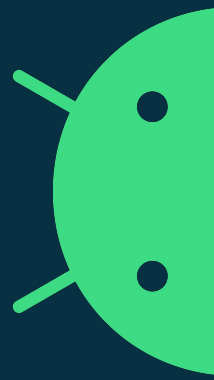
Android Virtualization



Current and future use cases

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android

Android Virtual Devices (AVDs)

- Many implementations:
  - Android Emulator - Part of Android Studio
  - Cuttlefish
  - Vendor IoT or automotive solutions

- Some ‘no brainer’ virtio drivers:
  - `virtio_blk`
  - `virtio_console`
  - `virtio_net`
  - `virtio_rng`

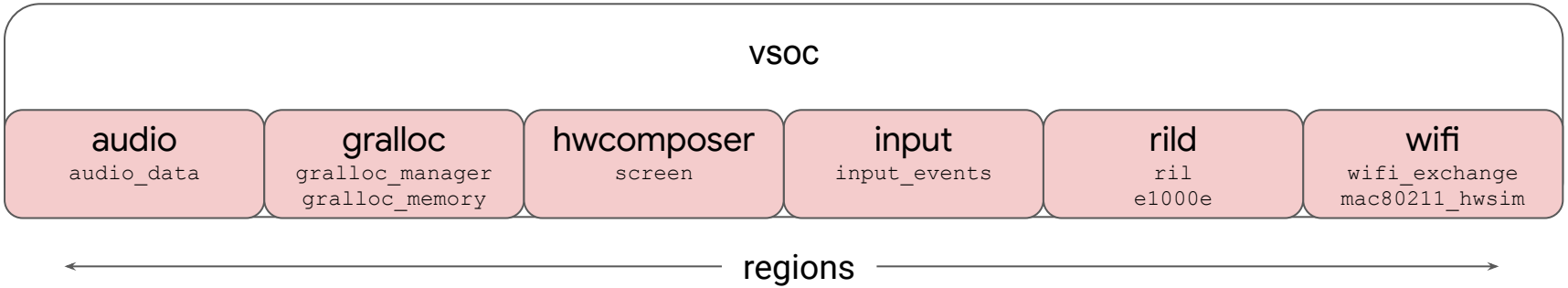
  Everybody uses these, they ‘just work’

Cuttlefish

- AVD based on `crosvm` (previously QEMU)
- Runs locally, or on Google Cloud Platform (GCP)
- Developed upstream: AOSP, mainline Linux
- Originally used a hand-rolled ‘virtual SoC’ architecture, but now aligned to virtio

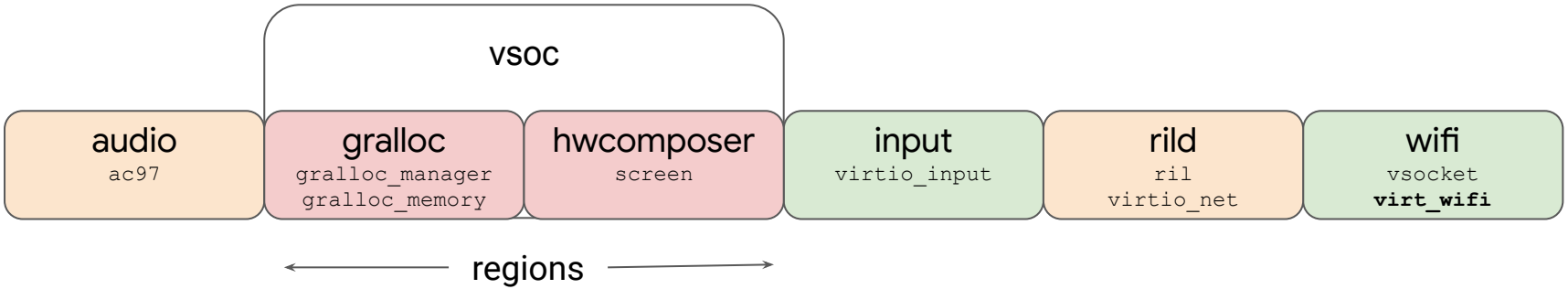
Cuttlefish in P

- Used `vsoc` driver, not virtio
  - Shared memory architecture based on QEMU `ivshmem`
- Upstreamed `vsoc` as stop gap; long term plan was to move to virtio
  - Wanted to leverage cuttlefish for kernel testing
  - Being able to work with upstream kernels helped virtio transition



Cuttlefish in Q

- Supported `crosvm` and QEMU
- Some functionality was converted to use emulated hardware instead
  - Not ideal, but no upstream solution
- Still used `vsoc` driver, but mostly converted to virtio
  - On `crosvm` we used `vsocket` for gralloc, hwcomposer, but it was slow

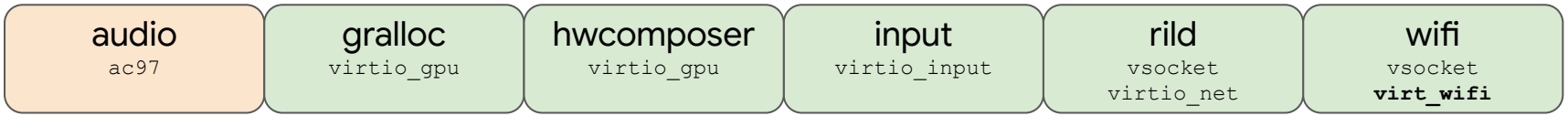


Cuttlefish in AOSP master

- No more `vsoc` driver :)
- New graphics stack isn't the default, but can be switched on:

```
$ launch_cvd -gpu_mode=drm_virgl
```

- Last step is to purge old graphics stack, drop `vsoc` from staging



Learnings from `virtio_gpu`

- Upstream moves very quickly; things break a lot
  - Fortunately, ChromeOS graphics team adapted
- Three kernels per Android release makes `virtio_gpu` extra hard
  - ‘Solved’ by backporting `virtio_gpu` to 4.14, 4.19
  - Backported for EDID support, in/out fence support, other fixes
- Issues we encountered
  - Multiple plane support needed for hardware composer
  - Needs better pixel format support in `virtio_gpu_2d`
  - Video overlay support (e.g. YV12) would be nice
  - Baked assumptions that `virgl` will be used, but we want SwiftShader too
  - Stride, format modifier queries needed to expose e.g. FBC

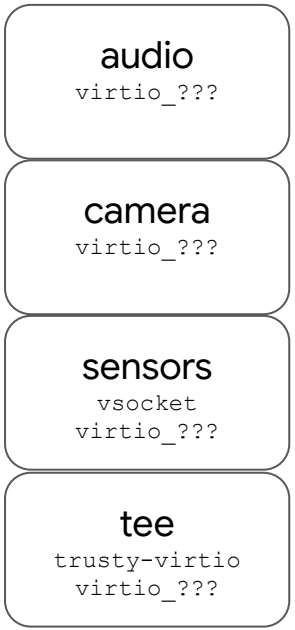
Camera Virtualization?

- Media/V4L2 has no reference in Android Common Kernel / Generic Kernel Image
- Emulated/fake Camera needs a lot of guest CPU, many threads to run well on GCP
  - Offload to host instead?
- Many testing use cases only need ‘EXTERNAL’ e.g. UVC camera
  - Could use USB passthrough, but we don’t have USB at the moment
  - Simplest mode, doesn’t really test Android Camera HAL
- Camera HAL ‘FULL’ or ‘LEVEL_3’ would require complex virtio driver(s)
- Sensor + interface + scaler + IPAs
  - One driver or many?

Virtualization vs Virtual Drivers

- Android WiFi required a real `nl80211` driver
- We used `mac80211_hwsim`, and tunneled frames using `vsoc` to `mac80211_hwsim` on host
  - Host setup required root permissions; not ideal
  - Not Ethernet between `mac80211_hwsim` implementations
  - Host bridge setup more complicated
- Upstreamed `virt_wifi`, an rtnetlink driver that wraps another Ethernet device
  - We get the advantages of `virtio_net`, but can also pretend to be WiFi!
- But what about inter-VM wifi testing?
  - Not possible with `virt_wifi` because there are never any 802.11 frames
- Do we need `virtio_wifi`?

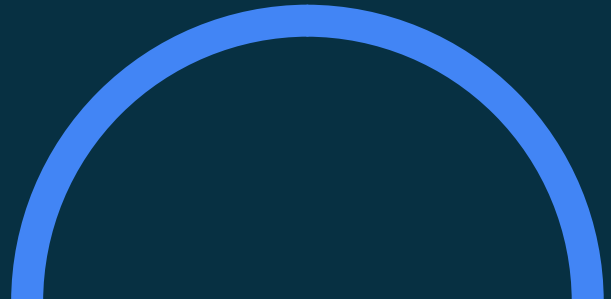
Virtualizing Other HALs

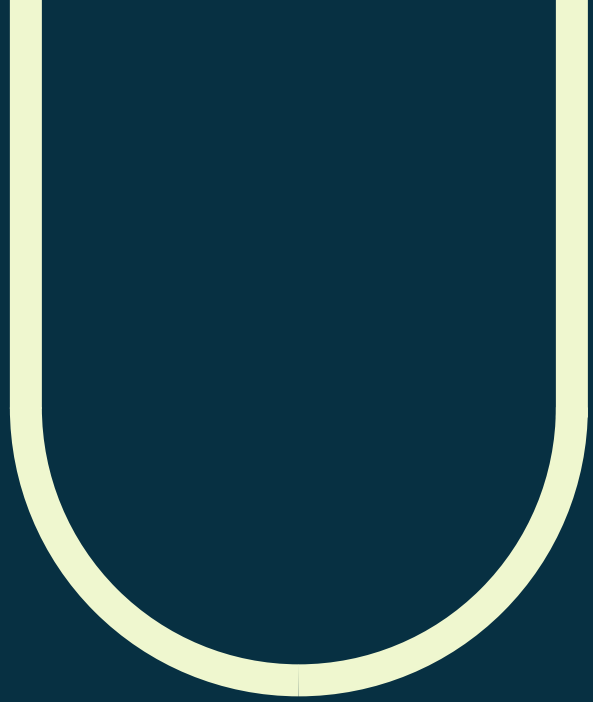


- Other non-upstream virtio drivers:
  - **virtio_audio** (ACRN)
  - virtio_gpio (ACRN)
  - virtio_i2c (ACRN)
  - virtio_hdcp (ACRN)
  - **virtio-vdec** (crosvm)
  - virtio-wl (crosvm)
  - ..probably more..

  Fitting needs of a particular use cases
- Other proprietary hypervisors w/ virtio e.g. COQOS, QNX, ...
- More virtio drivers! But not at the expense of hypervisor compatibility
- More Android virtual platform consolidation

Questions ?





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