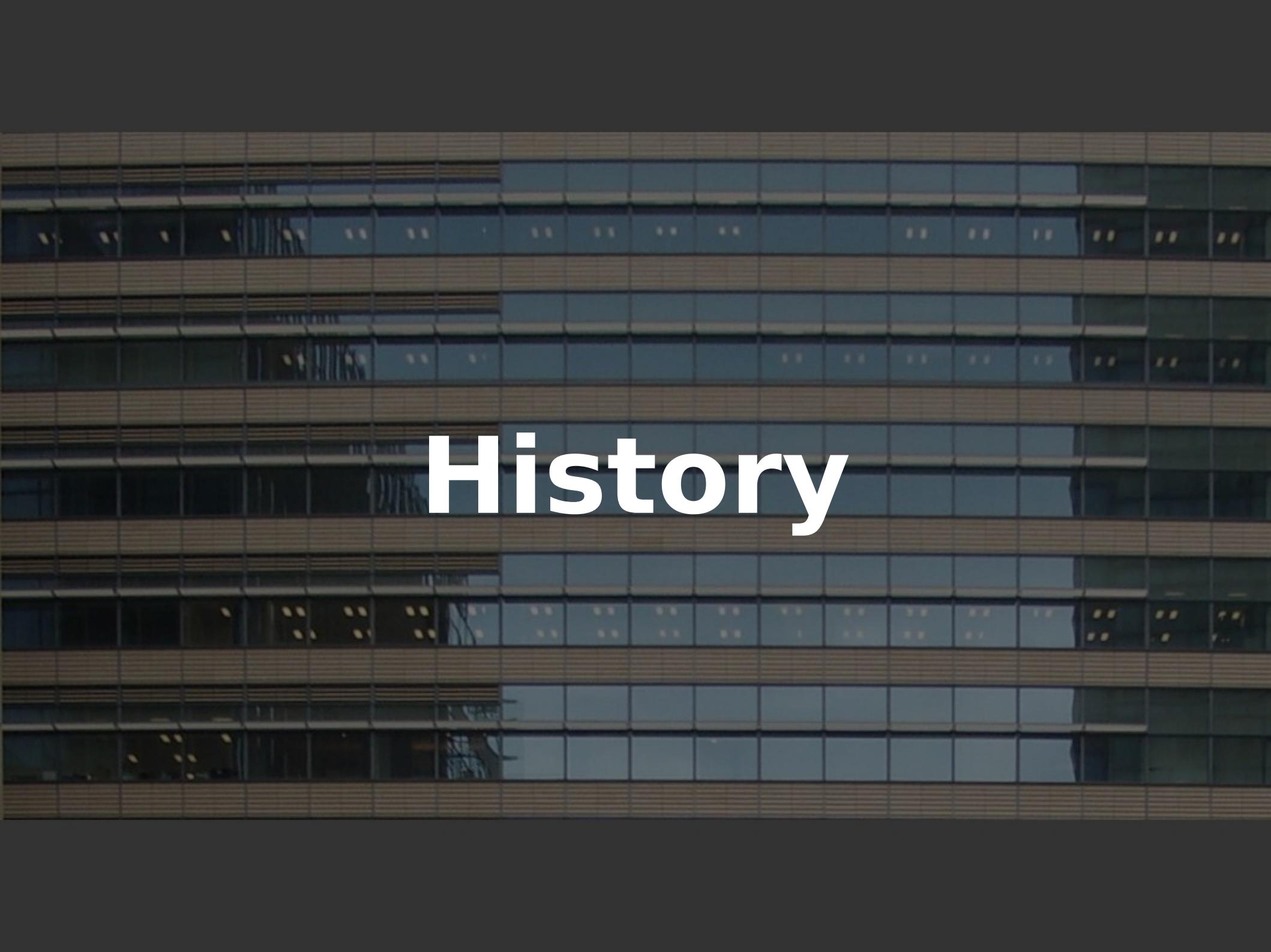


# **systemd: the new init system for Linux**

**Glenn Holmer**

Milwaukee Linux Users Group  
June 14, 2014

The background of the image shows a modern architectural structure with a facade composed of a grid of rectangular windows. The windows are arranged in horizontal rows, with some being dark and others illuminated from within, creating a pattern of light and shadow. The building appears to be a large office or institutional complex.

# History

# **init, the father of processes**

- ✓ BIOS loads bootloader from hard drive
- ✓ bootloader loads GRUB
- ✓ GRUB loads kernel
- ✓ kernel mounts filesystems and loads drivers
- ✓ kernel starts first process (init)

# **sysvinit startup**

- ✓ init looks for default runlevel and runs its scripts to start the appropriate services
- ✓ each runlevel has a directory **/etc/rcN.d/** with start and stop symlinks to scripts in **/etc/init.d**

# **init systems**

traditional: sysvinit (Linux)

alternate: OpenRC (Gentoo), upstart (Ubuntu)

other OS: BSD, SMF (Solaris), launchd (Mac)

# **systemd development**

started by Lennart Poettering, Kay Sievers



# **What's wrong with sysvinit?**

synchronous  
everything started at boot time  
can't control double-forked child processes

# **What's better about systemd?**

asynchronous  
services started only when needed (via socket)  
services run in cgroups

# **Why is systemd controversial?**

“do one thing and do it well” (feature creep)  
depends on dbus/kdbus

Linux-specific (because of cgroups)  
binary log file (the journal)

<http://0pointer.de/blog/projects/the-biggest-myths.html>

# Why is systemd controversial?

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<http://0pointer.de/blog/projects/the-biggest-myths.html>

personality conflicts...



I hate Lennart  
Poettering and his  
systemd, journ-

JUST RTFM, WILL  
YOU?

# **systemd adoption**

Ubuntu: upstart 2006 (native init 2009)

Fedora: upstart 2008, systemd 2011

RHEL: RHEL 7 (just released) uses systemd

SUSE: upstart option 2010, systemd 2011

SLES: SLES 12 (Q3) will use systemd

Debian: systemd 2014, Ubuntu will follow



# Mechanics

# **Why is sysvinit synchronous?**

services wait for their dependencies  
(which open a socket when ready)

# **Why not open the socket on startup?**

services with dependencies can start at once  
socket buffer holds messages until ready

# **Why is sysvinit slow?**

shell scripts! (shell loaded over and over)  
multiple invocations of grep, awk, sed...

# **Why not use configuration files?**

in **/usr/lib/systemd/system**

locals, overrides in **/etc/systemd/system**

```
[Unit]
Description=PostgreSQL database server
After=network.target

[Service]
Type=forking
User=postgres
Group=postgres
Environment=PGPORT=5432
Environment=PGDATA=/var/lib/pgsql/data
OOMScoreAdjust=-1000
ExecStartPre=/usr/bin/postgresql-check-db-dir ${PGDATA}
ExecStart=/usr/bin/pg_ctl start -D ${PGDATA} -s -o
    "-p ${PGPORT}" -w -t 300
ExecStop=/usr/bin/pg_ctl stop -D ${PGDATA} -s -m fast
ExecReload=/usr/bin/pg_ctl reload -D ${PGDATA} -s
TimeoutSec=300

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

## **some systemd unit types:**

**service:** traditional daemon (ssh, http, kdm...)

**socket:** listener socket for service activation

**target:** like a runlevel, but not exclusive

**no /etc/inittab:**

**/etc/systemd/system/default.target**

**is a symlink to e.g.**

**/lib/systemd/system/graphical.target**

## **some distros use symlinks:**

**runlevel0.target** → **poweroff.target**

**runlevel1.target** → **rescue.target**

**runlevel2.target** → **multi-user.target**

**runlevel3.target** → **multi-user.target**

**runlevel4.target** → **multi-user.target**

**runlevel5.target** → **graphical.target**

**runlevel6.target** → **reboot.target**

## **more unit types:**

- slice:** resource control via cgroups  
(can control CPU share,  
memory usage, IO bandwidth,  
device access)
- snapshot:** saves current runtime state,  
can return to it with **isolate**  
(lost on reboot)

# more unit types:

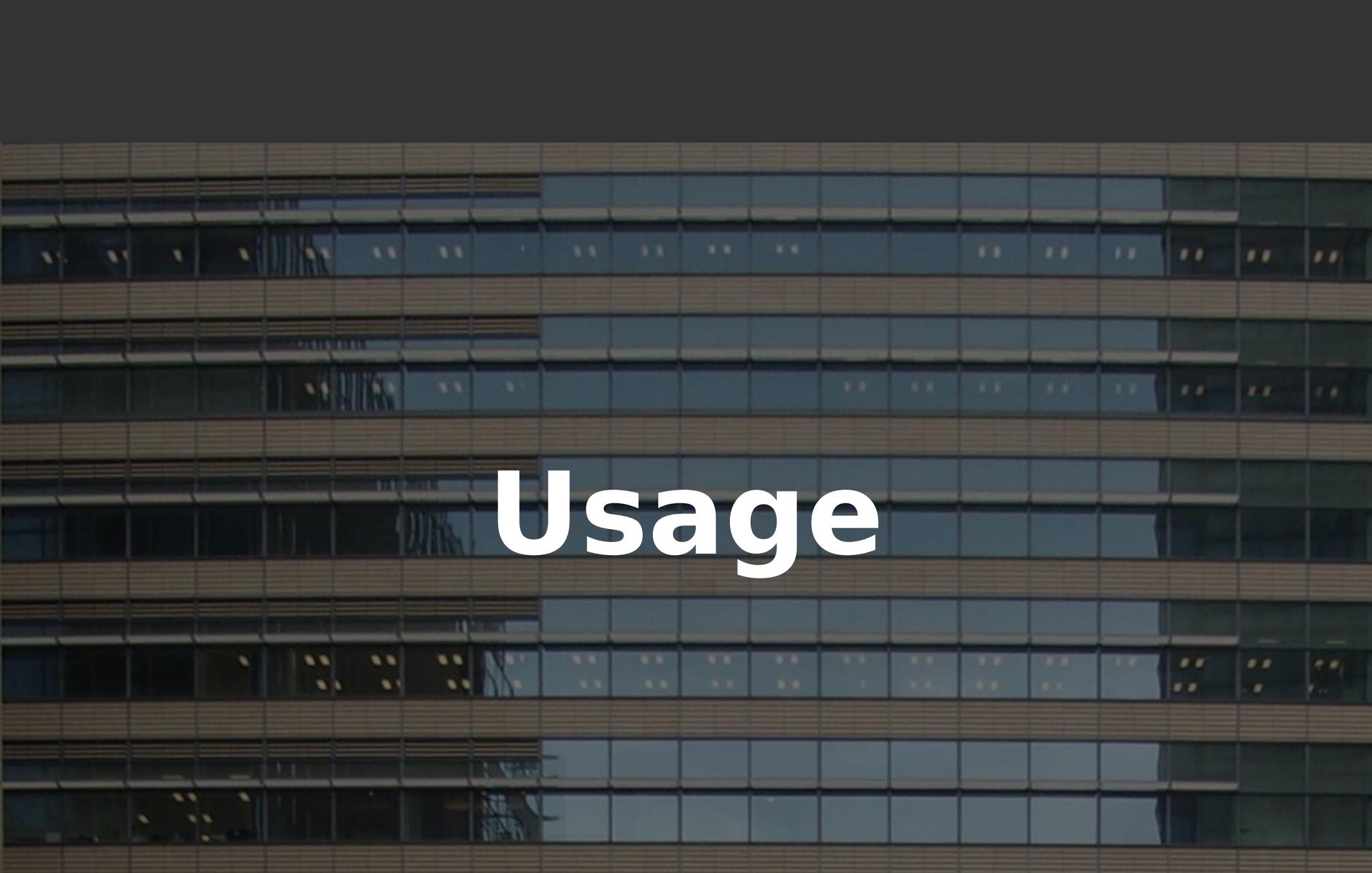
<b>device:</b>	when device is ready (udev)
<b>mount:</b>	( <code>/etc/fstab</code> still preferred)
<b>automount:</b>	(requires matching mount unit)
<b>swap:</b>	swap space
<b>path:</b>	unit activation on path change
<b>timer:</b>	event based on boot time, time since a unit's activation, calendar time

# **sysvinit compatibility**

“virtual” service units created in-memory  
look for **LSB:** or **SYSV:** in the output of  
**systemd list-units**

**service, chkconfig, telinit...** still work  
for more information:

[freedesktop.org/wiki/Software/systemd/Incompatibilities/](https://freedesktop.org/wiki/Software/systemd/Incompatibilities/)



# Usage

# **GUI front-end for systemd:**

**systemadm**

On Fedora 20 and OpenSUSE 13.1, install  
**systemd-ui** package.

Good for exploring and learning systemd.

# systemd System Manager

Units Jobs

All unit types  inactive too

Load

Reload Configuration

Take Snapshot

Load State	Active State	Unit State	Unit
loaded	active	running	cups.path
loaded	active	running	cups.service
loaded	active	running	cups.socket

**Id:** cups.service(running)

**Description:** CUPS Printing Service

**Dependencies:** requires: basic.target(active)  
wants: system.slice(active)  
conflicts: shutdown.target(dead)  
after: basic.target(active), cups.path(running), cups.socket(running), system.slice(active), systemd-journald.socket(running)  
before: shutdown.target(dead)

**Fragment Path:** /usr/lib/systemd/system/cups.service

**Control Group:** n/a

**Load State:** loaded

**Active State:** active

**Activated:** Mon, 26 May 2014 06:25:20

**Can Start/Stop:** Yes

**Unit State:** running

**Deactivated:** n/a

**Can Reload:** No

Start

Stop

Restart

Reload

# **Most frequently-used commands:**

`systemctl`  
`journalctl`

Completion prompting and color coding!

```
systemctl [list-units]
systemctl list-unit-files
systemctl -t service
systemctl --state failed
systemctl enable <servicename>
systemctl start <servicename>
systemctl status <servicename>
systemctl daemon-reload
systemctl halt
```

journalctl -f	<b>(follow, like tail -f)</b>
journalctl -x	<b>(show extra)</b>
journalctl -n99	<b>(last 99 entries)</b>
journalctl -b	<b>(since boot)</b>
journalctl -b -1	<b>(since previous boot)</b>
journalctl --since	<b>(since date/time)</b>
journalctl -p err	<b>(by priority)</b>
journalctl -u	<b>(by unit)</b>
journalctl /usr/...	<b>(by executable)</b>
journalctl /dev/...	<b>(by device)</b>

**switch “runlevel”:**  
**systemctl isolate <target-name>**

**emergency boot: start kernel with**  
**systemd.unit=<target-name>**

# **systemd diagnostics:**

**systemd-cgls**      (“control group ls”)

**systemd-cgtop**      (“control group top”)

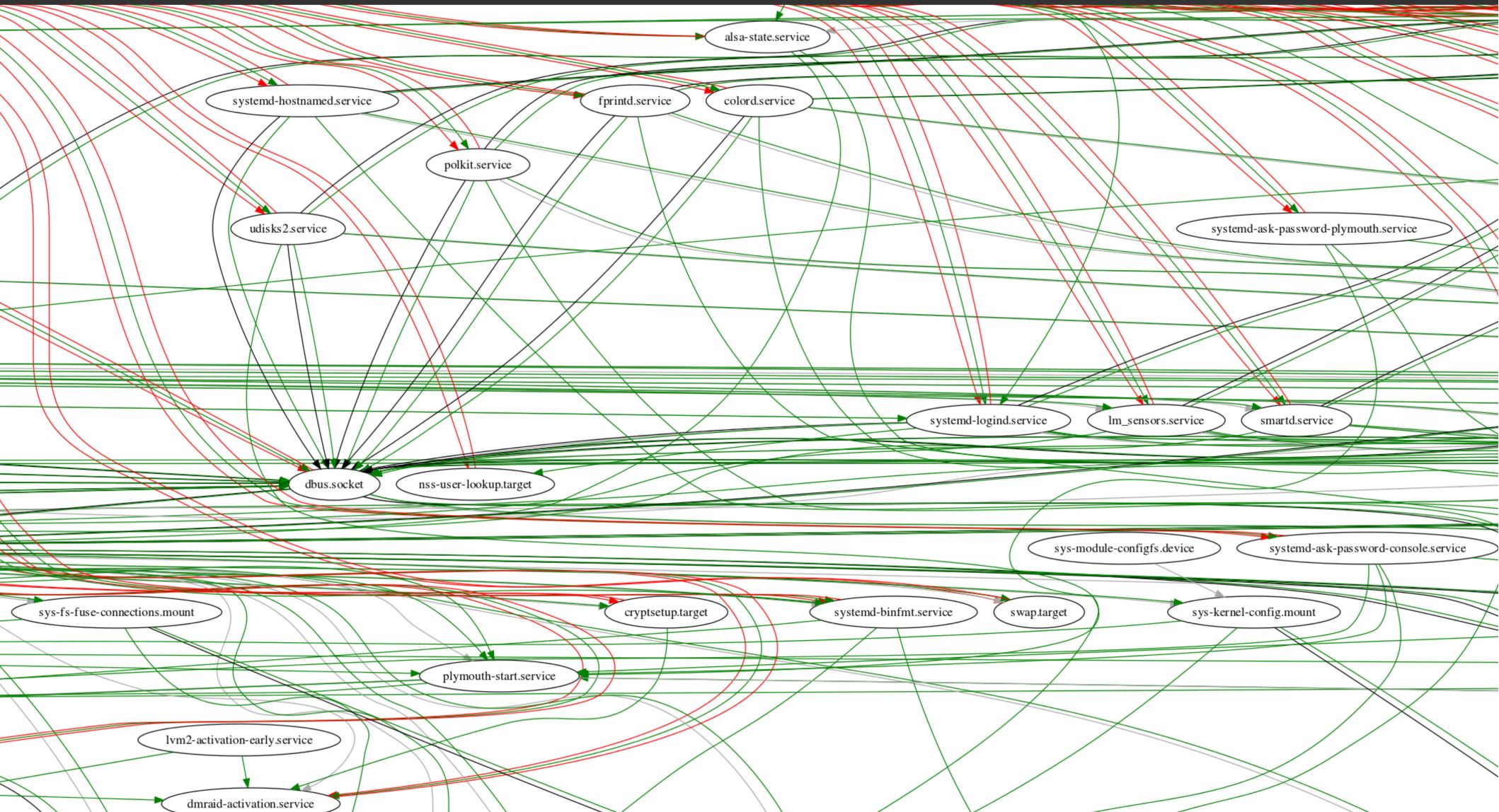
**systemd-analyze**

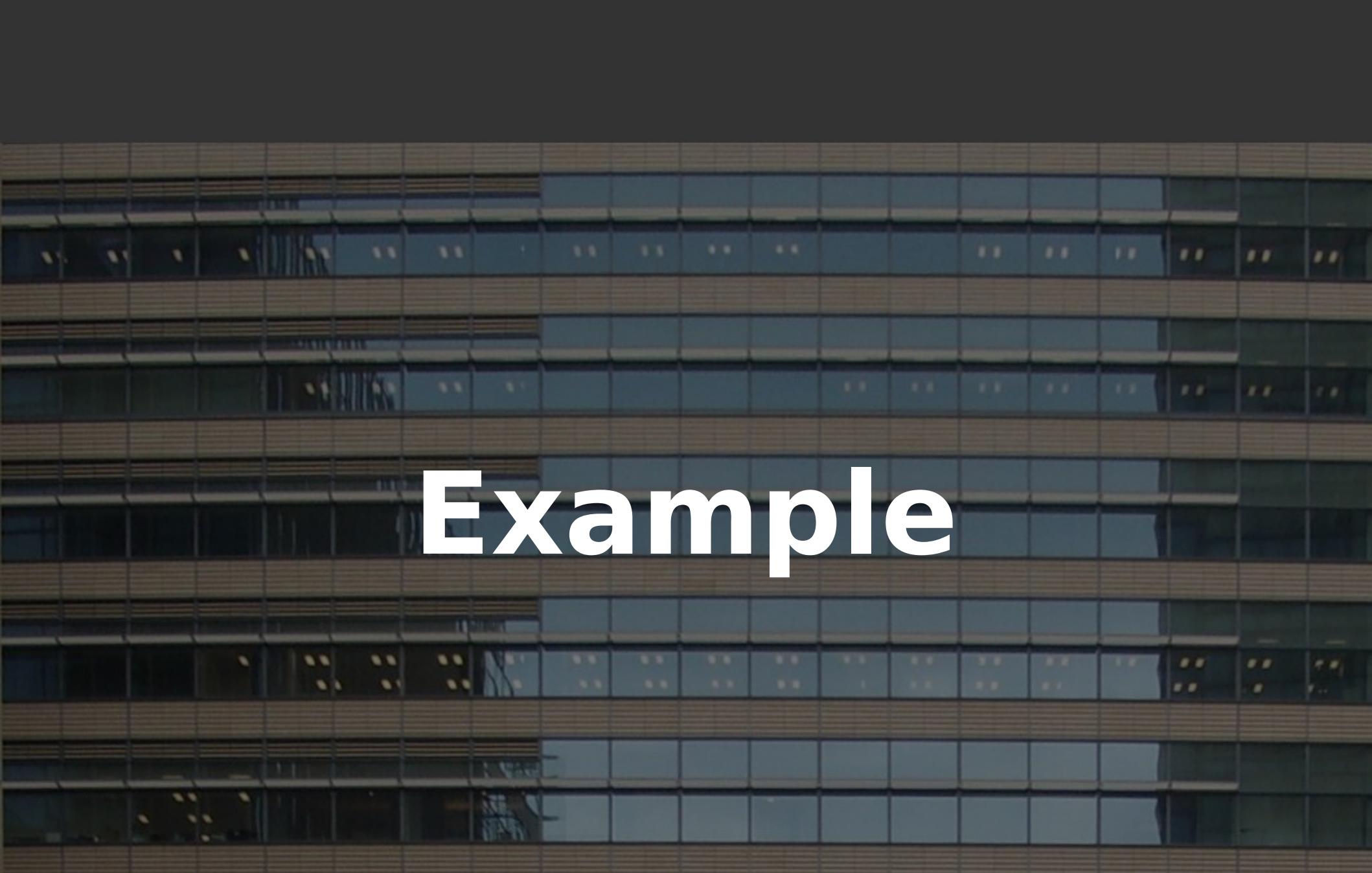
**systemd-analyze blame**

**systemd-analyze plot > filename.svg**

**systemd-analyze dot | \**

**dot -Tsvg > systemd.svg**





Example

```
[root@orac ~]# systemctl enable postgresql.service
ln -s '/usr/lib/systemd/system/postgresql.service' '/etc/systemd/system/multi-user.target.wants/postgresql.service'
[root@orac ~]#
```

```
[root@orac ~]# systemctl enable postgresql.service
ln -s '/usr/lib/systemd/system/postgresql.service' '/etc/systemd/system/multi-user.target.wants/postgresql.service'
[root@orac ~]# systemctl start postgresql.service
Job for postgresql.service failed. See 'systemctl status postgresql.service' and 'journalctl -xn' for details.
[root@orac ~]#
```

```
[root@orac ~]# systemctl enable postgresql.service
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[root@orac ~]# systemctl start postgresql.service
Job for postgresql.service failed. See 'systemctl status postgresql.service' and 'journalctl -xn' for details.
[root@orac ~]# systemctl status postgresql.service
postgresql.service - PostgreSQL database server
   Loaded: loaded (/usr/lib/systemd/system/postgresql.service; enabled)
   Active: failed (Result: exit-code) since Sat 2014-04-19 08:27:49 CDT; 10s ago
     Process: 13117 ExecStartPre=/usr/bin/postgresql-check-db-dir ${PGDATA} (code=exited, status=1/FAILURE)

Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13117]: "/var/lib/pgsql/data" is missing or empty.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13117]: Use "postgresql-setup initdb" to initialize the database cluster.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13117]: See /usr/share/doc/postgresql/README.rpm-dist for more information.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: postgresql.service: control process exited, code=exited status=1
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Failed to start PostgreSQL database server.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Unit postgresql.service entered failed state.
[root@orac ~]#
```

```
[root@orac ~]# systemctl enable postgresql.service
ln -s '/usr/lib/systemd/system/postgresql.service' '/etc/systemd/system/multi-user.target.wants/postgresql.service'
[root@orac ~]# systemctl start postgresql.service
Job for postgresql.service failed. See 'systemctl status postgresql.service' and 'journalctl -xn' for details.
[root@orac ~]# systemctl status postgresql.service
postgresql.service - PostgreSQL database server
   Loaded: loaded (/usr/lib/systemd/system/postgresql.service; enabled)
   Active: failed (Result: exit-code) since Sat 2014-04-19 08:27:49 CDT; 10s ago
     Process: 13l17 ExecStartPre=/usr/bin/postgresql-check-db-dir ${PGDATA} (code=exited, status=1/FAILURE)

Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13l17]: "/var/lib/pgsql/data" is missing or empty.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13l17]: Use "postgresql-setup initdb" to initialize the database cluster.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13l17]: See /usr/share/doc/postgresql/README.rpm-dist for more information.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: postgresql.service: control process exited, code=exited status=1
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Failed to start PostgreSQL database server.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Unit postgresql.service entered failed state.
[root@orac ~]# journalctl -xn
-- Logs begin at Wed 2014-03-26 19:23:59 CDT, end at Sat 2014-04-19 08:27:49 CDT. --
Apr 19 08:25:38 orac.lyonlabs.org su[13017]: pam_unix(su-l:session): session opened for user root by cenbe(uid=1002)
Apr 19 08:26:07 orac.lyonlabs.org fprintd[13018]: ** Message: No devices in use, exit
Apr 19 08:27:43 orac.lyonlabs.org systemd[1]: Reloading.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Starting PostgreSQL database server...
-- Subject: Unit postgresql.service has begun with start-up
-- Defined-By: systemd
-- Support: http://lists.freedesktop.org/mailman/listinfo/systemd-devel
--
-- Unit postgresql.service has begun starting up.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13l17]: "/var/lib/pgsql/data" is missing or empty.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13l17]: Use "postgresql-setup initdb" to initialize the database cluster.
Apr 19 08:27:49 orac.lyonlabs.org postgresql-check-db-dir[13l17]: See /usr/share/doc/postgresql/README.rpm-dist for more information.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: postgresql.service: control process exited, code=exited status=1
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Failed to start PostgreSQL database server.
-- Subject: Unit postgresql.service has failed
-- Defined-By: systemd
-- Support: http://lists.freedesktop.org/mailman/listinfo/systemd-devel
--
-- Unit postgresql.service has failed.
--
-- The result is failed.
Apr 19 08:27:49 orac.lyonlabs.org systemd[1]: Unit postgresql.service entered failed state.
[root@orac ~]# █
```

```
[root@orac ~]# postgresql-setup initdb
Initializing database ... OK
```

```
[root@orac ~]#
```

```
[root@orac ~]# postgresql-setup initdb
Initializing database ... OK

[root@orac ~]# systemctl start postgresql.service
[root@orac ~]#
```

```
[root@orac ~]# postgresql-setup initdb
Initializing database ... OK

[root@orac ~]# systemctl start postgresql.service
[root@orac ~]# systemctl status postgresql.service
postgresql.service - PostgreSQL database server
   Loaded: loaded (/usr/lib/systemd/system/postgresql.service; enabled)
   Active: active (running) since Sat 2014-04-19 08:43:36 CDT; 7s ago
     Process: 13748 ExecStart=/usr/bin/pg_ctl start -D ${PGDATA} -s -o -p ${PGPORT} -w -t 300 (code=exited, status=0/SUCCESS)
    Process: 13741 ExecStartPre=/usr/bin/postgresql-check-db-dir ${PGDATA} (code=exited, status=0/SUCCESS)
   Main PID: 13751 (postgres)
      CGroup: /system.slice/postgresql.service
              ├ 13751 /usr/bin/postgres -D /var/lib/pgsql/data -p 5432
              ├ 13752 postgres: logger process
              ├ 13754 postgres: checkpointer process
              ├ 13755 postgres: writer process
              ├ 13756 postgres: wal writer process
              ├ 13757 postgres: autovacuum launcher process
              └ 13758 postgres: stats collector process

Apr 19 08:43:35 orac.lyonlabs.org systemd[1]: Starting PostgreSQL database server...
Apr 19 08:43:35 orac.lyonlabs.org pg_ctl[13748]: LOG:  redirecting log output to logging collector process
Apr 19 08:43:35 orac.lyonlabs.org pg_ctl[13748]: HINT: Future log output will appear in directory "pg_log".
Apr 19 08:43:36 orac.lyonlabs.org systemd[1]: Started PostgreSQL database server.
[root@orac ~]# █
```

# **resources:**

overview:

<http://www.freedesktop.org/wiki/Software/systemd/>

“Demystifying systemd” slides:

<http://bit.ly/1jm87CJ>

“Getting Ready for Systemd” video:

<https://access.redhat.com/site/videos/403833>