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**Useful systemd functionalities  
without systemd**

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# Bartosz Golaszewski

- > 6.5 years professional experience in embedded Linux
- Contributor to the linux kernel, busybox, buildroot, uClibc, sigrok
- Part of the firmware team in Project Ara
- Maintainer of ACME software



# Agenda

- ACME, sigrok & faster boot
- Why not systemd?
- Recreating functionalities
  - Parallel startup
  - Readahead
  - Security
  - Watchdogs





**ACME, sigrok & faster boot**



# ELC 2015 – San Jose

- « Tunning systemd for embedded » by Alison Chaiken
- systemd philosophy & design
- Pros & cons
- Demoed systemd's cgroups support, privilege limitation, watchdogs



# ACME Cape

- Low-cost multi-channel power monitor
- Based on TI ina226 power monitor
- Open hardware/open source
- Standard BeagleBone Black cape
- USB, Jack & HE10 connectors
- <http://baylibre.com/acme/>
- [ACME wiki](#)



# Sigrok

- Portable, cross-platform, free signal analysis software suite
- Broad hardware support
- Various frontends
- Reusable libraries
- <http://sigrok.org/>



# Sigrok + ACME + PulseView

- X.org, fluxbox x 2, Qt5, Xvfb, x11vnc, PulseView x 2
- Boost, uClibc, etc.
- Startup scripts in /etc/init.d
- No parallelization







Why not systemd?



# Buildroot/busybox init

- Minimalistic version of SysV init
- No runlevels in busybox init
- Scripts in `/etc/init.d` with start/stop commands
- No restart, status, etc. commands
- Startup scripts provided by buildroot packages



# systemd

- Available as buildroot package
- Painless configuration
- Mostly just works
- Drastic improvement in boot-time
- X.org is integrated and supports socket activation



# Reasons not to use systemd in embedded devices

- Merciless deprecation of features
  - udev firmware loader
  - readahead
- Dependence on newer kernels
- Dependence on glibc
- Size & attack surface
- Level of complication



# Dependence on newer kernels

- Forcing kernel updates is great... but not always feasible
- Old kernels often in use by companies
- Out-of-tree SoC support
- Upgrade not always possible



# Size, attack surface & level of complication

- Unnecessarily many functionalities in PID 1
  - Could be avoided with `prctl(PR_SET_CHILD_SUBREAPER, ...)`
- Privileged process with many inputs and code paths
- >330000 LOC (src/core alone >36000 LOC)





Recreating systemd functionalities

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# Parallel service startup

- **systemd :**
  - several startup notification types
  - Requires=, After= & Before= configuration options
- **Busybox :**
  - Block runit startup scripts to wait for dependencies
  - Use inotifyd to find out when the pidfile has been created







# Demo: parallel startup

 *(with busyboxed runit and inotifyd)*

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# Readahead

- Obsolete on modern desktops
- Still useful on boards with slow eMMC's
- systemd implementation nuked...
- busybox applet
  - works out-of-the-box
  - can be run as init



# Demo: readahead

 *(busybox applet)*

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# Security features

- Extensive cgroups usage for security and resource management in systemd
- Not all these features needed in embedded systems
- Use cgroup-tools & unshare to achieve similar results



# Demo: security features

 (*cgroups + unshare*)

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# Software watchdogs

- **systemd:**
  - ShutdownWatchdogSec= option for hw watchdog
  - WatchdogSec= and Restart=on-failure for sw watchdog
  - process required to call `sd_notify("WATCHDOG=1")` periodically
- **Alternative:**
  - Use some trivial action to determine whether a process is still alive



# Demo: software watchdogs

 *(without dbus/libsystemd)*

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# Conclusion

- Philosophy of systemd is:  
*Extract duplicate functionality from daemons and move it to systemd core or kernel.*
- Most of this functionality already exists in a tiny busybox binary and also *mostly* does the job.





# References

- [http://she-devel.com/ELC\\_systemd.pdf](http://she-devel.com/ELC_systemd.pdf)
- <http://0pointer.net/blog/>
- busybox documentation
- systemd manuals
- <http://ewontfix.com/14/>
- <http://busybox.net/~vda/>



# Q & A

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