Agenda

- X11/Wayland/Android graphics overview
- Mali and Adreno driver status
- Linaro effort around graphics
- Discussion and Q&A
Wayland/X11 Graphics Architecture

X11 Clients

Wayland Clients

Window Manager

Toolkits (GTK, QT...)

X11

Wayland

Xserver

DDX

XWayland

Wayland Server

fbdev

DRM

EGL

OpenGL ES

GBM

libdrm

libdrm.xxx

Vendor IF library

Kernel

fbdev

DRM/KMS

GPU driver

KMS driver

dma_buf

TTM

Display Engine

RAM

Graphics Engine

User space components

Applications

User space components

Applications
Mali Driver Status

- Proprietary driver from ARM
  - Open source components
    - Kernel mode driver
    - UMP user space library
    - DDX driver (xf86-video-mali, fbdev/UMP based, no 2D HW acceleration)
    - Gralloc
  - Binary user space drivers
    - EGL (DRI2 based for X11)
    - OpenGL ES (ES3.1 support only for Midgard)
    - OpenCL and Renderscript (Midgard only)
    - No GLX and OpenGL support
    - DDK r5p1 or newer should be used for Wayland

- Open source driver from community (lima and tamil)
Adreno Driver Status

- **Proprietary driver from Qualcomm**
  - Open source components
    - Kernel mode driver (kgsl)
    - xf86-video-msm DDX driver
  - Binary user space drivers (EGL, OpenGL ES, Renderscript, OpenCL, gralloc, etc)

- **Open source driver from community (freedreno)**
  - Kernel mode driver (msm.ko)
    - First merged in kernel 3.12 for Adreno 2xx/3xx support
    - Adreno 4xx support added in kernel 3.19
  - libdrm_freedreno (support both msm and kgsl kernel mode drivers)
  - mesa/gallium (msm_dri.so)
    - OpenGL 3.1 and OpenGL ES3.0 for A3xx/4xx (OGL 1.4 and ES2.0 for A2xx)
    - **No OpenCL support**
  - xf86-video-freedreno DDX driver (support both fbdev and KMS display driver)
    - 2D HW acceleration with XA state tracker of Gallium
LHG - Wayland and Android

- Wayland/weston enablement on member platforms
- Metrological WPE (WebkitForWayland)
- CEF support in Linaro RDK (Ozone-Wayland, etc)
- OpenSDK to support V4L2, DRM/KMS, GStreamer and Wayland
- BKK16-209: Chromium V4L2 playback - is it ready today?
- Demo: LHG OE Chr-Wayland/Weston on DB & HiKey
LMG - Android

- DRM/KMS support for hwcomposer/gralloc
- ION and ADF upstreaming
- GPGPU support (OpenCL, etc)
- BKK16-202: LMG Lightning Talks
- BKK16-403: Android HAL Consolidation Status
96Boards RPB Support

<table>
<thead>
<tr>
<th>96Boards (SOC/GPU)</th>
<th>OGL ES</th>
<th>OCL</th>
<th>Linux/X11</th>
<th>AOSP</th>
</tr>
</thead>
<tbody>
<tr>
<td>HiKey (Kirin 620/Mali-450MP4)</td>
<td>2.0</td>
<td>N/A</td>
<td>binary</td>
<td>binary</td>
</tr>
<tr>
<td>DB410c (Snapdragon 410/Adreno 306)</td>
<td>3.0</td>
<td>1.1 EP</td>
<td>freedreno</td>
<td>binary/freedreno</td>
</tr>
<tr>
<td>Bubblegum96 (S900/PowerVR G6230)</td>
<td>3.1</td>
<td>1.2</td>
<td>binary(*)</td>
<td>binary(*)</td>
</tr>
<tr>
<td>Andromeda (IAP140/Vivante GC7000UL)</td>
<td>3.1</td>
<td>1.2</td>
<td>binary(*)</td>
<td>binary(*)</td>
</tr>
</tbody>
</table>

- Mali kernel mode driver is integrated in HiKey Linux RPB (no upstream)
- Kirin 620 ADE KMS driver is integrated in HiKey Linux RPB (upstream is ongoing)
- xf86-video-armsoc is used by HiKey Linux RPB now (no 2D HW accel, dma-buf based)
- The freedreno driver has been enabled for DB410c AOSP RPB
- The wayland/weston support will be enabled soon for OE/Yocto Linux RPB as well as Debian Linux RPB (once there is good driver support)
- OpenCL is not supported yet in the RPBs

(*) to be confirmed
Discussion

● Wayland/X11
  ○ GBM library for DRM backend of weston (decouple gbm from mesa or use minigbm?)
  ○ Mali DDK support for GBM and Wayland platforms (similar for other proprietary drivers)
  ○ More advanced wayland display servers enablement on ARM (gnome-shell, kwin, etc)
  ○ Toolkits/apps porting and optimization on ARM (GNOME, QT, SDL, gstreamer, etc)
  ○ Xwayland support with xf86-video-modesetting and glamor

● APIs
  ○ Vulkan
  ○ OpenCL/OpenVX/OpenCV
  ○ GLVND for Linux

● Use cases
  ○ VR/AR, AI and deep learning, wearables and IoT, etc

● Other
  ○ GPU virtualization (VirGL renderer support from QEMU 2.5/Mesa 11.1/kernel 4.4)
  ○ Discrete graphics card support on ARM platform
Vulkan briefing

- New API spec from Khronos for graphics and compute, unified for desktop, mobile, console and embedded
- **Vulkan 1.0** announced on Feb 16th together with WSI extension and SPIR-V
- Designed to be implementable on hardware with OpenGL ES3.1 or OpenGL 4.x capability
  - ARM Mali: Midguard (T6xx/T7xx/T8xx) and later
  - Qualcomm Adreno: 4xx, 5xx and later
  - Imagination PowerVR: Series 6 and later
- More development work to be done for Linux and Android
  - Driver enablement by GPU vendors and community
    - Intel Anvil open source Vulkan driver for mesa is a good reference
    - DRI3 is required for X11 WSI support
    - SPIR-V support, Vulkan synchronization primitives, etc
  - SDK and tools support (LunarG SDK for Linux, etc)
  - Middleware and toolkit support (Qt Vulkan integration, etc)
Q&A

Thanks!