CS 447/647

init

Overview

What is init?

What are units?

Exercises

Linux SysOps Handbook

A study notes book for the common knowledge and tasks of a Linux system admin.

GitBook.

▲ rythmshifter03 3 hours ago | prev | next [–]

This is amazingly useful to a person learning Linux in a corporate environment where they've just been thrown to the wolves to figure it out. Thank you!!

reply

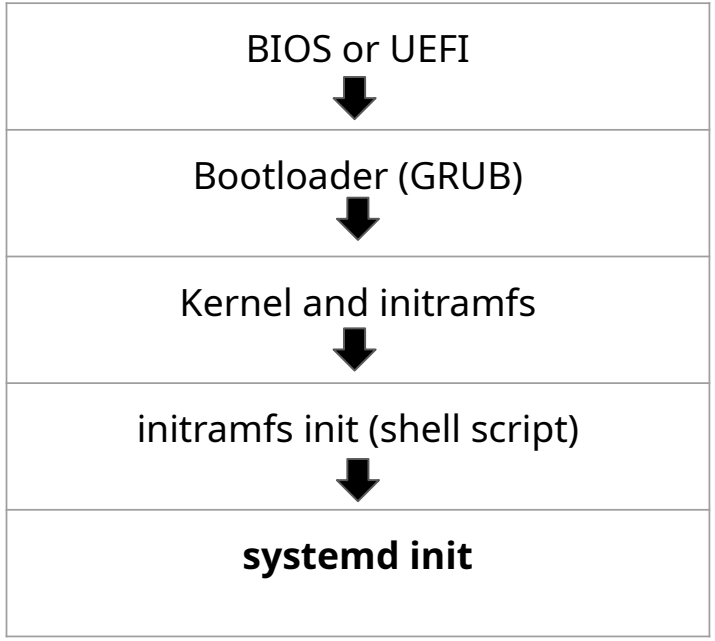
▲ sp33der89 3 hours ago | parent | next [–]

As somebody who's in this exact same position(well not really corporate), I feel the same way about this guide.

Thanks so much the author!

reply

Virtual Machine Boot (Recap)



What is init?

init

- Short for initialization
- First process to run
  - PID 1
    - Query processes with the ps(1) command: `ps -q 1`
    - `/sbin/init > /lib/systemd/systemd`
- Three types
  - SysV - System 5, Just a bunch of shell scripts (Legacy). 1983
  - BSD - Just like Sys5 but for the Berkeley Software Distribution
  - **systemd - Replaces SysV. used on nearly all modern Linux distributions**

Why you need to know SysV

- Legacy systems
  - CentOS 5 and older
- Debian used it before 2014
  - Ubuntu is downstream of Debian
- “The only reason why we still use it today is the cost of a migration.”

SysV init - Runlevels

Modes of operation

0 Shutdown

1 Single user mode - AKA Recovery

2-5 Normal multi-user mode - Most things run here, Networking, Graphics

6 Reboot

```
#!/bin/sh
# Start/stop the cron daemon.
#
### BEGIN INIT INFO
# Provides:          cron
# Required-Start:    $remote_fs $syslog $time
# Required-Stop:     $remote_fs $syslog $time
# Should-Start:      $network $named slapd autofs ypbind nscd nslcd winbind
# Should-Stop:       $network $named slapd autofs ypbind nscd nslcd winbind
# Default-Start:     2 3 4 5
# Default-Stop:
# Short-Description: Regular background program processing daemon
# Description:       cron is a standard UNIX program that runs user-specified
#                    programs at periodic scheduled times. vixie cron adds a
#                    number of features to the basic UNIX cron, including better
#                    security and more powerful configuration options.
### END INIT INFO

PATH=/bin:/usr/bin:/sbin:/usr/sbin
DESC="cron daemon"
NAME=cron
DAEMON=/usr/sbin/cron
PIDFILE=/var/run/crond.pid
SCRIPTNAME=/etc/init.d/"$NAME"

test -f $DAEMON || exit 0

. /lib/lsb/init-functions

[ -r /etc/default/cron ] && . /etc/default/cron
```

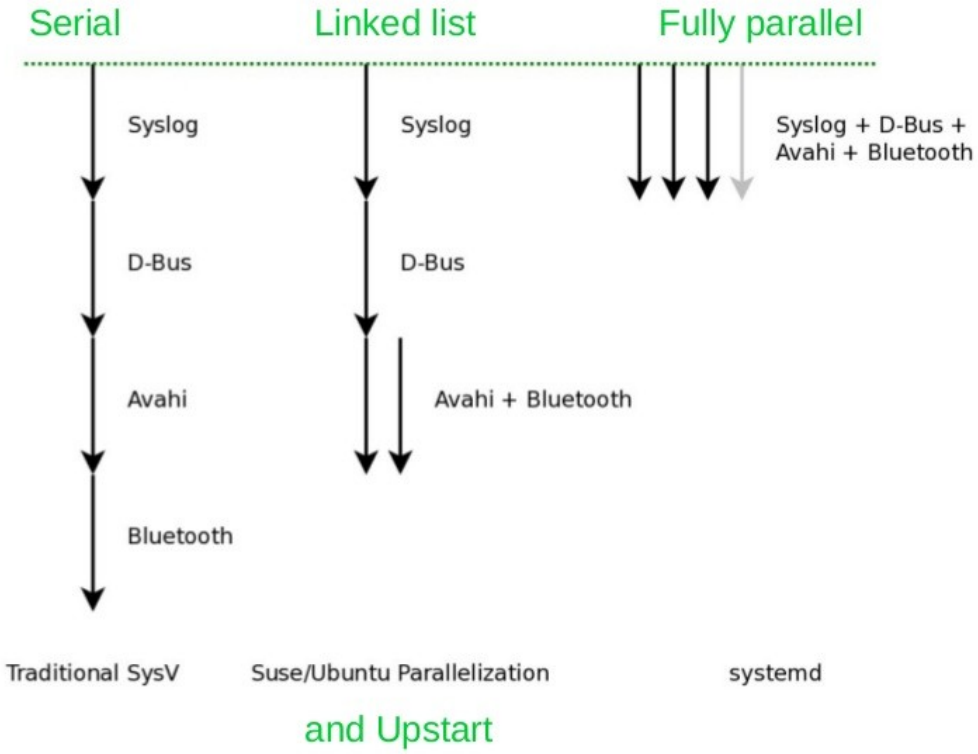
SysV init issues

- Not parallel
- Issues with dependencies
- Different conventions\code
- Difficult to maintain

systemd init

- Standardize system services management
- Collection of programs, daemons, libraries, technologies and kernel components
  - systemctl - Manages units
  - journalctl - Logging
  - networkd - Network Configuration
  - loginctl - Login manager
  - hostnamectl - Control the system hostname
- In short, it starts stuff.

Socket-based activation is key to systemd's fast boot



systemd.unit

- Unit - entity managed by systemd
  - **Service - Most common**
  - **Socket - Interprocess Communication (IPC)**
  - **Timer - Time-based process**
  - **Mount - Filesystem mounting**
  - **Target - Group of Units**
  - Scope - Group of processes
  - Slice - Resources for a group of processes
  - Path - A path monitored by systemd
  - Whatever else Lennart Poettering implements

```
systemctl --type help
```

```
systemctl list-units #Shows all units
```

Managing a systemd unit

vsftpd - lightweight, efficient FTP server written for security

1. Type **apt install -y vsftpd** to Install the Very Secure FTP Server
2. Type **systemctl start vsftpd** to activate the FTP server on your machine.
3. Type **systemctl status vsftpd**. You'll get output where you can see that the vsftpd service is currently operational.
4. Type **systemctl disable vsftpd** to stop the service from starting at boot.
5. Type **systemctl enable vsftpd** to automatically start the service after a restart.

systemd.unit

```
systemctl list-unit-files
```

```
UNIT FILE                                   STATE
proc-sys-fs-binfmt_misc.automount           static
-.mount                                     generated
data.mount                                  generated
dev-hugepages.mount                         static
dev-mqueue.mount                            static
proc-sys-fs-binfmt_misc.mount               static
sys-fs-fuse-connections.mount               static
sys-kernel-config.mount                     static
sys-kernel-debug.mount                      static
acpid.path                                  enabled
systemd-ask-password-console.path           static
systemd-ask-password-wall.path              static
watch-log.path                              linked
session-376.scope                           transient
session-38.scope                            transient
acpid.service                               disabled
apt-daily-upgrade.service                   static
apt-daily.service                           static
atftpd.service                              generated
autovt@.service                             enabled
```

systemd.unit states

State	Meaning
`bad`	Some kind of problem within **systemd**; usually a bad unit file
`disabled`	Present, but not configured to start autonomously
`enabled`	Installed and runnable; will start autonomously
`indirect`	Disabled, but has peers in `Also` clauses that may be enabled
`linked`	Unit file available through a symlink
`masked`	Banished from the **systemd** world from a logical perspective
`static`	Depended upon by another unit; has no install requirements

systemd.target

- Similar to runlevels
- Groups units together
- Important targets
  - `multi-user.target`: day-to-day use server
  - `graphical.target`: day-to-day use desktop
  - `emergency.target`: used for recovery
  - `rescue.target`: used for single-user mode

```
systemctl --type target #Show all targets
systemctl list-dependencies multi-user.target #Show
dependencies
systemctl get-default #Display the default target
systemctl set-default multi-user.target #Set the default
target
```

Run level	Target	Description
0	**poweroff.target**	System halt
emergency	**emergency.target**	Bare-bones shell for system recovery
1, s, single	**rescue.target**	Single-user mode
2	**multi-user.target** [a]	Multiuser mode (command line)
3	**multi-user.target** [a]	Multiuser mode with networking
4	**multi-user.target** [a]	Not normally used by **init**
5	**graphical.target**	Multiuser mode with networking and GUI
6	**reboot.target**	System reboot

a. By default, **multi-user.target** maps to **runlevel3.target**, multiuser mode with networking.

Unit locations

- **/usr/lib/systemd/system**
  a. Contains default unit files that have been installed from packages. You should never edit these files directly.
- **/etc/systemd/system** contains custom unit files.
  a. It may also contain files that have been written by an administrator or generated by the **systemctl edit** command.
- **/run/systemd/system**
  a. Contains unit files that have automatically been generated.
- `SYSTEMD_UNIT_PATH` env variable
  a. Has to exist before /sbin/init is executed.
  b. $SYSTEMD_UNIT_PATH ends with an empty component (":"), the usual unit load path will be appended to the contents of the variable.

```
[Unit]
Description=The Apache HTTP Server
After=network.target remote-fs.target nss-lookup.target

[Service]
Type=forking
Environment=APACHE_STARTED_BY_SYSTEMD=true
ExecStart=/usr/sbin/apachectl start
ExecStop=/usr/sbin/apachectl stop
ExecReload=/usr/sbin/apachectl graceful
PrivateTmp=true
Restart=on-abort

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

man 5 systemd.service

Apache2 Ubuntu Default Pa

localhost

Search

Apache2 Ubuntu Default Page

ubuntu

It works!

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Ubuntu systems. It is based on the equivalent page on Debian, from which the Ubuntu Apache packaging is derived. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should **replace this file** (located at `/var/www/html/index.html`) before continuing to operate your HTTP server.

If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator.

Configuration Overview

Ubuntu's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Ubuntu tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the `apache2-doc` package was installed on this server.

The configuration layout for an Apache2 web server installation on Ubuntu systems is as follows:

```
/etc/apache2/
|-- apache2.conf
|       `--  ports.conf
|-- mods-enabled
|       |-- *.load
|       `-- *.conf
|-- conf-enabled
|       `-- *.conf
|-- sites-enabled
|       `-- *.conf
```

Changing a unit configuration

1. Type **apt install nginx-extras** to install the nginx web server package.
2. Type **systemctl cat nginx.service** to show the current configuration of the unit file that starts the nginx web server.
3. Type **systemctl show nginx.service** to get an overview of available configuration options for this unit file.
4. Type **systemctl edit nginx.service** to change the default configuration, and ensure that the **[Service]** section includes the lines **Restart=always** and **RestartSec=5**s.
5. Type **systemctl daemon-reload** to ensure that systemd picks up the new configuration.
6. Type **systemctl restart nginx** to restart the nginx service.
7. Type **systemctl status nginx** and then repeat after 5 seconds. You'll notice that the nginx process gets automatically restarted.

```
export SYSTEMD_EDITOR=”/usr/bin/vim” #Changes the editor
```

Testing “Restart=always”

1. View the process
   ```
   ps ax | grep nginx
   #or
   ps -fp $(pgrep -d, -x nginx) #pgrep finds the process by name
   ```
2. Kill the process with a signal
   ```
   pkill -SIGTERM -f nginx
   ```
3. Wait 5 seconds… then check if it’s running
   ```
   ps ax | grep nginx
   ```
4. Check status
   ```
   systemctl status nginx
   ```

service

```
systemctl --type=service --all
```

```
  UNIT                                  LOAD      ACTIVE   SUB     DESCRIPTION
● apparmor.service                      not-found inactive dead    apparmor.service
  apt-daily-upgrade.service             loaded    inactive dead    Daily apt upgrade and clean acti
  apt-daily.service                     loaded    inactive dead    Daily apt download activities
● auditd.service                        not-found inactive dead    auditd.service
● clamav-daemon.service                 not-found inactive dead    clamav-daemon.service
● console-screen.service                not-found inactive dead    console-screen.service
  console-setup.service                 loaded    active   exited  Set console font and keymap
  cron.service                          loaded    active   running Regular background program proce
  dbus.service                          loaded    active   running D-Bus System Message Bus
● display-manager.service               not-found inactive dead    display-manager.service
  emergency.service                     loaded    inactive dead    Emergency Shell
  exim4.service                         loaded    active   running LSB: exim Mail Transport Agent
  fail2ban.service                      loaded    active   running Fail2Ban Service
● firewalld.service                     not-found inactive dead    firewalld.service
  getty-static.service                  loaded    inactive dead    getty on tty2-tty6 if dbus and l
  getty@tty1.service                    loaded    active   running Getty on tty1
```

Minecraft .service

```
apt install unzip
mkdir /srv/minecraft
cd /srv/minecraft/
wget
https://minecraft.azureedge.net/bin-linux/bedrock-server-1.16.40.02.zip
unzip bedrock-server-1.16.40.02.zip
#Test it
./bedrock_server
```

.service file

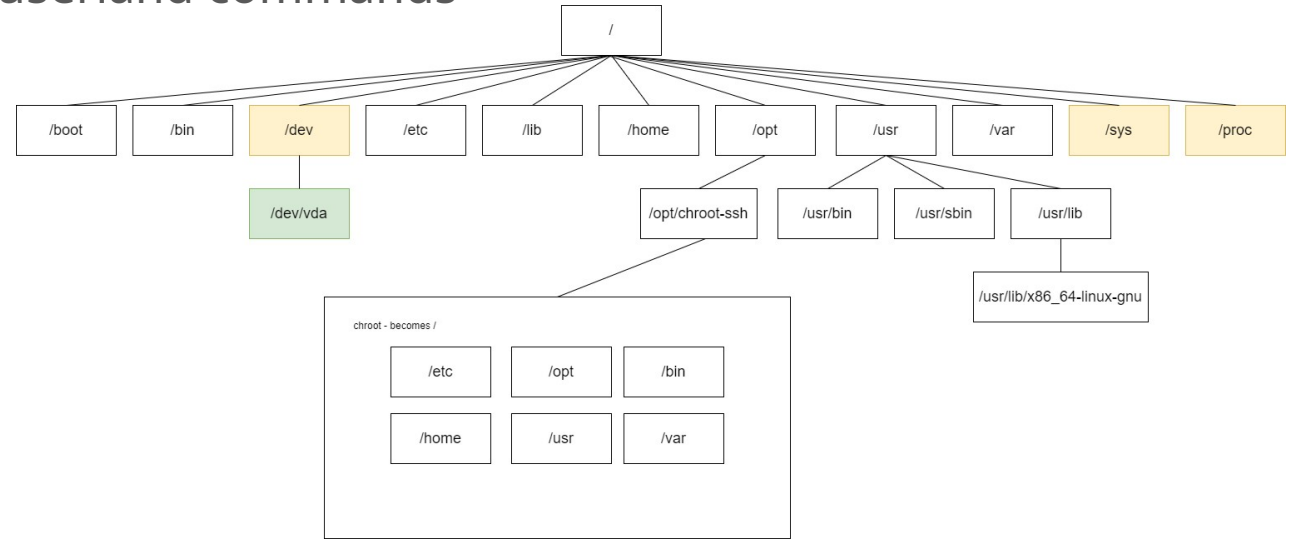
```
[Unit]
Description=Minecraft server
Requires=network.target local-fs.target
After=network.target local-fs.target

[Install]
WantedBy=multi-user.target

[Service]
Type=oneshot
KillMode=none
User=root
ExecStart=/usr/bin/tmux new-session -d -s minecraft-server -n minecraft-server  -c /srv/minecraft '/srv/minecraft/bedrock_server'
ExecStop=/usr/bin/tmux send-keys -t minecraft-server:minecraft-server s t o p Enter
WorkingDirectory=/srv/minecraft/
RemainAfterExit=yes
```

chroot-ssh

- Create a separate SSH service
- Limit filesystem access
- Untrustworthy users
- Limit userland commands



chroot-ssh

```
lxc config device add c0 proxy22 proxy
listen=tcp:0.0.0.0:2222 connect=tcp:127.0.0.1:22
```

socket

- A unit file that ends in “.socket”
- Unix Socket or Network Socket
  - A unix socket is a file
  - Network socket is an Internet Protocol (IP) address and a port. 127.0.0.01:4444
  - Inter-Process Communication
- Needs three sections
  - [Unit]
  - [Install]
  - [Socket]

/etc/systemd/system/echo.socket

```
[Unit]
Description=Simple echo server

[Socket]
ListenStream=/run/echo
Accept=yes

[Install]
WantedBy=sockets.target
```

```
systemctl list-unit-files | grep socket
```

/etc/systemd/system/echo@.service

```
[Unit]
Description=Echo server service

[Service]
ExecStart=/usr/local/bin/echo.py
StandardInput=socket
```

```
systemctl list-unit-files | grep “echo@”
```

/usr/local/bin/echo.py

Create a file:

```
#!/usr/bin/env python3
import sys
data = sys.stdin.read()

output = "{0}\r\n".format(data.strip().upper())

sys.stdout.write(output)
```

```
apt install -y socat
chmod +x /usr/local/bin/echo.py
echo “test” | echo.py # Output: TEST
```

Let’s use our echo.socket

1. `systemctl daemon-reload`
2. `systemctl list-unit-files | grep echo`
3. `systemctl start echo.socket`
4. `apt install -y socat # Used for communicating with a Unix socket`
5. `echo hello world | socat - unix-connect:/run/echo`

timer

- A unit file that ends in “.timer” that runs a service
- Built-in support for
  - Calendar Time, IE: OnCalendar=Mon *-*-* 00:00:00
  - Monotonic Time Events, IE: OnBootSec, OnStartupSec
  - Transient
    - `systemd-run --on-active=30 /bin/touch /tmp/foo`
- Needs three sections
  - `[Unit]`
  - `[Install]`
  - `[Timer]`

timer - OnCalendar Examples

```
DayOfWeek Year-Month-Day Hour:Minute:Second

minutely     → *-*-* *:*:00
hourly       → *-*-* *:00:00
daily        → *-*-* 00:00:00
monthly      → *-*-01 00:00:00
weekly       → Mon *-*-* 00:00:00
yearly       → *-01-01 00:00:00
quarterly    → *-01,04,07,10-01 00:00:00
semiannually → *-01,07-01 00:00:00
```

```
systemd-run -d --user --on-calendar '2022-02-22 23:59:00 PST' some-command
```

timer - OnCalendar Examples

```
#First Saturday of each month
Sat *-*-1..7 18:00:00

#Monday through Friday 10:30PM
Mon..Fri 22:30

#Run the first 4 days of a Month only if Mon or Tue
Mon,Tue *-*-01..04 12:00:00
```

```
#Run these
systemd-analyze calendar '*-*-* 20:00:0'
systemd-analyze calendar 'Mon,Tue *-*-01..04 12:00:00'
```

/etc/systemd/system/backup@.service

```
[Unit]
Description=Performs a system backup

[Service]
Type=oneshot
ExecStart=/usr/local/bin/backup.sh
```

/etc/systemd/system/backup@%i.timer

```
[Unit]
Description=Run a backup at %i interval

[Timer]
OnCalendar=%i
Persistent=true

[Install]
WantedBy=timers.target
```

/usr/local/bin/backup.sh

```
#!/bin/bash

DATE_STR=`date +'%d_%m_%Y_%H_%M'`
echo "Backup Script ${DATE_STR}"



# Test in with bash..

chmod +x /usr/local/bin/backup.sh
/usr/local/bin/backup.sh #Test it
```

timer

```
systemctl start backup@hourly.timer
systemctl status backup@hourly.timer


systemctl list-timers

systemctl start backup@hourly.service
systemctl status backup@hourly.service

#Transient Timer Example
systemd-run --on-active=30 /usr/local/bin/backup.sh
```

mount - Filesystem Mountpoint

```
#/etc/systemd/system/cs447.mount
[Unit]
Description=Server CS447 directory
After=network.target

[Mount]
What=192.168.1.1:/cs447
Where=/cs447
Type=nfs
Options=_netdev,auto

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

systemd logging

- journald
  - Handles logging from the kernel and all services from the early boot process (initramfs) to final shutdown
- Messages are stored in /run
  - rsyslog can forward them to /var/log

Common Commands

```
SYSTEMD_LOG_LEVEL=debug #Environmental variable for debugging
journalctl -n 20 #Last 20 lines
journalctl -u echo.socket
journalctl -f -u echo.socket #Follow the log, similar to tail -f
```

```python
import logging

from systemd.journal import JournaldLogHandler

##### BEGIN LOGGING SETUP #####

# Get an instance of the logger object this module will use
logger = logging.getLogger(__name__)

# Instantiate the JournaldLogHandler to hook into systemd
journald_handler = JournaldLogHandler()

# Set a formatter to include the level name
journald_handler.setFormatter(logging.Formatter(
    '[%(levelname)s] %(message)s'
))

# Add the journald handler to the current logger
logger.addHandler(journald_handler)

# Set the logging level
logger.setLevel(logging.DEBUG)

##### END OF LOGGING SETUP #####


logger.info(__name__)
```

Exercise

Tar file inspecting socket

1. Pipe a tar file to the socket.
2. The socket sends the input to list_tar.py,
3. list_tar.py iterates over the TarInfo objects and prints their names.
4. Need .socket and .service files

```
cp /cs447/demos/systemd/list_tar-socket/list_tar.py.start ~/
cp /cs447/demos/systemd/list_tar-socket/troff_files.tar ~/
mv list_tar.py /usr/local/bin/list_tar.py
cat troff_files.tar | list_tar.py
cat troff_files.tar | socat - unix-connect:/run/list_tar #UDS
```