45 cockpit-wsinstance-https-factory.socket
-rw-r--r--. 1 root root  215 Apr  2 05:45 cockpit-wsinstance-http.socket
-rw-r--r--. 1 root root  264 Apr  2 05:45 cockpit-wsinstance-https@.service
-rw-r--r--. 1 root root  478 Apr  2 05:45 cockpit-wsinstance-https@.socket
-rw-r--r--. 1 root root  295 Aug  9  2021 colord.service
-rw-r--r--. 1 root root  154 Aug 11  2021 configure-printer@.service
-rw-r--r--. 1 root root 1102 Jul 18 13:00 console-getty.service
-rw-r--r--. 1 root root 1254 Jul 18 13:00 container-getty@.service
-rw-r--r--. 1 root root  294 Sep 13 18:49 cpupower.service
-rw-r--r--. 1 root root  371 Nov 30  2023 crond.service
-rw-r--r--. 1 root root  473 Oct 31  2022 cryptsetup-pre.target
-rw-r--r--. 1 root root  420 Oct 31  2022 cryptsetup.target
lrwxrwxrwx. 1 root root   13 Jul 18 13:00 ctrl-alt-del.target -> reboot.target
-rw-r--r--. 1 root root  234 Jan  7  2021 cups-browsed.service
-rw-r--r--. 1 root root  142 Jun 19 11:00 cups.path
-rw-r--r--. 1 root root  298 Jun 19 11:00 cups.service
drwxr-xr-x. 2 root root   25 Sep 25 12:03 cups.service.d
-rw-r--r--. 1 root root  148 Jun 19 11:00 cups.socket
-rw-r--r--. 1 root root  529 Aug 23  2022 dbus-broker.service
-rw-r--r--. 1 root root  560 Jun 12  2023 dbus-daemon.service
lrwxrwxrwx. 1 root root   25 Jul 18 13:00 dbus-org.freedesktop.hostname1.service -> systemd-hostnamed.service
```

```
lrwxrwxrwx. 1 root root   23 Jul 18 13:00 dbus-org.freedesktop.locale1.service -> systemd-localed.service
lrwxrwxrwx. 1 root root   22 Jul 18 13:00 dbus-org.freedesktop.login1.service -> systemd-logind.service
--More--
[q]
```

Some configuration files are created on the fly in the **/run/systemd/system** directory during runtime and then destroyed when the system no longer needs them:

```
[root@redhat9 ~]# ls -l /run/systemd/system/
total 0
```

Unit configuration files created by users must be placed in the **/usr/lib/systemd/user** directory:

```
[root@redhat9 ~]# pkg-config systemd --variable=systemduserunitdir
/usr/lib/systemd/user
```

Important: This way the files in **/usr/lib/systemd/user** override the files in the **/run/systemd/system** directory which override the files in the **/usr/lib/systemd/system** directory.

Let's take the case of the **sshd** service, which is configured by the **/usr/lib/systemd/system/sshd.service** file:

```
[root@redhat9 ~]# cat /usr/lib/systemd/system/sshd.service
[Unit]
Description=OpenSSH server daemon
Documentation=man:sshd(8) man:sshd_config(5)
After=network.target sshd-keygen.target
Wants=sshd-keygen.target

[Service]
Type=notify
```

```
EnvironmentFile=-/etc/sysconfig/sshd
ExecStart=/usr/sbin/sshd -D $OPTIONS
ExecReload=/bin/kill -HUP $MAINPID
KillMode=process
Restart=on-failure
RestartSec=42s

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

The file contains the following lines in the **[Unit]** section:

- **Description=OpenSSH server daemon**,
  - This directive is used to give a short description of the Unit's functionality,
- **Documentation=man:sshd(8) man:sshd_config(5)**,
  - This directive specifies the manual chapters and URLs containing information relating to the Unit,
- **After=network.target sshd-keygen.target**,
  - This directive specifies targets that should be reached and units that should be started before the sshd unit. However, this directive does not specify a dependency,
- **Wants=sshd-keygen.target**,
  - This directive specifies a soft dependency. In other words, Systemd will try to start the **sshd-keygen.target** unit, but if this fails, the sshd unit will be started regardless.

The file also contains the following lines in the **[Service]** section:

- **Type=notify**,
  - This directive indicates that the service will inform Systemd when it has finished starting,
- **ExecStart=/usr/sbin/sshd -D $OPTIONS**,
  - This directive specifies the executable to start,
- **ExecReload=/bin/kill -HUP $MAINPID**,
  - This directive specifies the command needed to restart the service,
- **KillMode=process**,
  - This directive is used to specify how processes in the service should be stopped. The value of **process** implies the use of SIGTERM followed by SIGHUP,

- **Restart=on-failure**,
  - This line indicates that the service must be restarted if it is stopped.
- **RestartSec=42s**,
  - This directive specifies the time to wait between the service being stopped and Systemd restarting it,

Finally, we note the presence of the following line in the **[Install]** section:

- **WantedBy=multi-user.target**,
  - This directive indicates the Target in which the service should be started. The presence of this directive creates a symbolic link in the **/etc/systemd/system/multi-user.target.wants** directory which points to this file.

To view **all** the configuration directives and their values for a Unit, use the **systemctl show** command, specifying the Unit concerned:

```
[root@redhat9 ~]# systemctl show sshd
Type=notify
ExitType=main
Restart=on-failure
NotifyAccess=main
RestartUSec=42s
TimeoutStartUSec=1min 30s
TimeoutStopUSec=1min 30s
TimeoutAbortUSec=1min 30s
TimeoutStartFailureMode=terminate
TimeoutStopFailureMode=terminate
RuntimeMaxUSec=infinity
RuntimeRandomizedExtraUSec=0
WatchdogUSec=0
WatchdogTimestampMonotonic=0
RootDirectoryStartOnly=no
RemainAfterExit=no
GuessMainPID=yes
MainPID=875
ControlPID=0
FileDescriptorStoreMax=0
```

```
NFileDescriptorStore=0
StatusErrno=0
Result=success
ReloadResult=success
CleanResult=success
UID=[not set]
GID=[not set]
NRestarts=0
OOMPolicy=stop
ReloadSignal=1
ExecMainStartTimestamp=Wed 2024-09-25 12:44:53 CEST
ExecMainStartTimestampMonotonic=18089127
ExecMainExitTimestampMonotonic=0
ExecMainPID=875
ExecMainCode=0
ExecMainStatus=0
ExecStart={ path=/usr/sbin/sshd ; argv[]=/usr/sbin/sshd -D $OPTIONS ; ignore_errors=no ; start_time=[n/a] ;
stop_time=[n/a] ; pid=0 ; code=(null) ; status=0/0 }
ExecStartEx={ path=/usr/sbin/sshd ; argv[]=/usr/sbin/sshd -D $OPTIONS ; flags= ; start_time=[n/a] ;
stop_time=[n/a] ; pid=0 ; code=(null) ; status=0/0 }
ExecReload={ path=/bin/kill; argv[]=/bin/kill -HUP $MAINPID; ignore_errors=no; start_time=[n/a]; stop_time=[n/a];
pid=0; code=(null); status=0/0 }
ExecReloadEx={ path=/bin/kill ; argv[]=/bin/kill -HUP $MAINPID ; flags= ; start_time=[n/a] ; stop_time=[n/a] ;
pid=0 ; code=(null) ; status=0/0 }
Slice=system.slice
ControlGroup=/system.slice/sshd.service
ControlGroupId=3690
MemoryCurrent=5275648
MemoryAvailable=infinity
CPUUsageNSec=122370000
TasksCurrent=1
IPIngressBytes=[no data]
IPIngressPackets=[no data]
IPEgressBytes=[no data]
```

```
IPEgressPackets=[no data]
IOReadBytes=18446744073709551615
IOReadOperations=18446744073709551615
IOWriteBytes=18446744073709551615
IOWriteOperations=18446744073709551615
lines 1-55
```

To view the list of dependencies for a Unit, use **systemctl list-dependancies** and specify the Unit concerned:

```
[root@redhat9 ~]# systemctl list-dependencies sshd.service
sshd.service
● ├─system.slice
● ├─sshd-keygen.target
○ │ ├─sshd-keygen@ecdsa.service
○ │ ├─sshd-keygen@ed25519.service
○ │ └─sshd-keygen@rsa.service
● └─sysinit.target
●   ├─dev-hugepages.mount
●   ├─dev-mqueue.mount
●   ├─dracut-shutdown.service
○   ├─iscsi-onboot.service
○   ├─iscsi-starter.service
●   ├─kmod-static-nodes.service
○   ├─ldconfig.service
●   ├─lvm2-lvmpolld.socket
●   ├─lvm2-monitor.service
○   ├─multipathd.service
●   ├─nis-domainname.service
●   ├─plymouth-read-write.service
●   ├─plymouth-start.service
●   ├─proc-sys-fs-binfmt_misc.automount
○   ├─selinux-autorelabel-mark.service
●   ├─sys-fs-fuse-connections.mount
●   ├─sys-kernel-config.mount
```

```
●   ├─sys-kernel-debug.mount
●   ├─sys-kernel-tracing.mount
○   ├─systemd-ask-password-console.path
○   ├─systemd-binfmt.service
○   ├─systemd-boot-random-seed.service
●   ├─systemd-boot-update.service
○   ├─systemd-firstboot.service
○   ├─systemd-hwdb-update.service
○   ├─systemd-journal-catalog-update.service
●   ├─systemd-journal-flush.service
●   ├─systemd-journald.service
○   ├─systemd-machine-id-commit.service
●   ├─systemd-modules-load.service
●   ├─systemd-network-generator.service
○   ├─systemd-pcrmachine.service
○   ├─systemd-pcrphase-sysinit.service
○   ├─systemd-pcrphase.service
●   ├─systemd-random-seed.service
○   ├─systemd-repart.service
●   ├─systemd-sysctl.service
○   ├─systemd-sysusers.service
●   ├─systemd-tmpfiles-setup-dev.service
●   ├─systemd-tmpfiles-setup.service
●   ├─systemd-udev-trigger.service
●   ├─systemd-udevd.service
○   ├─systemd-update-done.service
●   ├─systemd-update-utmp.service
●   ├─cryptsetup.target
●   ├─integritysetup.target
●   ├─local-fs.target
●   │ ├─-.mount
lines 1-55
```

2.2 - Overriding the Default Configuration Files

Default configuration files can also be overridden by files in other directories:

```
[root@redhat9 ~]# pkg-config systemd --variable=systemdsystemunitpath
/etc/systemd/system:/etc/systemd/system:/run/systemd/system:/usr/local/lib/systemd/system:/usr/lib/systemd/system
:/usr/lib/systemd/system:/lib/systemd/system
```

```
[root@redhat9 ~]# ls -l /etc/systemd/system
total 8
drwxr-xr-x. 2 root root   65 Oct 19  2023  basic.target.wants
drwxr-xr-x. 2 root root   31 Oct 19  2023  bluetooth.target.wants
lrwxrwxrwx. 1 root root   37 Oct 19  2023  ctrl-alt-del.target -> /usr/lib/systemd/system/reboot.target
lrwxrwxrwx. 1 root root   41 Oct 19  2023  dbus-org.bluez.service -> /usr/lib/systemd/system/bluetooth.service
lrwxrwxrwx. 1 root root   41 Oct 19  2023  dbus-org.fedoraproject.FirewallD1.service ->
/usr/lib/systemd/system/firewalld.service
lrwxrwxrwx. 1 root root   44 Oct 19  2023  dbus-org.freedesktop.Avahi.service -> /usr/lib/systemd/system/avahi-
daemon.service
lrwxrwxrwx. 1 root root   44 Oct 19  2023  dbus-org.freedesktop.ModemManager1.service ->
/usr/lib/systemd/system/ModemManager.service
lrwxrwxrwx. 1 root root   57 Oct 19  2023  dbus-org.freedesktop.nm-dispatcher.service ->
/usr/lib/systemd/system/NetworkManager-dispatcher.service
lrwxrwxrwx. 1 root root   43 Oct 19  2023  dbus.service -> /usr/lib/systemd/system/dbus-broker.service
lrwxrwxrwx. 1 root root   40 Oct 19  2023  default.target -> /usr/lib/systemd/system/graphical.target
drwxr-xr-x. 2 root root   45 Oct 19  2023  default.target.wants
drwxr-xr-x. 2 root root   38 Oct 19  2023 'dev-virtio\x2dports-org.qemu.guest_agent.0.device.wants'
lrwxrwxrwx. 1 root root   35 Oct 19  2023  display-manager.service -> /usr/lib/systemd/system/gdm.service
drwxr-xr-x. 2 root root   32 Oct 19  2023  getty.target.wants
drwxr-xr-x. 2 root root  181 Oct 19  2023  graphical.target.wants
drwxr-xr-x. 2 root root   36 Oct 19  2023  local-fs.target.wants
drwxr-xr-x. 2 root root 4096 Oct 19  2023  multi-user.target.wants
drwxr-xr-x. 2 root root   48 Oct 19  2023  network-online.target.wants
drwxr-xr-x. 2 root root   26 Oct 19  2023  printer.target.wants
```

```
drwxr-xr-x. 2 root root   27 Oct 19  2023  remote-fs.target.wants
drwxr-xr-x. 2 root root  186 Oct 19  2023  sockets.target.wants
drwxr-xr-x. 2 root root 4096 Sep 25 12:08  sysinit.target.wants
drwxr-xr-x. 2 root root   86 Oct 19  2023  timers.target.wants
drwxr-xr-x. 2 root root   29 Oct 19  2023  vmtoolsd.service.requires
```

LAB #3 - The systemd-analyze command

To consult the system start-up timeline, use the following command:

```
[root@redhat9 ~]# systemd-analyze
Startup finished in 1.309s (kernel) + 4.384s (initrd) + 29.375s (userspace) = 35.069s
graphical.target reached after 29.358s in userspace.
```

The **blame** option in the systemd-analyze command allows you to see the boot time of each individual Unit so that you can concentrate on the slowest ones:

```
[root@redhat9 ~]# systemd-analyze blame
15.289s plymouth-quit-wait.service
 8.760s dev-disk-by\x2dpartuuid-d00dfc8a\x2d02.device
 8.760s dev-disk-by\x2did-scsi\x2d0QEMU_QEMU_HARDDISK_drive\x2dscsi0\x2dpart2.device
 8.760s sys-devices-pci0000:00-0000:00:05.0-0000:01:01.0-virtio2-host0-target0:0:0-0:0:0:0-block-sda-sda2.device
 8.760s dev-disk-by\x2dpath-pci\x2d0000:01:01.0\x2dscsi\x2d0:0:0:0\x2dpart2.device
 8.760s dev-sda2.device
 8.662s sys-devices-pci0000:00-0000:00:05.0-0000:01:01.0-virtio2-host0-target0:0:0-0:0:0:0-block-sda-sda1.device
 8.662s dev-disk-by\x2did-scsi\x2d0QEMU_QEMU_HARDDISK_drive\x2dscsi0\x2dpart1.device
 8.662s dev-sda1.device
 8.662s dev-disk-by\x2dpath-pci\x2d0000:01:01.0\x2dscsi\x2d0:0:0:0\x2dpart1.device
 8.662s dev-disk-by\x2duuid-6f6c5bb9\x2d30be\x2d4734\x2dbc23\x2d03fed8541616.device
 8.662s dev-disk-by\x2dpartuuid-d00dfc8a\x2d01.device
 8.629s dev-sda.device
 8.629s dev-disk-by\x2dpath-pci\x2d0000:01:01.0\x2dscsi\x2d0:0:0:0.device
 8.629s dev-disk-by\x2did-scsi\x2d0QEMU_QEMU_HARDDISK_drive\x2dscsi0.device
```

```
8.629s sys-devices-pci0000:00-0000:00:05.0-0000:01:01.0-virtio2-host0-target0:0:0-0:0:0:0-block-sda.device
8.629s dev-disk-by\x2ddiskseq-1.device
8.589s sys-module-fuse.device
8.578s sys-devices-pci0000:00-0000:00:12.0-virtio1-net-ens18.device
8.578s sys-subsystem-net-devices-ens18.device
8.560s sys-devices-platform-serial8250-tty-ttyS0.device
8.560s dev-ttyS0.device
8.559s sys-devices-platform-serial8250-tty-ttyS2.device
8.559s dev-ttyS2.device
8.558s dev-ttyS1.device
8.558s sys-devices-platform-serial8250-tty-ttyS1.device
8.557s dev-ttyS3.device
8.557s sys-devices-platform-serial8250-tty-ttyS3.device
8.510s sys-module-configfs.device
4.024s initrd-switch-root.service
2.468s firewalld.service
2.157s kdump.service
1.944s systemd-udev-settle.service
1.548s dnf-makecache.service
1.454s NetworkManager-wait-online.service
1.309s udisks2.service
1.294s NetworkManager.service
1.112s power-profiles-daemon.service
1.091s polkit.service
1.015s accounts-daemon.service
 953ms ModemManager.service
 900ms user@42.service
 888ms dracut-initqueue.service
 671ms dbus-broker.service
 661ms systemd-tmpfiles-setup-dev.service
 658ms systemd-udevd.service
 561ms lvm2-monitor.service
 547ms boot.mount
 506ms cups.service
```

```
  464ms sshd.service
  446ms logrotate.service
  382ms systemd-random-seed.service
  376ms auditd.service
  371ms systemd-tmpfiles-setup.service
  324ms systemd-sysctl.service
lines 1-55
```

The **critical-chain** option of the **systemd-analyze** command allows you to see the sequence of events that lead to the loading of the Unit passed as an argument:

```
[root@redhat9 ~]# systemd-analyze critical-chain sshd.service
The time when unit became active or started is printed after the "@" character.
The time the unit took to start is printed after the "+" character.

sshd.service +464ms
└─network.target @12.377s
  └─wpa_supplicant.service @25.556s +119ms
    └─basic.target @7.432s
      └─dbus-broker.service @6.758s +671ms
        └─dbus.socket @6.741s
          └─sysinit.target @6.737s
            └─systemd-update-utmp.service @6.721s +15ms
              └─auditd.service @6.333s +376ms
                └─systemd-tmpfiles-setup.service @5.951s +371ms
                  └─local-fs.target @5.939s
                    └─run-user-42.mount @14.616s
                      └─local-fs-pre.target @5.379s
                        └─systemd-tmpfiles-setup-dev.service @3.398s +661ms
                          └─kmod-static-nodes.service @3.243s +49ms
                            └─systemd-journald.socket
                              └─system.slice
                                └─-.slice
```

The command line switches for the **systemd-analyze** command are:

```
[root@redhat9 ~]# systemd-analyze --help
systemd-analyze [OPTIONS...] COMMAND ...

Profile systemd, show unit dependencies, check unit files.

Commands:
  [time]                     Print time required to boot the machine
  blame                      Print list of running units ordered by
                             time to init
  critical-chain [UNIT...]   Print a tree of the time critical chain
                             of units
  plot                       Output SVG graphic showing service
                             initialization
  dot [UNIT...]              Output dependency graph in dot(1) format
  dump [PATTERN...]          Output state serialization of service
                             manager
  cat-config                 Show configuration file and drop-ins
  unit-files                 List files and symlinks for units
  unit-paths                 List load directories for units
  exit-status [STATUS...]    List exit status definitions
  capability [CAP...]        List capability definitions
  syscall-filter [NAME...]   List syscalls in seccomp filters
  filesystems [NAME...]      List known filesystems
  condition CONDITION...     Evaluate conditions and asserts
  compare-versions VERSION1 [OP] VERSION2
                             Compare two version strings
  verify FILE...             Check unit files for correctness
  calendar SPEC...           Validate repetitive calendar time
                             events
  timestamp TIMESTAMP...     Validate a timestamp
  timespan SPAN...           Validate a time span
  security [UNIT...]         Analyze security of unit
```

```
  inspect-elf FILE...        Parse and print ELF package metadata

Options:
     --recursive-errors=MODE Control which units are verified
     --offline=BOOL          Perform a security review on unit file(s)
     --threshold=N           Exit with a non-zero status when overall
                             exposure level is over threshold value
     --security-policy=PATH  Use custom JSON security policy instead
                             of built-in one
     --json=pretty|short|off Generate JSON output of the security
                             analysis table, or plot's raw time data
     --no-pager              Do not pipe output into a pager
     --no-legend             Disable column headers and hints in plot
                             with either --table or --json=
     --system                Operate on system systemd instance
     --user                  Operate on user systemd instance
     --global                Operate on global user configuration
  -H --host=[USER@]HOST      Operate on remote host
  -M --machine=CONTAINER     Operate on local container
     --order                 Show only order in the graph
     --require               Show only requirement in the graph
     --from-pattern=GLOB     Show only origins in the graph
     --to-pattern=GLOB       Show only destinations in the graph
     --fuzz=SECONDS          Also print services which finished SECONDS
lines 1-55
```

LAB #4 - Systemd Targets

Each Target is described in a configuration file:

```
[root@redhat9 ~]# cat /usr/lib/systemd/system/graphical.target
#  SPDX-License-Identifier: LGPL-2.1-or-later
#
```

```
#  This file is part of systemd.
#
#  systemd is free software; you can redistribute it and/or modify it
#  under the terms of the GNU Lesser General Public License as published by
#  the Free Software Foundation; either version 2.1 of the License, or
#  (at your option) any later version.

[Unit]
Description=Graphical Interface
Documentation=man:systemd.special(7)
Requires=multi-user.target
Wants=display-manager.service
Conflicts=rescue.service rescue.target
After=multi-user.target rescue.service rescue.target display-manager.service
AllowIsolate=yes
```

The following lines can be found in this file:

- **Requires=multi-user.target**,
  - This line indicates that the **graphical.target** cannot be reached if the **multi-user.target** has not been reached first,
- **After=multi-user.target rescue.service rescue.target display-manager.service**,
  - This line indicates that the **multi-user.target** and **rescue.target** must be reached first and that the **rescue.service** and **display-manager.service** services must be started first,
- **Conflicts=rescue.service rescue.target**,
  - This line indicates the target and service in conflict with the **graphical.target**,
- **Wants=display-manager.service**,
  - This line indicates which service should be started.

4.1 - Checking Target dependencies

The dependencies of a Target can be checked using the **systemctl list-dependencies** command:

```
[root@redhat9 ~]# systemctl list-dependencies multi-user.target
```

```
multi-user.target
● ├─atd.service
● ├─auditd.service
● ├─avahi-daemon.service
● ├─crond.service
● ├─cups.path
● ├─cups.service
● ├─firewalld.service
○ ├─insights-client-boot.service
● ├─irqbalance.service
● ├─kdump.service
● ├─libstoragemgmt.service
● ├─mcelog.service
○ ├─mdmonitor.service
● ├─ModemManager.service
● ├─NetworkManager.service
○ ├─ostree-readonly-sysroot-migration.service
● ├─plymouth-quit-wait.service
○ ├─plymouth-quit.service
● ├─rhsmcertd.service
● ├─rsyslog.service
○ ├─smartd.service
● ├─sshd.service
○ ├─sssd.service
● ├─systemd-ask-password-wall.path
● ├─systemd-logind.service
○ ├─systemd-update-utmp-runlevel.service
● ├─systemd-user-sessions.service
○ ├─tuned.service
○ ├─vmtoolsd.service
● ├─basic.target
● │ ├─-.mount
○ │ ├─low-memory-monitor.service
○ │ ├─microcode.service
```

```
● │ ├─paths.target
● │ ├─slices.target
● │ │ ├─-.slice
● │ │ └─system.slice
● │ ├─sockets.target
● │ │ ├─avahi-daemon.socket
● │ │ ├─cups.socket
● │ │ ├─dbus.socket
● │ │ ├─dm-event.socket
● │ │ ├─iscsid.socket
● │ │ ├─iscsiuio.socket
○ │ │ ├─multipathd.socket
● │ │ ├─sssd-kcm.socket
● │ │ ├─systemd-coredump.socket
● │ │ ├─systemd-initctl.socket
● │ │ ├─systemd-journald-dev-log.socket
● │ │ ├─systemd-journald.socket
● │ │ ├─systemd-udevd-control.socket
● │ │ └─systemd-udevd-kernel.socket
● │ ├─sysinit.target
● │ │ ├─dev-hugepages.mount
lines 1-55
```

The black dots at the start of each line in the output above can be three different colours:

- **Green** implies that the service, target or unit is enabled and started.
- **White** means that the service, target or unit is inactive.
- **Red** means that the service, target or unit has not started due to a fatal error.

To view Units in a fatal error state, use the **systemctl –failed** command:

```
[root@redhat9 ~]# systemctl --failed
  UNIT LOAD ACTIVE SUB DESCRIPTION
0 loaded units listed.
```

Dependencies are created as symbolic links in the **/etc/systemd/system/multi-user.target.wants** and **/usr/lib/systemd/system/multi-user.target.wants** directories:

```
[root@redhat9 ~]# ls -l /etc/systemd/system/multi-user.target.wants
total 0
lrwxrwxrwx. 1 root root 35 Oct 19  2023 atd.service -> /usr/lib/systemd/system/atd.service
lrwxrwxrwx. 1 root root 38 Oct 19  2023 auditd.service -> /usr/lib/systemd/system/auditd.service
lrwxrwxrwx. 1 root root 44 Oct 19  2023 avahi-daemon.service -> /usr/lib/systemd/system/avahi-daemon.service
lrwxrwxrwx. 1 root root 37 Oct 19  2023 crond.service -> /usr/lib/systemd/system/crond.service
lrwxrwxrwx. 1 root root 33 Oct 19  2023 cups.path -> /usr/lib/systemd/system/cups.path
lrwxrwxrwx. 1 root root 36 Oct 19  2023 cups.service -> /usr/lib/systemd/system/cups.service
lrwxrwxrwx. 1 root root 41 Oct 19  2023 firewalld.service -> /usr/lib/systemd/system/firewalld.service
lrwxrwxrwx. 1 root root 52 Oct 19  2023 insights-client-boot.service -> /usr/lib/systemd/system/insights-client-
boot.service
lrwxrwxrwx. 1 root root 42 Oct 19  2023 irqbalance.service -> /usr/lib/systemd/system/irqbalance.service
lrwxrwxrwx. 1 root root 37 Oct 19  2023 kdump.service -> /usr/lib/systemd/system/kdump.service
lrwxrwxrwx. 1 root root 46 Oct 19  2023 libstoragemgmt.service -> /usr/lib/systemd/system/libstoragemgmt.service
lrwxrwxrwx. 1 root root 38 Oct 19  2023 mcelog.service -> /usr/lib/systemd/system/mcelog.service
lrwxrwxrwx. 1 root root 41 Oct 19  2023 mdmonitor.service -> /usr/lib/systemd/system/mdmonitor.service
lrwxrwxrwx. 1 root root 44 Oct 19  2023 ModemManager.service -> /usr/lib/systemd/system/ModemManager.service
lrwxrwxrwx. 1 root root 46 Oct 19  2023 NetworkManager.service -> /usr/lib/systemd/system/NetworkManager.service
lrwxrwxrwx. 1 root root 40 Oct 19  2023 remote-fs.target -> /usr/lib/systemd/system/remote-fs.target
lrwxrwxrwx. 1 root root 41 Oct 19  2023 rhsmcertd.service -> /usr/lib/systemd/system/rhsmcertd.service
lrwxrwxrwx. 1 root root 39 Oct 19  2023 rsyslog.service -> /usr/lib/systemd/system/rsyslog.service
lrwxrwxrwx. 1 root root 38 Oct 19  2023 smartd.service -> /usr/lib/systemd/system/smartd.service
lrwxrwxrwx. 1 root root 36 Oct 19  2023 sshd.service -> /usr/lib/systemd/system/sshd.service
lrwxrwxrwx. 1 root root 36 Oct 19  2023 sssd.service -> /usr/lib/systemd/system/sssd.service
lrwxrwxrwx. 1 root root 37 Oct 19  2023 tuned.service -> /usr/lib/systemd/system/tuned.service
lrwxrwxrwx. 1 root root 40 Oct 19  2023 vmtoolsd.service -> /usr/lib/systemd/system/vmtoolsd.service

[root@redhat9 ~]# ls -l /usr/lib/systemd/system/multi-user.target.wants
total 0
lrwxrwxrwx. 1 root root 15 Jul 18 13:00 getty.target -> ../getty.target
lrwxrwxrwx. 1 root root 44 May 17 18:27 ostree-readonly-sysroot-migration.service -> ../ostree-readonly-sysroot-
```

```
migration.service
lrwxrwxrwx. 1 root root 24 Jul 14  2023 plymouth-quit.service -> ../plymouth-quit.service
lrwxrwxrwx. 1 root root 29 Jul 14  2023 plymouth-quit-wait.service -> ../plymouth-quit-wait.service
lrwxrwxrwx. 1 root root 33 Jul 18 13:00 systemd-ask-password-wall.path -> ../systemd-ask-password-wall.path
lrwxrwxrwx. 1 root root 25 Jul 18 13:00 systemd-logind.service -> ../systemd-logind.service
lrwxrwxrwx. 1 root root 39 Jul 18 13:00 systemd-update-utmp-runlevel.service -> ../systemd-update-utmp-
runlevel.service
lrwxrwxrwx. 1 root root 32 Jul 18 13:00 systemd-user-sessions.service -> ../systemd-user-sessions.service
```

4.2 - The Default Target

Consulting the Default Target

To view the default target, use the **systemctl get-default** command:

```
[root@redhat9 ~]# systemctl get-default
graphical.target
```

The default target is represented by the symbolic link **/etc/systemd/system/default.target** :

```
[root@redhat9 ~]# ls -l /etc/systemd/system/default.target
lrwxrwxrwx. 1 root root 40 Oct 19 2023 /etc/systemd/system/default.target ->
/usr/lib/systemd/system/graphical.target
```

Modifying the Default Target

To modify the Default Target to be taken into account at the **next** boot, use the **systemctl set-default** command:

```
[root@redhat9 ~]# systemctl set-default multi-user.target
Removed "/etc/systemd/system/default.target".
```

```
Created symlink /etc/systemd/system/default.target → /usr/lib/systemd/system/multi-user.target.

[root@redhat9 ~]# ls -l /etc/systemd/system/default.target
lrwxrwxrwx. 1 root root 41 Sep 26 14:50 /etc/systemd/system/default.target -> /usr/lib/systemd/system/multi-
user.target

[root@redhat9 ~]# systemctl set-default graphical.target
Removed "/etc/systemd/system/default.target".
Created symlink /etc/systemd/system/default.target → /usr/lib/systemd/system/graphical.target.

[root@redhat9 ~]# ls -l /etc/systemd/system/default.target
lrwxrwxrwx. 1 root root 40 Sep 26 14:51 /etc/systemd/system/default.target ->
/usr/lib/systemd/system/graphical.target
```

Modifying the Current Target

The current target can be modified using the **systemctl isolate** command:

```
[root@redhat9 ~]# systemctl isolate rescue

[root@redhat9 ~]# systemctl list-units --type target | egrep "eme|res|gra|mul" | head -1
  rescue.target         loaded active active Rescue Mode
[root@redhat9 ~]# runlevel
5 1

[root@redhat9 ~]# who -r
         run-level 1  2024-09-26 14:52                   last=5
```

```
[root@redhat9 ~]# systemctl isolate graphical

[root@redhat9 ~]# systemctl list-units --type target | egrep "eme|res|gra|mul" | head -1
  graphical.target       loaded active active Graphical Interface
```

```
[root@redhat9 ~]# runlevel
1 5

[root@redhat9 ~]# who -r
         run-level 5  2024-09-26 14:55                   last=1
```

LAB #5 - Managing Services

5.1 - Managing Single Instances

Start by installing the **httpd** package:

```
[root@redhat9 ~]# dnf install httpd
```

To obtain details of a given service, use the **systemctl status** command:

```
[root@redhat9 ~]# systemctl status httpd.service
○ httpd.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd.service; disabled; preset: disabled)
     Active: inactive (dead)
       Docs: man:httpd.service(8)
```

In the case of the httpd service above, we can see that the status is **disabled**. The status can be one of 2 values:

- **disabled** - the service will not be started the next time the system is started.
- **enabled** - the service will start the next time the system is started.

You can check the status using the **systemctl is-enabled** command:

```
[root@redhat9 ~]# systemctl is-enabled httpd.service
disabled
```

To make the status **enabled**, use the **systemctl enable** command:

```
[root@redhat9 ~]# systemctl enable httpd.service
Created symlink /etc/systemd/system/multi-user.target.wants/httpd.service →
/usr/lib/systemd/system/httpd.service.

[root@redhat9 ~]# systemctl is-enabled httpd.service
enabled

[root@redhat9 ~]# systemctl status httpd.service
○ httpd.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd.service; enabled; preset: disabled)
     Active: inactive (dead)
       Docs: man:httpd.service(8)
```

In the case of the httpd service above, we can now see that the state is **inactive (dead)**. The status can be one of 7 values:

- **inactive (dead)** - the service is stopped.
- **active(running** - the service is started with one or more processes.
- **active(exited)** - the service has completed a single configuration.
- **active(waiting)** - the service is started but waiting for an event.
- **activating** - the service is in the process of being activated.
- **deactivating** - the service is being deactivated.
- **failed** - the service has encountered a fatal error.

You can check the status using the **systemctl is-active** command:

```
[root@redhat9 ~]# systemctl is-active httpd.service
inactive
```

To set the status to **active(running)**, use the following command:

```
[root@redhat9 ~]# systemctl start httpd.service
```

Then check the state of the service:

```
[root@redhat9 ~]# systemctl is-active httpd.service
active

[root@redhat9 ~]# systemctl status httpd.service
● httpd.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd.service; enabled; preset: disabled)
     Active: active (running) since Thu 2024-09-26 15:01:28 CEST; 43s ago
       Docs: man:httpd.service(8)
   Main PID: 7187 (httpd)
     Status: "Total requests: 0; Idle/Busy workers 100/0;Requests/sec: 0; Bytes served/sec:   0 B/sec"
      Tasks: 177 (limit: 48800)
     Memory: 40.5M
        CPU: 128ms
     CGroup: /system.slice/httpd.service
             ├─7187 /usr/sbin/httpd -DFOREGROUND
             ├─7188 /usr/sbin/httpd -DFOREGROUND
             ├─7189 /usr/sbin/httpd -DFOREGROUND
             ├─7190 /usr/sbin/httpd -DFOREGROUND
             └─7191 /usr/sbin/httpd -DFOREGROUND

Sep 26 15:01:28 redhat9.ittraining.loc systemd[1]: Starting The Apache HTTP Server...
Sep 26 15:01:28 redhat9.ittraining.loc httpd[7187]: Server configured, listening on: port 80
Sep 26 15:01:28 redhat9.ittraining.loc systemd[1]: Started The Apache HTTP Server.
```

To stop a Service Unit, use the following command :

```
[root@redhat9 ~]# systemctl stop httpd.service

[root@redhat9 ~]# systemctl status httpd.service
○ httpd.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd.service; enabled; preset: disabled)
     Active: inactive (dead) since Thu 2024-09-26 15:02:55 CEST; 2s ago
```

```
   Duration: 1min 26.084s
       Docs: man:httpd.service(8)
    Process: 7187 ExecStart=/usr/sbin/httpd $OPTIONS -DFOREGROUND (code=exited, status=0/SUCCESS)
   Main PID: 7187 (code=exited, status=0/SUCCESS)
     Status: "Total requests: 0; Idle/Busy workers 100/0;Requests/sec: 0; Bytes served/sec:   0 B/sec"
        CPU: 178ms

Sep 26 15:01:28 redhat9.ittraining.loc systemd[1]: Starting The Apache HTTP Server...
Sep 26 15:01:28 redhat9.ittraining.loc httpd[7187]: Server configured, listening on: port 80
Sep 26 15:01:28 redhat9.ittraining.loc systemd[1]: Started The Apache HTTP Server.
Sep 26 15:02:54 redhat9.ittraining.loc systemd[1]: Stopping The Apache HTTP Server...
Sep 26 15:02:55 redhat9.ittraining.loc systemd[1]: httpd.service: Deactivated successfully.
Sep 26 15:02:55 redhat9.ittraining.loc systemd[1]: Stopped The Apache HTTP Server.
```

To deactivate a service the next time the system is started, use the **disable** option:

```
[root@redhat9 ~]# systemctl disable httpd.service
Removed "/etc/systemd/system/multi-user.target.wants/httpd.service".

[root@redhat9 ~]# systemctl status httpd.service
○ httpd.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd.service; disabled; preset: disabled)
     Active: inactive (dead)
       Docs: man:httpd.service(8)

Sep 26 15:01:28 redhat9.ittraining.loc systemd[1]: Starting The Apache HTTP Server...
Sep 26 15:01:28 redhat9.ittraining.loc httpd[7187]: Server configured, listening on: port 80
Sep 26 15:01:28 redhat9.ittraining.loc systemd[1]: Started The Apache HTTP Server.
Sep 26 15:02:54 redhat9.ittraining.loc systemd[1]: Stopping The Apache HTTP Server...
Sep 26 15:02:55 redhat9.ittraining.loc systemd[1]: httpd.service: Deactivated successfully.
Sep 26 15:02:55 redhat9.ittraining.loc systemd[1]: Stopped The Apache HTTP Server.
```

5.2 - Managing Multiple Instances

Systemd allows the use of templates in Unit configuration files. This allows two or more instances of the same service to co-exist. A template can be recognised by the **@** character, which is placed just before the full stop in the file name:

```
[root@redhat9 ~]# cat /usr/lib/systemd/system/httpd@.service
# This is a template for httpd instances.
# See httpd@.service(8) for more information.

[Unit]
Description=The Apache HTTP Server
After=network.target remote-fs.target nss-lookup.target
Documentation=man:httpd@.service(8)

[Service]
Type=notify
Environment=LANG=C
Environment=HTTPD_INSTANCE=%i
ExecStartPre=/bin/mkdir -m 710 -p /run/httpd/instance-%i
ExecStartPre=/bin/chown root.apache /run/httpd/instance-%i
ExecStartPre=/bin/mkdir -m 700 -p /var/lib/httpd/instance-%i
ExecStartPre=/bin/chown apache.apache /var/lib/httpd/instance-%i
ExecStart=/usr/sbin/httpd $OPTIONS -DFOREGROUND -f conf/%i.conf
ExecReload=/usr/sbin/httpd $OPTIONS -k graceful -f conf/%i.conf
# Send SIGWINCH for graceful stop
KillSignal=SIGWINCH
KillMode=mixed
PrivateTmp=true
OOMPolicy=continue

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

An instance created using this template should have a name like :

```
httpd@<instance_name>.service
```

In this file we can see the use of an **identifier** in the form of **%i**. Identifiers are of two types - one called **escaped** where non-ASCII alphanumeric characters are replaced by **escapes** of the C language type and the other not escaped:

- %n: is replaced by the full escaped name of the Unit.
- %N: is replaced by the full name of the Unit.
- %p: is replaced by the escaped prefix of the Unit, i.e. the part **before** the @ character.
- %P : is replaced by the non-escaped prefix of the Unit, i.e. the part **before** the @ character.
- %i: is replaced by the escaped instance name of the Unit, i.e. the part **after** the @ character and **before** the dot.
- %I: is replaced by the name of the non-escaped instance of the Unit, i.e. the part **after** the @ character and **before** the full stop.
- %f: is replaced by the non-escaped prefix or the name of the non-escaped instance prefixed by the **/** character.
- %c: is replaced by the Unit CGroup without the /sys/fs/cgroup/systemd/ path.
- %u: is replaced by the name of the user responsible for running the Unit.
- %U: is replaced by the UID of the user responsible for running the Unit.
- %H: is replaced by the hostname on which the Unit is running.
- %%: is replaced by the **%** character.

Now create two copies of the file **/usr/lib/systemd/system/httpd@.service** :

```
[root@redhat9 ~]# cp /usr/lib/systemd/system/httpd@.service /usr/lib/systemd/system/httpd@instance01.service

[root@redhat9 ~]# cp /usr/lib/systemd/system/httpd@.service /usr/lib/systemd/system/httpd@instance02.service
```

Create two copies of the **/etc/httpd/conf/httpd.conf** file:

```
[root@redhat9 ~]# cp /etc/httpd/conf/httpd.conf /etc/httpd/conf/instance01.conf

[root@redhat9 ~]# cp /etc/httpd/conf/httpd.conf /etc/httpd/conf/instance02.conf
```

Edit the **Listen** directive in **/etc/httpd/conf/instance01.conf** and add the **PidFile** directive:

```
[root@redhat9 ~]# vi /etc/httpd/conf/instance01.conf

[root@redhat9 ~]# more /etc/httpd/conf/instance01.conf
#
# This is the main Apache HTTP server configuration file.  It contains the
# configuration directives that give the server its instructions.
# See <URL:http://httpd.apache.org/docs/2.4/> for detailed information.
# In particular, see
# <URL:http://httpd.apache.org/docs/2.4/mod/directives.html>
# for a discussion of each configuration directive.
#
# See the httpd.conf(5) man page for more information on this configuration,
# and httpd.service(8) on using and configuring the httpd service.
#
# Do NOT simply read the instructions in here without understanding
# what they do.  They're here only as hints or reminders.  If you are unsure
# consult the online docs. You have been warned.
#
# Configuration and logfile names: If the filenames you specify for many
# of the server's control files begin with "/" (or "drive:/" for Win32), the
# server will use that explicit path.  If the filenames do *not* begin
# with "/", the value of ServerRoot is prepended -- so 'log/access_log'
# with ServerRoot set to '/www' will be interpreted by the
# server as '/www/log/access_log', where as '/log/access_log' will be
# interpreted as '/log/access_log'.

#
# ServerRoot: The top of the directory tree under which the server's
# configuration, error, and log files are kept.
#
# Do not add a slash at the end of the directory path.  If you point
# ServerRoot at a non-local disk, be sure to specify a local disk on the
# Mutex directive, if file-based mutexes are used.  If you wish to share the
# same ServerRoot for multiple httpd daemons, you will need to change at
```

```
# least PidFile.
#
ServerRoot "/etc/httpd"

#
# Listen: Allows you to bind Apache to specific IP addresses and/or
# ports, instead of the default. See also the <VirtualHost>
# directive.
#
# Change this to Listen on a specific IP address, but note that if
# httpd.service is enabled to run at boot time, the address may not be
# available when the service starts.  See the httpd.service(8) man
# page for more information.
#
#Listen 12.34.56.78:80
Listen 8008
PidFile /var/run/httpd/instance01.pid
#
# Dynamic Shared Object (DSO) Support
#
# To be able to use the functionality of a module which was built as a DSO you
# have to place corresponding `LoadModule' lines at this location so the
# directives contained in it are actually available _before_ they are used.
--More--(19%)
[q]
```

Edit the **Listen** directive in **/etc/httpd/conf/instance02.conf** and add the **PidFile** directive:

```
[root@redhat9 ~]# vi /etc/httpd/conf/instance02.conf

[root@redhat9 ~]# more /etc/httpd/conf/instance02.conf
#
# This is the main Apache HTTP server configuration file.  It contains the
# configuration directives that give the server its instructions.
```

```
# See <URL:http://httpd.apache.org/docs/2.4/> for detailed information.
# In particular, see
# <URL:http://httpd.apache.org/docs/2.4/mod/directives.html>
# for a discussion of each configuration directive.
#
# See the httpd.conf(5) man page for more information on this configuration,
# and httpd.service(8) on using and configuring the httpd service.
#
# Do NOT simply read the instructions in here without understanding
# what they do.  They're here only as hints or reminders.  If you are unsure
# consult the online docs. You have been warned.
#
# Configuration and logfile names: If the filenames you specify for many
# of the server's control files begin with "/" (or "drive:/" for Win32), the
# server will use that explicit path.  If the filenames do *not* begin
# with "/", the value of ServerRoot is prepended -- so 'log/access_log'
# with ServerRoot set to '/www' will be interpreted by the
# server as '/www/log/access_log', where as '/log/access_log' will be
# interpreted as '/log/access_log'.

#
# ServerRoot: The top of the directory tree under which the server's
# configuration, error, and log files are kept.
#
# Do not add a slash at the end of the directory path.  If you point
# ServerRoot at a non-local disk, be sure to specify a local disk on the
# Mutex directive, if file-based mutexes are used.  If you wish to share the
# same ServerRoot for multiple httpd daemons, you will need to change at
# least PidFile.
#
ServerRoot "/etc/httpd"

#
# Listen: Allows you to bind Apache to specific IP addresses and/or
```

```
# ports, instead of the default. See also the <VirtualHost>
# directive.
#
# Change this to Listen on a specific IP address, but note that if
# httpd.service is enabled to run at boot time, the address may not be
# available when the service starts.  See the httpd.service(8) man
# page for more information.
#
#Listen 12.34.56.78:80
Listen 8009
PidFile /var/run/httpd/instance02.pid

#
# Dynamic Shared Object (DSO) Support
#
# To be able to use the functionality of a module which was built as a DSO you
# have to place corresponding `LoadModule' lines at this location so the
# directives contained in it are actually available _before_ they are used.
--More--(19%)
[q]
```

Start both services:

```
[root@redhat9 ~]# systemctl start httpd@instance01.service

[root@redhat9 ~]# systemctl status httpd@instance01.service
● httpd@instance01.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd@instance01.service; disabled; preset: disabled)
     Active: active (running) since Thu 2024-09-26 15:14:25 CEST; 9s ago
       Docs: man:httpd@.service(8)
    Process: 7424 ExecStartPre=/bin/mkdir -m 710 -p /run/httpd/instance-instance01 (code=exited,
status=0/SUCCESS)
    Process: 7425 ExecStartPre=/bin/chown root.apache /run/httpd/instance-instance01 (code=exited,
status=0/SUCCESS)
```

```
    Process: 7426 ExecStartPre=/bin/mkdir -m 700 -p /var/lib/httpd/instance-instance01 (code=exited,
status=0/SUCCESS)
    Process: 7427 ExecStartPre=/bin/chown apache.apache /var/lib/httpd/instance-instance01 (code=exited,
status=0/SUCCESS)
   Main PID: 7429 (httpd)
     Status: "Total requests: 0; Idle/Busy workers 100/0;Requests/sec: 0; Bytes served/sec:   0 B/sec"
      Tasks: 177 (limit: 48800)
     Memory: 42.1M
        CPU: 122ms
     CGroup: /system.slice/system-httpd.slice/httpd@instance01.service
             ├─7429 /usr/sbin/httpd -DFOREGROUND -f conf/instance01.conf
             ├─7430 /usr/sbin/httpd -DFOREGROUND -f conf/instance01.conf
             ├─7431 /usr/sbin/httpd -DFOREGROUND -f conf/instance01.conf
             ├─7432 /usr/sbin/httpd -DFOREGROUND -f conf/instance01.conf
             └─7433 /usr/sbin/httpd -DFOREGROUND -f conf/instance01.conf

Sep 26 15:14:24 redhat9.ittraining.loc systemd[1]: Starting The Apache HTTP Server...
Sep 26 15:14:25 redhat9.ittraining.loc httpd[7429]: Server configured, listening on: port 8008
Sep 26 15:14:25 redhat9.ittraining.loc systemd[1]: Started The Apache HTTP Server.

[root@redhat9 ~]# systemctl start httpd@instance02.service

[root@redhat9 ~]# systemctl status httpd@instance02.service
● httpd@instance02.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd@instance02.service; disabled; preset: disabled)
     Active: active (running) since Thu 2024-09-26 15:14:43 CEST; 7s ago
       Docs: man:httpd@.service(8)
    Process: 7614 ExecStartPre=/bin/mkdir -m 710 -p /run/httpd/instance-instance02 (code=exited,
status=0/SUCCESS)
    Process: 7615 ExecStartPre=/bin/chown root.apache /run/httpd/instance-instance02 (code=exited,
status=0/SUCCESS)
    Process: 7616 ExecStartPre=/bin/mkdir -m 700 -p /var/lib/httpd/instance-instance02 (code=exited,
status=0/SUCCESS)
    Process: 7617 ExecStartPre=/bin/chown apache.apache /var/lib/httpd/instance-instance02 (code=exited,
```

```
status=0/SUCCESS)
   Main PID: 7618 (httpd)
     Status: "Started, listening on: port 8009"
      Tasks: 177 (limit: 48800)
     Memory: 42.1M
        CPU: 113ms
     CGroup: /system.slice/system-httpd.slice/httpd@instance02.service
             ├─7618 /usr/sbin/httpd -DFOREGROUND -f conf/instance02.conf
             ├─7619 /usr/sbin/httpd -DFOREGROUND -f conf/instance02.conf
             ├─7620 /usr/sbin/httpd -DFOREGROUND -f conf/instance02.conf
             ├─7621 /usr/sbin/httpd -DFOREGROUND -f conf/instance02.conf
             └─7622 /usr/sbin/httpd -DFOREGROUND -f conf/instance02.conf

Sep 26 15:14:43 redhat9.ittraining.loc systemd[1]: Starting The Apache HTTP Server...
Sep 26 15:14:43 redhat9.ittraining.loc httpd[7618]: Server configured, listening on: port 8009
Sep 26 15:14:43 redhat9.ittraining.loc systemd[1]: Started The Apache HTTP Server.
```

5.3 - Prohibiting Service Status Changes

It is possible to prohibit service status changes using the **systemctl mask** command:

```
[root@redhat9 ~]# systemctl status httpd.service
○ httpd.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd.service; disabled; preset: disabled)
     Active: inactive (dead)
       Docs: man:httpd.service(8)

Sep 26 15:01:28 redhat9.ittraining.loc systemd[1]: Starting The Apache HTTP Server...
Sep 26 15:01:28 redhat9.ittraining.loc httpd[7187]: Server configured, listening on: port 80
Sep 26 15:01:28 redhat9.ittraining.loc systemd[1]: Started The Apache HTTP Server.
Sep 26 15:02:54 redhat9.ittraining.loc systemd[1]: Stopping The Apache HTTP Server...
Sep 26 15:02:55 redhat9.ittraining.loc systemd[1]: httpd.service: Deactivated successfully.
Sep 26 15:02:55 redhat9.ittraining.loc systemd[1]: Stopped The Apache HTTP Server.
```

```
[root@redhat9 ~]# systemctl mask httpd.service
Created symlink /etc/systemd/system/httpd.service → /dev/null.

[root@redhat9 ~]# systemctl enable httpd.service
Failed to enable unit: Unit file /etc/systemd/system/httpd.service is masked.

[root@redhat9 ~]# systemctl start httpd.service
Failed to start httpd.service: Unit httpd.service is masked.
```

To authorise changes again, use the **systemctl unmask** command:

```
[root@redhat9 ~]# systemctl unmask httpd.service
Removed "/etc/systemd/system/httpd.service".

[root@redhat9 ~]# systemctl enable httpd.service
Created symlink /etc/systemd/system/multi-user.target.wants/httpd.service →
/usr/lib/systemd/system/httpd.service.

[root@redhat9 ~]# systemctl start httpd.service

[root@redhat9 ~]# systemctl status httpd.service
● httpd.service - The Apache HTTP Server
     Loaded: loaded (/usr/lib/systemd/system/httpd.service; enabled; preset: disabled)
     Active: active (running) since Thu 2024-09-26 15:17:38 CEST; 18s ago
       Docs: man:httpd.service(8)
   Main PID: 7896 (httpd)
     Status: "Total requests: 0; Idle/Busy workers 100/0;Requests/sec: 0; Bytes served/sec:   0 B/sec"
      Tasks: 177 (limit: 48800)
     Memory: 40.1M
        CPU: 99ms
     CGroup: /system.slice/httpd.service
             ├─7896 /usr/sbin/httpd -DFOREGROUND
             ├─7897 /usr/sbin/httpd -DFOREGROUND
             ├─7898 /usr/sbin/httpd -DFOREGROUND
```

```
             ├─7899 /usr/sbin/httpd -DFOREGROUND
             └─7900 /usr/sbin/httpd -DFOREGROUND

Sep 26 15:17:38 redhat9.ittraining.loc systemd[1]: Starting The Apache HTTP Server...
Sep 26 15:17:38 redhat9.ittraining.loc httpd[7896]: Server configured, listening on: port 80
Sep 26 15:17:38 redhat9.ittraining.loc systemd[1]: Started The Apache HTTP Server.
```
