

# virtio-video status update

24 November

# V4I2 codecs

## V4L2 Supports 2 types of codec devices

- Memory to memory **stateful** decoder and encoders
  - Typically a co-processor on the SoC which has a firmware. V4I2 driver passes the raw video bitstream to be parsed and receives back decoded frames. Examples are Venus hardware on Qcom Dragonboards and the RPi decoder.
  
- Memory to memory **stateless** decoders and encoders
  - Relatively new to the Linux kernel, hw expects all the bitstream parsing to be done and handling of reference frames etc in SW. IP registers are configured per frame or slice. Examples include Verisilicon Hantro IP on NXP iMX & Rockchip SoCs.

<https://www.kernel.org/doc/html/latest/userspace-api/media/v4l/dev-mem2mem.html>

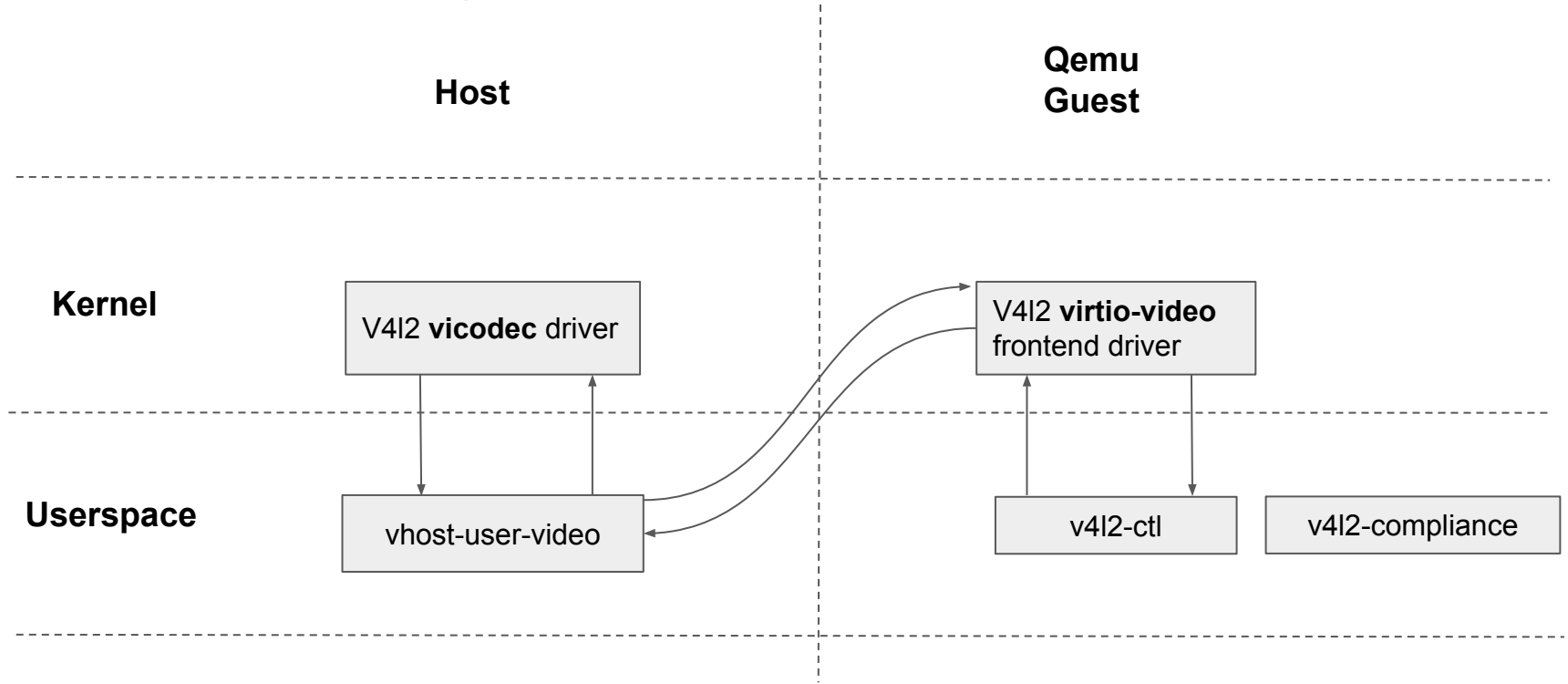
# What & Why?

- I've been working vhost-user virtio-video C backend for Qemu.
  - It implements v3 of virtio-video spec currently
    - **Why?** This matches the Linux virtio-video frontend driver from ChromeOS kernel tree / Opensynergy)
  - It allows you to test virtio-video interface with 100% open source code (Linux + Qemu + vhost-user-video).
  - It allows virtio-video development in a purely “virtual” environment without any physical decoder/encoder hardware.
    - By leveraging v4l2 vicodec mem2mem codec test driver in Linux kernel.
    - Should be useful for testing the virtio-video interface with kernelci, lkft etc
  - 
  - *Intended to be used as a basis for further development and upstreaming of virtio-video standard and frontend driver.*

# vicodec

- Driver enumerates as 4 /dev/video<num> v4l2 video device nodes
  - **Stateful decoder** (*usually /dev/video3*)
  - **Stateful encoder**
  - Stateless decoder
  - Stateless encoder
- Decodes a “test” video codec called FWHT (Fast Walsh Hadamard Transform).
- Can easily switch from splane to mplane v4l2 api with module parameter modprobe multiplanar=1
- <https://lwn.net/Articles/760650/>

# Architecture diagram



# What works

- Integrated into optee-build system for easy development of Qemu, Linux, etc
- Fixes to virtio-video frontend driver
- Qemu vhost-user-video vmm
  - Maps virtio-protocol to v4l2 stateful API
  - Tested with 'v4l2-compliance' tool which is used by upstream Linux media maintainers for merging drivers to mainline.
    - Issues many opens/closes and lots of syscall level interface tests. Stress tests the system a bit
  - v4l2-ctl tool from v4l-utils to do video decodes.
  - Simultaneous decodes using v4l2-ctl

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# Known issues

- v4l2-compliance has 6 failures still
  - Caused in part by frontend driver reporting multi-planar buf types to guest userspace even though backend and vicodec is sending single planar buf types.
- Shutdown (end of stream or ctrl+c) of a decode leaves some v4l2 buffers in the *guest* v4l2 frontend driver in a incorrect “active” state.
- v4l2 mplane support in vhost-user-video is buggy
- Misleading v4l2-ctl fps output from guest

Demo!



## Next steps

- Start hacking virtio-video frontend driver and vhost-user-video to v5 protocol
- Test with a “real” stateful decoder & real video codec.
- Combine video decode demo with vhost-user-gpu for display
- Validate with more userspaces (ffmpeg?, gst?, codec2?)

# Code

optee-build - <https://github.com/petegriffin/build/tree/virtio-video>

Linux virtio-video frontend - <https://github.com/petegriffin/linux/commits/v5.10-virtio-video-latest>

Qemu vhost-user-video - <https://github.com/petegriffin/qemu/tree/vhost-virtio-video-latest-squashed>

README with cheat sheet - <https://github.com/petegriffin/qemu/commit/32bf46acb41f7dec5498f40022f95322590fe1b4>

## Host

```
modprobe vicodec
```

```
./vhost-user-video -v --socket-path=/tmp/video.sock --v4l2-device=/dev/video3
```

```
make QEMU_VIRTFS_ENABLE=y QEMU_USERNET_ENABLE=y CFG_TA_ASLR=n QEMU_VHOSTUSER_MEM=y QEMU_VIRTVIDEO_ENABLE=y SSH_PORT_FW=y run-only
```

## Guest

```
wget https://people.linaro.org/~peter.griffin/jelly\_640\_480-420P.fwht
```

```
v4l2-ctl -d0 -x width=640,height=480 -v width=640,height=480,pixelformat=YU12 --stream-mmap --stream-out-mmap --stream-from  
jelly_640_480-420P.fwht --stream-to out-jelly-640-480.YU12
```

# Discussion topics

- What userspaces are members using with virtio-video
  - crosvm uses Chromium VDA unit tests I believe
  - Codec2 v4l2 - seen mentioned by OpenSynergy
  - ffmpeg (has a v4l2 mem2mem backend)
  - Gstreamer

