TrueOS: A rolling FreeBSD with OpenRC

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What motivated me to work on TrueOS?

- My interest in running FreeBSD on the desktop grew from my enjoyment of administering FreeBSD servers.
- I became an active PC-BSD committer in 2013 (The precursor to TrueOS).
- It was a struggle for me to find a decent laptop to run FreeBSD.
vBSDcon 2015

- What’s wrong with this picture?
Why improve the boot process?

- With rc.d PC-BSD / TrueOS averaged 45 seconds, or longer to boot.
- Boot speed is noticeable when you are mobile.
- Accurate service management, and supervision is also important for a good mobile experience.
- Perhaps a better mobile experience means more FreeBSD developers can dogfood?
- I strongly believe that more dogfooding means a better FreeBSD for everyone.
A brief overview of the FreeBSD boot process

- The kernel loads early drivers from `loader.conf`.
- The kernel boots in around 6 seconds.
- `/sbin/init` starts as pid 1, and executes `/etc/rc`. 
What is rc?

- Shell script executed by /sbin/init that exists to execute processes at bootup.
- Prior to rc.d all processes had to be hardcoded into /etc/rc.
- This approach had the cons of hanging the boot process if a mistake was made editing /etc/rc.
- The user would have to keep track of service ordering when using this method.
- The user would have to daemonize processes by hand, and no service status options.
What is rc.d?

- To solve these, and other problems FreeBSD adopted rc.d from the NetBSD community.
- The rc.d system is a collection of shell scripts which often source other shell scripts.
- Allows support for arguments, startup order, service status, and daemonizing within each script.
- Base default configuration for defaults is done in `/etc/defaults/rc.conf`.
- User configuration is typically done with `/etc/rc.conf`.
Joining iXSystems

- Joe Maloney joins iXSystems, and teams up with “The Moore Dynasty” to change some things.
- We produced a rolling release based on FreeBSD CURRENT.
- Using this new model we are able to include modern graphics from drm-next (Thank you Matt Macey), and we inherited better wireless support from CURRENT automatically (Thank you Adrian Chadd).
- This enabled us to push out frequent improvements to our tools as well.
The result: TrueOS runs on a brand new Lenovo X1 Carbon
Efforts to improve rc.d

- DHCP vs SYNCDHCP tested for wireless.
- Unfortunately wpa_supplicant unreliable without SYNCDHCP, and hung boot process without backgrounding.
- rcorder: Parallel startup patches no longer apply cleanly.
- rc_delay: This could have delayed network startup. (stalled in reviews).
- It became clear that neither parallel startup support, or rc_delay alone would truly fix much at all.
Other options

- LaunchD (NextBSD, launchd-xml, launchd-ucl)
- Re-Launchd (now jobd)
- nosh
- It seemed to me the most obvious choice was the overlooked one.
Possible misconceptions about OpenRC?

- "I bet that puppy is full of bashisms!" - FreeBSD forums
Why OpenRC?

- OpenRC is an evolution of rc.d.
- OpenRC is a drop in replacement for rc.d.
- OpenRC is mostly written in C.
What’s different under the hood?

- The libeinfo library is used for openrc binaries.
- The `#!/sbin/openrc-run` interpreter is used in place of `#!/bin/sh`.
- Binaries, and special binaries in `/libexec/rc/bin`, and `/libexec/rc/sbin` for `openrc-run`, `rc-update`, `rc-service`, `rc-status`.
- Dependencies are cached in `/libexec/rc/cache`.
- Runlevels are in `/etc/runlevels`. 
Differences in base services

- We use an updated dhcpcd v7 from TrueOS ports instead of dhclient.
- Our netif is a port of FreeBSD netif now labeled network.
- We start dhcpcd in network rather than dhclient.
- Most other FreeBSD services were imported to init.d almost unmodified aside from the interpreter.
Why dhcpcd?

- DHCPCD continues to try to request a lease when started, and not just once.
- DHCPCD works better with OpenRC.
- DHCPCD works efficiently with parallel boot.
- DHCPCD works well for ipv6 out of box.
OpenRC and dhcpcd background

- OpenRC, and dhcpcd are BSD licensed.
- Both were written by Roy Marples, a NetBSD developer.
- Gentoo, PacBSD, UbuntuBSD, and others use OpenRC.
- NetBSD includes dhcpcd in base.
Merging OpenRC to base

- We removed code for Linux portability.
- Our OpenRC implementation uses BSD make.
- We added hooks to /etc/rc and /etc/rc.shutdown.
- We reworked many rc.d scripts to be init.d compatible.
- /etc/init.d/ - replaces rc.d
- Both /etc/defaults/rc.conf, and /etc/rc.conf no longer start, or stop services but can still be used for flags.
- /etc/conf.d/ - replaces rc.conf.d
## Runlevels

- Introduction of standard sysinit, boot, nonetwork, default, shutdown runlevels

<table>
<thead>
<tr>
<th>Service</th>
<th>State</th>
</tr>
</thead>
<tbody>
<tr>
<td>abil</td>
<td>boot</td>
</tr>
<tr>
<td>adjkernzt</td>
<td>boot</td>
</tr>
<tr>
<td>automount</td>
<td>default</td>
</tr>
<tr>
<td>bootmisc</td>
<td>boot</td>
</tr>
<tr>
<td>bridge</td>
<td>boot</td>
</tr>
<tr>
<td>cron</td>
<td>default</td>
</tr>
<tr>
<td>cupsd</td>
<td>default</td>
</tr>
<tr>
<td>dbus</td>
<td>default</td>
</tr>
<tr>
<td>devd</td>
<td>boot</td>
</tr>
<tr>
<td>devfs</td>
<td>boot</td>
</tr>
<tr>
<td>dummton</td>
<td>boot</td>
</tr>
<tr>
<td>fsck</td>
<td>boot</td>
</tr>
<tr>
<td>hostname</td>
<td>boot</td>
</tr>
<tr>
<td>ipfw</td>
<td>boot</td>
</tr>
<tr>
<td>local</td>
<td>boot</td>
</tr>
<tr>
<td>localmount</td>
<td>boot</td>
</tr>
<tr>
<td>lockd</td>
<td>default</td>
</tr>
<tr>
<td>loopback</td>
<td>boot</td>
</tr>
<tr>
<td>modules</td>
<td>boot</td>
</tr>
<tr>
<td>motd</td>
<td>boot</td>
</tr>
<tr>
<td>moused</td>
<td>default</td>
</tr>
<tr>
<td>netmount</td>
<td>boot</td>
</tr>
<tr>
<td>network</td>
<td>boot</td>
</tr>
<tr>
<td>newsyslog</td>
<td>boot</td>
</tr>
<tr>
<td>openmpd</td>
<td>boot</td>
</tr>
<tr>
<td>pcdm</td>
<td>boot</td>
</tr>
<tr>
<td>root</td>
<td>boot</td>
</tr>
<tr>
<td>routing</td>
<td>boot</td>
</tr>
<tr>
<td>rpcbind</td>
<td>default</td>
</tr>
<tr>
<td>savecache</td>
<td>boot</td>
</tr>
<tr>
<td>savecore</td>
<td>boot</td>
</tr>
<tr>
<td>statd</td>
<td>default</td>
</tr>
<tr>
<td>staticroute</td>
<td>boot</td>
</tr>
<tr>
<td>swap</td>
<td>boot</td>
</tr>
<tr>
<td>sysads</td>
<td>default</td>
</tr>
<tr>
<td>syscons</td>
<td>boot</td>
</tr>
<tr>
<td>sysctl</td>
<td>boot</td>
</tr>
<tr>
<td>syslogd</td>
<td>boot</td>
</tr>
<tr>
<td>sysvinit</td>
<td>default</td>
</tr>
<tr>
<td>urandom</td>
<td>boot</td>
</tr>
<tr>
<td>zfs</td>
<td>boot</td>
</tr>
<tr>
<td>zvool</td>
<td>boot</td>
</tr>
</tbody>
</table>
Ports

- In Makefiles use of `USE_RC_SUBR` is replaced by `USE_OPENRC_SUBR`.
- We have been replacing rc.d scripts with init.d compatible scripts.
- `/usr/local/etc/init.d/` - Ports init scripts (services)
- `/usr/local/etc/conf.d/` - Ports config for service flags
- `/etc/rc.conf` – Config can still be done here as well
- Ports services in the `/usr/local` prefix cannot be added to boot, or sysinit runlevel by OpenRC design.
Booting OpenRC

- OpenRC makes it easy to see startup order, successes, failures, and warnings.

```
OpenRC 0.23.83 is starting up FreeBSD 12.0-CURRENT (amd64)
  * Caching service dependencies ... [ ok ]
zfs  | * Starting ZFS ...
adjkerntz | * Starting the System Clock Adjuster [UTC] ...
ipfw | * Starting firewall rules ...
loopback | * Bringing up network interface lo0 ...
systm | * Configuring kernel parameters ...
zfs | * Checking if zfs userspace tools present
swap | * Activating swap devices ...
hostname | * Setting hostname to trueos-5754 ...
[ ok ]
zfs | * Importing ZFS pools
zfs | * Mounting ZFS filesystems
abi | * Additional ABI support: linux [ ok ]
modules | * Autoloaded 24 module(s) [ ok ]
sck | * Checking local filesystems ...
[ ok ]
zfs | * Exporting ZFS filesystems
localmount | * Mounting local filesystems ...
root | * Remounting root filesystem read/write ...
[ ok ]
root | * Remounting filesystems ...
[ ok ]
newsyslog | * Creating and/or trimming log files ...
urandom | * Initializing random number generator ...
[ ok ]
zvol | * Starting ZFS swap ...
```
The service utility

- The service command is a symlink to rc-service.
- The onestart parameter is no longer used, and is replaced by start, and stop.
- The usage is otherwise identical to the rc.d system.
- Our existing graphical service manager required no modifications to start, stop, or restart services.
The rc-update utility

- Service are added to startup with `rc-update add`.
- Remove services with `rc-update delete`.
- Dependency caches can be cleaned with `rc-update -u`. 
The rc-status utility

- Any running service shows with rc-status.
- Note the hotplugged, individual *.wlan0 services.
Service supervision

- OpenRC now has built in service supervision.
- We use service supervision for SysAdm.
Graphical service management with sysadm

- We can manage services graphically with sysadm without worries of sysadm itself crashing.
OpenRC documentation

- All OpenRC commands have great man pages. The `man openrc-run` command is shown here.
### TrueOS Handbook documentation

The TrueOS® rc.conf file is much smaller because rc.conf is now primarily used for tuning OpenRC behavior. By default, TrueOS® uses 3 elements, documented in Table 6.2.1.

<table>
<thead>
<tr>
<th>Tunable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>rc_parallel=&quot;YES&quot;</td>
<td>Starts all services in parallel</td>
</tr>
<tr>
<td>rc_logger=&quot;YES&quot;</td>
<td>Enables logging</td>
</tr>
<tr>
<td>rc_log_path=&quot;/var/log/rc.log&quot;</td>
<td>Defines the location for logging rc activity</td>
</tr>
</tbody>
</table>

**Table 6.2.1: OpenRC Primary Tunables**

Table 6.2.2 shows all other tunables enabled on a clean TrueOS® installation. Many of these tunables continue to work in /etc/rc.conf to ensure a smoother migration for existing users to upgrade. The eventual target locations for these services are also listed.

**Note**

These migration targets are estimates and subject to change.

<table>
<thead>
<tr>
<th>Tunable</th>
<th>Description</th>
<th>Migration Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>linux_enable=&quot;YES&quot;</td>
<td>Notifies /etc/init.d/ab$ service to enable the Linux compatibility during boot</td>
<td>/etc/conf.d/abi</td>
</tr>
<tr>
<td>ifconfig_re0=&quot;DHCP&quot;</td>
<td>TBD</td>
<td>/etc/conf.d/network</td>
</tr>
<tr>
<td>ifconfig_re0_ipv6=&quot;inet6 accept_rtadv&quot;</td>
<td>TBD</td>
<td>/etc/conf.d/network</td>
</tr>
<tr>
<td>hostname=&quot;trueos-4843&quot;</td>
<td>TBD</td>
<td>/etc/conf.d/hostname</td>
</tr>
<tr>
<td>kldload_j915kms=&quot;j915kms&quot;</td>
<td>TrueOS specific. Allows loading an individual module via the installer post installation.</td>
<td>/etc/conf.d/modules</td>
</tr>
<tr>
<td>zfs_enable=&quot;YES&quot;</td>
<td>Obsolete, marked for removal</td>
<td>None</td>
</tr>
<tr>
<td>wlan_iwm0=&quot;wlan0&quot;</td>
<td>TBD</td>
<td>/etc/conf.d/network</td>
</tr>
<tr>
<td>wlan_iwm0=&quot;wlan0 DHCP&quot;</td>
<td>TBD</td>
<td>/etc/conf.d/network</td>
</tr>
<tr>
<td>ifconfig_wlan0_ipv6=&quot;inet6 accept_rtadv&quot;</td>
<td>TBD</td>
<td>/etc/conf.d/network</td>
</tr>
</tbody>
</table>

**Table 6.2.2: OpenRC Other Tunables**
TrueOS OpenRC migration status

- Our OpenRC implementation mostly complete.
- We will finish converting scripts to OpenRC format for all ports.
- We will finish converting a few scripts for base.
- We will continue to troubleshoot edge cases, and continue to tailor init scripts where needed.
- We will continue to update handbook documentation.
- The TrueOS community is active in helping us, if you want to help please contact us!
Improvements

- Even without parallel TrueOS averages a 10 second startup in most cases, a 127% improvement for laptops.
- We now have simpler service files due to openrc-run built in functions.
- All services now report service status properly.
What’s next?

● Network profiles
● Integrate dhcpcd v7 (when final) into base
● Automatic timezone setup (dhcpcd hooks)
● Lumina exclusive integration for devd, automountd, and autounmountd services
Consideration for FreeBSD?

- Does FreeBSD need OpenRC to accomplish its wider goals?
Thanks for coming!

Questions, concerns?