OpenBSD developer since 2006

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sysmerge, rc.d, rc.subr, rcctl, libtool…

>400 ports, GNOME (Foundation member)

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Stuff we're going to talk about

- historical (& current) system boot process
- rc.d alternatives and requirements
- rc.d usage
- rc.subr internals
- rcctl
“I went to Canada and I all I got to see was a talk about a shell script!”
- kill -HUP
- apachectl graceful
- rndc reload
- haproxy -sf $(cat /var/run/haproxy.pid)
The 90's called...

- boot loader -> kernel -> init
- init(1) uses sh(1) to run /etc/rc
- dependable, predictive, sequential
- dependency-less
Controlling the startup

/etc/rc.conf, default configuration
/etc/rc.conf.local, rc.conf(8) overrides

daemon_flags=flags|NO
service=YES|NO
- current paradigm cannot change
- preserve existing behavior
- plug rc.d on top (!= replacement)
- only handle daemons
- small, simple, robust, comprehensive
- easily debuggable
Alternatives at the time

- SMF, launchd
- OpenRC
- runit, daemontools
- Slackware Linux rc.d
- FreeBSD and NetBSD rc.d + rconfig
- ...

- small and targeted to our requirements
- no supervision
- no event driven / socket activated
- no parallelization
- no automatic startup ordering
October 2010: first implementation

/etc/rc.d/rc.subr, /etc/rc.d/foobar

designed for ports only

base was the ultimate goal
Initial implementation

- standard facility to signal daemons: `kill(1)`
- does not rely on PID files
- no `start-stop-daemon(8)`...
- good enough for ~95% of the ecosystem
- shell (ksh)
- *rc.d* scripts initially called from `/etc/rc.local`
  - no disruption to the existent
  - traditional way to start external daemons
for _r in $rc_scripts; do
  [ -x /etc/rc.d/${_r} ] && \
  /etc/rc.d/${_r} start && \
  echo -n " ${_r}" done
• sourced by rc.d scripts
• provides all subroutines
• 54 LOC at that time
“Who would need such a bloated interface?”
one release later: base system daemons

why the change of mind?
  ○ process not started in isolation
  ○ unexpected and/or dangerous behavior

"su(1) -l" for environment sanitation
su root -c 'apachectl2 start'

versus

su root -c '/etc/rc.d/apache2 start'
<table>
<thead>
<tr>
<th>Environment Variable</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>AUTHORITY</td>
<td>/var/run/gdm/auth-for-ajacoutot-m3vPl9/database</td>
</tr>
<tr>
<td>EC2_HOME</td>
<td>/usr/local/ec2-api-tools</td>
</tr>
<tr>
<td>LOGNAME</td>
<td>ajacoutot</td>
</tr>
<tr>
<td>WINDOWID</td>
<td>39950112</td>
</tr>
<tr>
<td>LC_PAPER</td>
<td>en_US.UTF-8</td>
</tr>
<tr>
<td>HOME</td>
<td>/root</td>
</tr>
<tr>
<td>JAVA_HOME</td>
<td>/usr/local/jdk-1.7.0</td>
</tr>
<tr>
<td>MORE</td>
<td>-e</td>
</tr>
<tr>
<td>GDM_LANG</td>
<td>en_US.UTF-8</td>
</tr>
<tr>
<td>XMODIFIERS</td>
<td>@im=ibus</td>
</tr>
<tr>
<td>LC_MONETARY</td>
<td>en_US.UTF-8</td>
</tr>
<tr>
<td>GNOME_DESKTOP_SESSION_ID</td>
<td>this-is-deprecated</td>
</tr>
<tr>
<td>XDG_SESSION_COOKIE</td>
<td>peck.home.bsdfrog.org-1457525880.169095-987613489</td>
</tr>
<tr>
<td>LANG</td>
<td>en_US.UTF-8</td>
</tr>
<tr>
<td>SSH_AUTH_SOCK</td>
<td>/tmp/ssh-fYV14jcellEs/agent.20253</td>
</tr>
<tr>
<td>LC_MEASUREMENT</td>
<td>en_US.UTF-8</td>
</tr>
<tr>
<td>SHELL</td>
<td>/bin/ksh</td>
</tr>
<tr>
<td>TERM</td>
<td>xterm-256color</td>
</tr>
<tr>
<td>DBUS_SESSION_BUS_ADDRESS</td>
<td>unix:path=/tmp/dbus-bTXFGN5XVm.guid=c1ba1bc5f3988d9ee7337f4156e0147b</td>
</tr>
<tr>
<td>USERNAME</td>
<td>ajacoutot</td>
</tr>
<tr>
<td>LC_NUMERIC</td>
<td>en_US.UTF-8</td>
</tr>
<tr>
<td>XDG_MENU_PREFIX</td>
<td>gnome-</td>
</tr>
<tr>
<td>WINDOWPATH</td>
<td>5</td>
</tr>
<tr>
<td>XDG_SESSION_TYPE</td>
<td>x11</td>
</tr>
<tr>
<td>PWD</td>
<td>/home/ajacoutot</td>
</tr>
<tr>
<td>DESKTOP_AUTOSTART_ID</td>
<td>10577b4c3ea13dc5f41457525883346266000000287180001</td>
</tr>
<tr>
<td>PKG_PATH</td>
<td>ftp.fr.openbsd.org</td>
</tr>
<tr>
<td>LD_LIBRARY_PATH</td>
<td>/usr/local/lib</td>
</tr>
<tr>
<td>LC_CTYPE</td>
<td>en_US.UTF-8</td>
</tr>
<tr>
<td>DISPLAY</td>
<td>:0</td>
</tr>
<tr>
<td>SSH_AGENT_PID</td>
<td>16845</td>
</tr>
</tbody>
</table>

“Too much information!”
OpenBSD startup sequence

- do things -> start_daemon() -> do other things -> start_daemon() -> ...
- hostname.if, rc.securelevel, rc.local, rc.shutdown
- run_upgrade_script() (sysmerge, firsttime)

rc.d = small subset of the startup sequence
- rc.subr 224 LOC
- /etc/rc -150 LOC
  - source rc.subr (functions only)
  - start_daemon()
  - start/stop pkg_scripts (while loop)
- big feature gain for 70 LOC
Features and usage

- 4+1 actions available
  - *start* the daemon (flags, timeout, user, class, rtable)
  - *stop* the daemon (SIGTERM)
  - *reload* the daemon (SIGHUP)
  - *check* if the daemon is running (pgrep)
  - *restart* the daemon (stop && start)
- need to run as a privileged user (~!check)
- fully configurable and overridable
- main user interface: just a few knobs
#!/bin/sh
#
#
# $OpenBSD$

daemon="/path/to/daemon"
.
/etc/rc.d/rc.subr
rc_cmd $1
2 optional flags

- **-d** debug mode
  - describe and display stdout/stderr

- **-f** force mode
  - similar to *onestart*
  - no-op for packages rc.d scripts
Enabling daemons

- daemon_flags
  - base system daemons
- pkg_scripts (ordered or reversed)
  - package daemons
- `daemon_class`
  - default: daemon
  - BSD login class the daemon will run under (resource limits, environment variables...)

---

**rc.d variables**
• daemon_flags
  . default: NO|<empty> (from /etc/rc.conf)
  . flags passed to the daemon
- daemon_rtable
  - default: 0
  - routing table to run the daemon under
• daemon_timeout
  ○ default: 30
  ○ maximum time in seconds to start/stop/reload a daemon
- `daemon_user`
  - default: `root`
  - user the daemon will run as
variables are overridable by
- the rc.d script itself
- /etc/rc.conf
- /etc/rc.conf.local
rc.d variables

- /etc/rc.d/netsnmpd
  - daemon_flags="-u _netsnmp -I -ipv6"

- rc.conf.local
  - netsnmpd_flags=-u _netsnmp -a

override: rc.d script name is substituted to daemon in the variable name
- set to a login class of the same name as the rc.d script
- `netsnmpd_class=myclass`

```
netsnmpd:\n  :openfiles-cur=512:\n  :tc=daemon:\n```
apmd_flags=-A
hotplugd_flags=
saned_flags=-s128
ntpd_flags=NO
pkg_scripts=messagebus saned cupsd
Special cases

- meta rc.d script
  - /etc/rc.d/samba start
  - /etc/rc.d/smbd start && /etc/rc.d/nmbd start
• multiple instances of the same daemon
  ○ `ln -s /etc/rc.d/foobar /etc/rc.d/foobar2`
  ○ `pgrep(1)` much match the correct one!
  ○ `foobar2_flags`, `foobar2_user`...
- entry point
- where the whole framework is defined
- sourced by rc.d scripts
  - to get std functions and default vars
  - functions can be overridden by the script itself
rc_start()

```bash
${rcexec} "${daemon} ${daemon_flags} ${_bg}"

rcexec="su -l -c ${daemon_class} -s /bin/sh ${daemon_user} -c"

[ "${daemon_rtable}" -eq 0 ] || \
   rcexec="route -T ${daemon_rtable} exec ${rcexec}"

rc_bg=YES -> "&"

e.g.

su -l -c daemon -s /bin/sh root -c "/usr/sbin/sshd -flags"
```
At shutdown: base system daemons scripts are not run (SIGTERM)

```bash
pkkill -T "${daemon_rtable}" -xf "${pexp}"

pexp="${daemon}${daemon_flags:+ ${daemon_flags}}"
```
pkill -HUP -T "${daemon_rtable}" \ 
    -xf "${pexp}"
pgrep -T "${daemon_rtable}" -q -xf "${pexp}"
- *start* will invoke `rc_pre()` before starting a daemon
- pre-launch time requirements
  - e.g. create a directory to store a socket
invoked by *stop* after a daemon process has been killed

- cleanup
  - remove dangling lock files
  - putting the system back into a pristine state (e.g. cups)
- main function
- last command called by an rc.d script
- 1 of 5 arguments
rc_cmd() start

- check that the daemon is enabled
- check it is not already running
- run rc_pre()
- run rc_start()
- daemon variables in /var/run/rc.d/${rcscriptname}
- wait up to ${daemon_timeout} seconds
rc_cmd() stop

- check that the daemon is running
- run rc_stop()
- wait up to ${daemon_timeout} seconds
- run rc_post()
- rm /var/run/rc.d/${rcscriptname}
• /etc/rc.d/daemon stop
• /etc/rc.d/daemon start
- check that the daemon is running
- run rc_reload()
rc_cmd() check

- rc_check()
Unsupported actions

- some daemons do not support an action
  - turn function into a variable set to “NO”
    - e.g. rc_reload=NO
● if rc_check() requires higher privileges
  ○ rc_usercheck=NO
- match currently running process in case configuration changed
  - e.g. /var/run/rc.d/ntpd

  ```
  daemon_class=daemon
  daemon_flags=-s
  daemon_rtable=0
  daemon_timeout=30
  daemon_user=root
  pexp=/usr/sbin/ntpd
  ```
daemon="/path/to/bin/foob --daemonize"

#daemon_flags=
#daemon_rtable="0"
#daemon_timeout="30"
#daemon_user="root"

. /etc/rc.d/rc.subr

#pexp="${daemon}${daemon_flags:+ ${daemon_flags}}"
#rc_bg=
#rc_reload=
#rc_usercheck=YES
#rc_pre() { }
#rc_start() { ${rcexec} "${daemon} ${daemon_flags} ${_bg}" }
#rc_check() { pgrep -T "${daemon_rtable}" -q -xf "${pexp}" }
#rc_reload() { pkill -HUP -T "${daemon_rtable}" -xf "${pexp}" }
#rc_stop() { pkill -T "${daemon_rtable}" -xf "${pexp}" }
#rc_post() { }

rc_cmd $1
- rc.conf.local "editor" (sorting)
- configure & control daemons and services
- ala service(8) + chkconfig(8) + sysconfig
- syntax not compatible with service(8)
- alternative, not an $EDITOR replacement
multicast=YES
sshd=YES

multicast=
sshd_flags=

multicast_flags=NO
sshd_flags=NO
- unified interface
- abstraction
- daemon versus service
- regular versus meta script
- rcctl support in Puppet, Ansible and Salt
  - puppet: 120 additions and 441 deletions
rcctl -> rc.subr -> rc.d script -> rc.conf+rc.conf.local

-> rc.subr

- FUNCS_ONLY=1
- from sourced to parsed: _rc_parse_conf()
- stop injecting shell code in dangerous places
usage:  rcctl get|getdef|set service | daemon [variable [args]]
rcctl [-df] start|stop|restart|reload|check daemon ...
rcctl disable|enable|order [daemon ...]
rcctl ls all|failed|off|on|started|stopped
rcctl enable multicast messagebus cupsd
rcctl set ntpd flags -s
rcctl restart ntpd smtpd sshd
rcctl ls started

“rcctl ls failed” is run daily(8)
Conclusion

- replacement for the traditional BSD init
- process control framework
- service supervisor
- compromise
  - may not be suitable for all possible uses
boringly simple and robust
preserved the original paradigm
built on decades-old components
consistent and unified interface with rcctl
easy integration into other OSes
Questions?

Thank you BSDCan!

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The OpenBSD Project