On-going challenges in the Raspberry Pi driver stack

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Itoral, jasuarez, mairacanal

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Raspberry Pi 5!

- V3D 7.1.6, same VideoCore architecture.
- Higher clock rate, up to 8 RTs, better support for subgroup operations, better instruction-level parallelism (but a bit more register pressure!), ...
- Driver code merged into existing v3d and v3dv drivers in Mesa and Kernel. Upstreaming in progress.
- Same high-level feature support as Raspberry Pi 4:
  - Conformant OpenGL ES 3.1 and Vulkan 1.2 (with some bonuses).
  - Non-Conformant OpenGL 3.1 (more on this later).
CPU job handling in Vulkan

➢ Recap from XDC22:
  ➢ Some aspects of command buffer execution need to execute in the CPU.
  ➢ Required GPU flushes and CPU stalls.
  ➢ Disallowed SYNC_FD exports.
CPU job handling in Vulkan

➢ Some jobs could be implemented in the GPU using compute (e.g. events).
➢ For things that really required CPU execution (e.g. timestamp queries), we created a new CPU kernel queue.
➢ Allows CPU job execution using same sync infrastructure as for GPU jobs: no more stalls and flushes in user-space.
➢ SYNC_FD exports now available.
OpenGL 3.1

- Not supported by hardware specs, won’t be conformant...
  ...but we can support a very large subset of the required feature set.
- Important for quality of life on Raspberry Pi platform: most apps target desktop OpenGL instead of OpenGL ES.
- Implemented all missing features to get Mesa to expose OpenGL 3.1.
- Multiple bugfixes for OpenGL 3 features from Piglit and CTS tests.
OpenGL 3.1

- Mostly piglit failures
  - New extensions disclosed (tests go from skip to pass/fail)
  - Missing features (as we know right now)
    - 8 RT (Fixed in Raspberry Pi 5, but everyone lying 😐)
    - Missed required formats ($R\{GBA\}16$)
    - Non-seamless texture cubemap filtering

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Global GPU stats

- Expose the GPU stats per file and globally.
- Due to hardware limitations, we used `local_clock()` to calculate the accumulated amount of active time.
- Use of the standard DRM client usage stats to expose the GPU stats per file.
- Use of sysfs to expose the global GPU stats.
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Q&A

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