Open ARM GPU drivers:

Where are we today, 1 year after the unveiling of the lima driver.

Luc Verhaegen

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The problem.
The solution?
Legal?

(IANAL)
GPU #1:

ARM Mali
ARM Mali-200/400

- OpenGLES 2.0
- Separate Vertex (GP) and Fragment (PP) shaders
- SoCs:
  - Samsung exynos 4: world beater in 2011-2012
  - Allwinner, Amlogic, Rockchip, Telechips, Wondermedia, ...
- Future: Mali-450
ARM Mali T6xx

- OpenGLES 3.0/OpenCL 1.1
- Unified shaders
- SoCs:
  - Samsung exynos 5
- Future: ARM T624/T628/T658/T678
Project: Lima

Luc Verhaegen (libv)

Connor Abbott (cwabbott)

Ben Brewer (flatmush)
Lima

- Status: research (highly advanced)
  - No big secrets left in command-stream
  - Compiler is tough due to Mali architecture
  - Actual driver work will start after FOSDEM
- Full GNU/linux systems available
- Website: http://limadriver.org
- Repository: http://gitorious.org/lima
- Demos at the end of this talk / Lima compiler talk in X.org DevRoom (K.3.401) at 17:30.
GPU #2:
Qualcomm Adreno
Qualcomm Adreno 2xx/3xx

- Former ATI Imageon
- OpenGLES 2.0, 3.0 (3xx)
- Unified shaders
- SoCs:
  - Qualcomm Snapdragon S1-S4
  - Freescale iMX5
Project: Freedreno

Rob Clark
(robclark)
Freedreno

• Status: WIP driver
  • Job submission is like ATI radeon.
  • Command-stream is mostly known.
  • Shader architecture also mostly known.
  • WIP xf86 (exa), mesa (gallium) drivers available
• No proper GNU/linux available :(  
• Website: http://freedreno.github.com/
• Further details and demos in the X.org DevRoom (K.3.401) at 17:00 today.
GPU #3:

Nvidia Geforce ULP (Tegra)
Nvidia GeForce ULP/Tegra

- Supposedly a cut down older GeForce but...
- OpenGLES 2.0, 3.0 (tegra4), openCL/renderscript (tegra4)
- Split vertex and fragment shader design.
- SoCs: well duh.
Project: Tegra-re

Erik Faye-Lund
(kusma)
Tegra-re

• Status: Early research.
  • Job submission wrapping.
  • Early shader disassembler.
  • Early command stream capture.
  • Replay is up next.

• Limited availability of GNU/linux systems (AC-100, Trimslice)

• Website: https://github.com/kusma/tegra-re
GPU #4:

Vivante GCxxxx
Vivante GCxxxx

- OpenGLES 2.0/3.0
- Unified shader design
- SoCs:
  - Marvell Armada
  - Freescale iMX6
  - Hisilicon, Ingenic, rockchip, loongson, ...
Project: etna-viv

Wladimir J. Van Der Laan (wumpus)
Etna-Viv

- Status: early research (rapidly advancing)
  - Full command stream capture and replay
  - Slowly prying apart command stream
  - Shader disassembler and assembler
- Repository: http://github.com/laanwj/etna_viv
GPU #5:

Broadcom Videocore
Broadcom Videocore

- OpenGLES 2.0, OpenVG, OpenMax, ...
- ... Media Decoding, Shader Compiler, Modesetting, ARM Core bringup...
- DSP based proprietary architecture.
- Found in Broadcom SoCs and standalone Broadcom Media Chips.
RPi == Closed platform.

- Videocore is a separate undocumented DSP/SIMD architecture.
- Runs a RTOS in a reserved bit of RAM.
- Responsible for much of the system level functionality, and even bringing up the ARM core.
- Communication from ARM userspace through a message-passing interface through the kernel and out some shared ringbuffers.
- Userspace GPU drivers are just a shim.
Project: videocore

Scott Mansel (phire)
Matthew Parlance (matt)
(booto)
(Herman)
(David)

Tiernan Hubble (thubble)
Mathias Gottschlag (mgottschlag)
(eizo_san)
Mark Marshall (mm120)
Videocore

• Status: research (rapidly advancing)
  • Scalar processor fully RE-ed.
  • Loads of documentation.
  • Assembler/disassembler.
  • Binutils
  • Compiler work started.
  • Some Hello World code for booting the RPi

• Repository: https://github.com/hermanhermitage/videocoreiv/

• IRC: #raspberrypi-internals
GPU #6:
Imagination PowerVR SGX
PowerVR SGX (5xx)

- OpenGLES 2.0, 3.0, OpenVG, ...
- Unified shader design (USSE)
- SoCs:
  - Texas Instruments Omap.
  - Apple A4, A5, A6.
  - Intel Poulsbo through Medfield.
  - ... Everyone really, at one point or another...
- Future: Rogue (6xx)
PowerVR is ...

... a mix of microcode, kernel and userspace.

This makes PVR:

• Highly adaptable
• Scalable
• Versatile

But also...

• Fragile
• Synchronization nightmare
• Hard to debug and maintain...
• ... and therefore hard to Reverse Engineer.
Project: ...

(slightly gratuitous, but only slightly ;p)
Lima demo time!
Demo Hardware: Mele A1000

- Allwinner A10
  - Single ARM Cortex A8 at 1152MHz
  - 512MB of 360MHz DDR3
  - Mali-400MP1 at 320MHz
- UART exposed
- [http://linux-sunxi.org](http://linux-sunxi.org)
  - U-boot
  - Kernel
  - Further utilities and documentation.