

Update on Open Source Vulkan Driver for Adreno GPUs

Danylo Piliaiev

2024-02-04

1



New Hardware Support

- A7XX GPUs are now supported
 - A730/A740 merged last year
 - A750 has MR on review
 - Direct (non-tile-based) rendering passes CTS tests
 - Tile-based rendering is still WIP
- Most A6XX GPU variants are supported
 - A6XX is divided in 5 sub-generations

Notable Changes

- Major Extensions:
 - `VK_EXT_descriptor_buffer`
 - `VK_EXT_extended_dynamic_state3`
 - `VK_EXT_graphics_pipeline_library`
 - `VK_EXT_fragment_density_map`
 - `VK_EXT_inline_uniform_block`
 - `VK_KHR_dynamic_rendering`
- Vulkan 1.3 is supported for a while now

Notable Changes

- A lot of recent focus was on correctness:
 - Fixing vkcts tests
 - Fixing issues in various games
- Lots of pipelines code improvements from Connor
- IR3 optimizations
- Better debug tooling

Better Debug Tooling

- Especially important for reverse-engineering
- Gave in-depth talk at 2023 XDC
 - "Debugging GPU faults: QoL tools for your driver"
<https://www.youtube.com/watch?v=FI0nfK4O8r>
 - **Q**
- Tooling:
 - GPU breadcrumbs
 - GPU command stream replaying
 - GPU command stream editing
 - Printing from shader assembly
 - Stale reg debugging

GPU breadcrumbs

- API level breadcrumbs like Graphics Flight Recorder are cool
- They may be too coarse
- They generally don't work with unrecoverable hangs

GPU command stream replaying

- Reproducing hangs and other failures may be hard
- Recording submitted commands is simple and effective
- Not all issues are reproducible this way
- Requires recording ALL used buffers

```
> ~/bin/replay /tmp/tu_vkcube.vkcube_device0_combined
Reading /tmp/tu_vkcube.vkcube_device0_combined.rd..
chip_id: 0x7090000
cmdstream 0: 169 dwords
cmdstream 1: 238 dwords
```

alia

GPU command stream editing

- Reproducing issue is not enough
- How to find out the cause?
- What if we could edit any submitted GPU packet?
- Good news! It's easy to implement and already used in Turnip!

```
/* pkt4: GRAS_2D_RESOLVE_CNTL_2 = { X = 63 | Y = 63 } */
pkt(cs, 4128831);
/* pkt4: RB_BLIT_SCISSOR_TL = { X = 0 | Y = 0 } */
pkt4(cs, 0x88d1, (2), 0);
/* pkt4: RB_BLIT_SCISSOR_BR = { X = 63 | Y = 63 } */
pkt(cs, 4128831);
pkt7(cs, CP_MEM_WRITE, 20);
/* { ADDR_LO = 0x1f7580 } */
pkt(cs, 2061696);
```


Printing from shader assembly

- There is a fault in shader, a hang, misrenderings?
- Even the most basic print is useful!

```
sel.b32 r0.y, c1.x, r0.x, c0.x
sel.b32 r0.z, c1.y, r0.x, c0.y
sel.b32 r1.y, c1.z, r0.x, c0.z
sel.b32 r1.z, c1.w, r0.x, c0.w

print r2.x, r0.y, r0.z, r1.y, r1.z
```

- Uses `r2.xyz` as tmp storage, prints the rest



Stale reg debugging

- Using value from stale reg is not a rare occurrence
- Could result in geometry flickering, hangs, random cts failures
- What if we write invalid values to regs:
 - All regs at the start of each command buffer
 - To regs used in renderpasses before each reanderpass/blit

Turnip and emulators on Android

- Proprietary drivers on Android are rarely updated
- Many users are stuck with old drivers and issues
- For emulators supporting all quirks of old drivers is hard
- It's easier to use Turnip in many cases

Turnip vs Proprietary Driver on Zelda

- Sony Xperia 5 II (Adreno 650) + Turnip
- Credits to `@crumpetdialogue` discord user on Yuzu channel



alia

Turnip vs Proprietary Driver on Zelda

- Same device, same user, proprietary driver



Turnip runs desktop games

- Turnip implements all extension for DXVK and VKD3D-Proton
 - Adreno GPUs are rather capable ones!
- FEX emulator allows to run x86-64 apps on aarch64
- We test game traces and games themselves

Future

- Support tiling (GMEM) rendering on A7XX
 - Mark Collins is working on it
- Squeeze more performance!
- Distant future:
 - Support raytracing
 - Maybe mesh shaders are doable

Future

- Easy way to run desktop games on Android!
 - (NOT Igalia's project)
 - There is work-in-progress project called Cassia
 - It's a Wine+DXVK+VKD3D-Proton+FEXCore on Android
 - Turnip would have first party support there

But I already saw desktop games there

- Yes, people already running them! On Android, with Turnip
- Via Mobox project: termux + box64 + wine + dxvk + mesa
- Credits to Mad CatZ youtube channel:

Q&A

We're hiring!
igalia.com/jobs/



