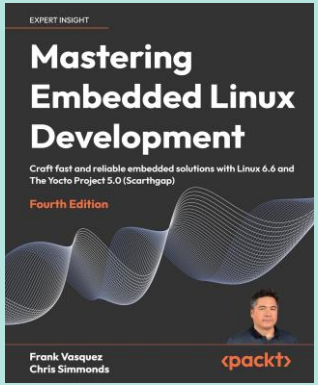
Overlay Images to the Rescue

by Frank Vasquez

About me



- coauthor of Mastering Embedded Linux Programming
- 20 years developing software
- distributed data warehousing, networked audio systems, imaging sonars, IoT gateways, home batteries, grid batteries
- OTA consumer device updates and containerized blockchain node deployments

Agenda

- immutable distro origins
- What are extension images?
- SSH
- GDB
- eBPF
- VPN

Steam Deck

- 4 million sold since February 25, 2022
- less than 50% of all PC handhelds
- Arch not Windows
- over 150 million Nintendo Switches sold in 8 years
- over 3 million Switch 2s sold on launch day

A/B updates

- Android and SteamOS updates
- *How I forked SteamOS for my living room PC*
- iliana etaoin
- RAUC
- btrfs subvolumes

Immutable distros

- read-only root filesystem
- only /var partition is writable
- all system changes happen in layered or sandboxed environments
- Project Bluefin
- Framework Laptop 13 "compatible community supported" out of the box

Capsule images

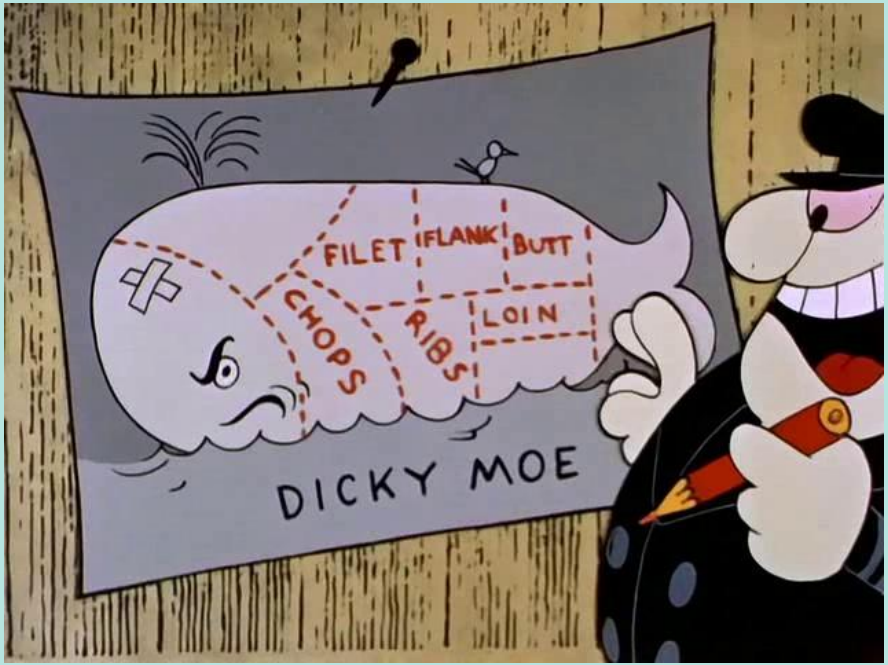
- *Do one thing!*
- Chuck Wolber
- Yocto Project Summit 2024.12
- Install packages to an “image” without its dependencies being pulled in
- `ssh-image.bb: PACKAGE_INSTALL += "openssh-sshd"`

Extension images

- systemd 248 released March 2021
- `/var/lib/extensions` & `confexts`
- `systemd-sysext merge` composes `/usr` or `/opt`
- `systemd-confext merge` composes `/etc`
- Flatcar and ParticleOS

Why not containers?

- Dare to be different
- Leverage Yocto
- Don't you love systemd?



How do I work this?

- *Adding software to the Steam Deck with systemd-sysext*
- Alberto Garcia
- Steam Deck recommends Flatpak
- sysexts offer an alternative

Overlays

- Yukuake is a drop-down terminal emulator

```
$ mkdir yakuake
```

```
$ wget https://steamdeck-packages.steamos.cloud/archlinux-mirror/extra/os/x86_64/yakuake-21.12.1-1-x86_64.pkg.tar.zst
```

```
$ tar -C yakuake -xaf yakuake-*.tar.zst usr
```

- "Extensions are not distribution packages"

Release files

```
$ mkdir -p yakuake/usr/lib/extension-release.d/

$ echo ID=steamos > yakuake/usr/lib/extension-release.d/extension-release.yakuake

$ echo VERSION_ID=3.3.1 >> yakuake/usr/lib/extension-release.d/extension-release.yakuake

$ mksquashfs yakuake yakuake.raw
```

SSH

```
/usr/bin/sshd

/usr/lib/systemd/system/ssh*

/etc/default/ssh

/etc/ssh/sshd_config_readonly

USERADD_PARAM:${PN} = "--system --no-create-home --home-dir
/var/run/sshd --shell /bin/false --user-group sshd"
```

Native GDB

- `/usr/bin/gdb`
- debug symbols
- source code
- `EXTRA_IMAGE_FEATURES:append = " tools-debug dbg-pkgs src-pkgs"`
- `IMAGE_INSTALL:append = " gdb <package>-dbg <package>-src"`

Avocado SDK

```
# Pull SDK container
❯ podman pull avocadolinux/sdk:apollo-edge

# Start development environment
❯ podman run -it --rm -e AVOCADO_SDK_TARGET=qemux86-64 -v
$(pwd):/opt:z --entrypoint entrypoint.sh avocadolinux/sdk:apollo-
edge /bin/bash
```

Remote GDB

```
bash-5.2# dnf update
Avocado SDK                                                 15 kB/s
| 1.4 kB 00:00
Dependencies resolved.
Nothing to do.
Complete!
bash-5.2# avocado-repo sysext install gdbserver
bash-5.2# avocado-build sysext debug-tools
bash-5.2# avocado-build image
```

Remote GDB

```
# On target, start gdbserver
root@avocado-qemux86-64:~# gdbserver :2345 /usr/bin/myapp

# In SDK container, connect with cross-gdb
bash-5.2# avocado-repo sdk install nativesdk-gdb
bash-5.2# $GDB /opt/_avocado/sysroots/<target>/usr/bin/myapp
(gdb) target remote 192.168.7.2:2345
```

bpftrace

- https://github.com/kraj/meta-clang
- meta-python/recipes-devtools/bpftrace
- `DEPENDS += "bison-native flex-native … elfutils bcc … libbpf"`
- `RDEPENDS:${PN} += "bash python3 xz"`
- `IMAGE_INSTALL:append = " bpftrace"`

Tailscale

- Flatcar Container Linux
- https://github.com/flatcar/sysext-bakery
- https://flatcar.github.io/sysext-bakery/tailscale/
- `usr/lib/systemd/system/multi-user.target.d/10-tailscale.conf`

Auto-reload

- `systemd-sysext merge`
- `systemd-sysext unmerge`
- `systemd-sysext refresh`
- `EXTENSION_RELOAD_MANAGER=1`
- `usr/lib/systemd/system/multi-user.target.upholds/systemd-oomd.service → /usr/lib/systemd/system/systemd-oomd.service`

“... entering a world of pain”

“I build Yocto so you don’t have to.”

—Justin Schneck

Co-Founder and Chief Product Officer of Peridio

Avocado Linux

- Yocto binary distro
- RPM package feeds
- extension image SDK
- https://docs.avocadolinux.org
- https://github.com/avocado-linux/meta-avocado

References

- https://www.freedesktop.org/software/systemd/man/latest/systemd-sysext.html
- https://iliana.fyi/blog/build-your-own-steamos-updates/
- https://lists.yoctoproject.org/g/yocto/topic/install_packages_to_an/85016309
- https://blogs.igalia.com/berto/2022/09/13/adding-software-to-the-steam-deck-with-systemd-sysext/
- System and Configuration Extensions for Image-based Linux Distros and Beyond https://www.youtube.com/watch?v=XTy3scX6rF4

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Questions