Running Android on the Mainline Graphics Stack

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FOSDEM 18
Agenda

- Android History
- Android on Mainline
- Current Status
- Big Picture
Android History
Android History

Qualcomm diff with mainline, # lines
Android History

- Android forked the Kernel
Android History

- Android forked the Kernel
  - Better Graphics stack was needed
Android History

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  - Better Graphics stack was needed
  - Support for low power was lacking
Android History

- Android forked the Kernel
  - Better Graphics stack was needed
  - Support for low power was lacking
  - Support for atomic operations
Android History

- Android forked the Kernel
- Android Atomic Display Framework created
Android History

- Android forked the Kernel
- Android Atomic Display Framework created
  - Not extensible or generic
Android History

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- Android Atomic Display Framework created
  - Not extensible or generic
  - Only atomic for plane updates
Android History

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- Android Atomic Display Framework created
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  - Not compatible with current ABI
Android History

- Android forked the Kernel
- Android Atomic Display Framework created
  - Not extensible or generic
  - Only atomic for plane updates
  - Not compatible with current ABI
  - Not upstreamable
Android History

- Android forked the Kernel
- Android Atomic Display Framework created
- Mainline Atomic KMS ABI introduced
Android History

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  - Supports the ADF usecases
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  - Uses Properties to be generic
Android History

- Android forked the Kernel
- Android Atomic Display Framework created
- Mainline Atomic KMS ABI introduced
  - Supports the ADF usecases
  - Uses Properties to be generic
  - Is now replacing ADF in vendor drivers
Android on Mainline
Android Graphics Stack

- Kernel
- Vendor driver
- SurfaceFlinger
- HWC2
- Apps
Android Graphics Stack

- Kernel
- Vendor driver
- HWC2
- SurfaceFlinger
- Apps

The Really Good Stuff ™
Android Graphics Stack

- Kernel
- Vendor driver
- HWC2
- SurfaceFlinger
- Apps

The Really Good Stuff™
- No really, this is the whole point!
Android Graphics Stack

Interface between applications and hardware

- Apps
- SurfaceFlinger
- HWC2
- HWC2
- Vendor driver
- Kernel
Android Graphics Stack
Android Graphics Stack

- Kernel
- Vendor driver
- HWC2
- SurfaceFlinger
- Apps

Status Bar
Android Graphics Stack

Status Bar

Apps
SurfaceFlinger
HWC2
HWC2
Vendor driver
Kernel
Android Graphics Stack

Apps

SurfaceFlinger

HWC2

HWC2

Vendor driver

Kernel

Status Bar

Navigation Bar

Background
Android Graphics Stack

SurfaceFlinger speaks HWC to the Composer
Android Graphics Stack

What does the Hardware Composer do?
Android Graphics Stack

What does the Hardware Composer do?

Get Layers Through HWC API
Android Graphics Stack

What does the Hardware Composer do?

- Get Layers Through HWC API
- Optimize Layers for Display
Android Graphics Stack

What does the Hardware Composer do?

1. Get Layers Through HWC API
2. Optimize Layers for Display
3. Output Layers To Display HW
Android Graphics Stack

The non-kernel part of the graphics driver
Android Graphics Stack

The non-kernel part of the graphics driver
- OpenGL, Vulkan, memory allocator, etc.
Android Graphics Stack

The non-kernel part of the graphics driver
- OpenGL, Vulkan, memory allocator, etc.
- Hardware Composer
Android Graphics Stack

The Linux Kernel

- Kernel
- Vendor driver
- HWC2
- SurfaceFlinger
- Apps
Mainline Graphics Stack

- Mainline now has good Graphics ABI
Mainline Graphics Stack

- Mainline now has good Graphics ABI
- Google Pixel C shipped using Atomic KMS
Mainline Graphics Stack

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Mainline Graphics Stack

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  - Mesa and the Kernel does not implement it
Mainline Graphics Stack

- Mainline now has good Graphics ABI
- Google Pixel C shipped using Atomic KMS
  - Android requires HWC implementation
  - Mesa and the Kernel does not implement it
  - drm_hwcomposer does!
Mainline Graphics Stack

What is the Hardware Composer?
Mainline Graphics Stack

What is the Hardware Composer?

- Apps
- SurfaceFlinger
- HWC2
- HWC2
- Vendor driver
- Kernel

Proprietary
Mainline Graphics Stack

What is the Hardware Composer?
Mainline Graphics Stack

What is the Hardware Composer?

1. Kernel
2. Vendor driver
3. HWC2
4. SurfaceFlinger
5. HWC2
6. drm_hwc
7. Driver
8. Kernel
9. HWC2
10. SurfaceFlinger
11. Apps
12. Apps
Mainline Graphics Stack

What is the Hardware Composer?

- Apps
- SurfaceFlinger
- HWC2
- DRM
- Vendor driver
- Kernel
- Apps
- SurfaceFlinger
- HWC2
- drm_hwc
- Driver
- Kernel
- Apps
- SurfaceFlinger
- HWC2
- drm_hwc
- mesa
- libdrm
- DRM
- Kernel
Mainline Graphics Stack

What is the Hardware Composer?
drm_hwcomposer
HWC2
drm_hwcomposer

HWC2

- Android added buffer Fence support
• Android added buffer Fence support
  - Ensures ordering between operations
Android added buffer Fence support
- Ensures ordering between operations
- Synchronizes buffer sharing
Android added buffer Fence support

HWC version 2 is improved using Fences
drm_hwcomposer

HWC2

- Android added buffer Fence support
- HWC version 2 is improved using Fences
- Mainline received Fence support
- Android added buffer Fence support
- HWC version 2 is improved using Fences
- Mainline received Fence support
- drm_hwcomposer implemented HWC2
drm_hwcomposer

Previously hosted within ChromiumOS
drm_hwcomposer

- Previously hosted within ChromiumOS
- Now hosted on Freedesktop.org
drm_hwcomposer

Project Hosting

- Previously hosted within ChromiumOS
- Now hosted on Freedesktop.org

- Thanks Google:
  - Sean Paul
  - Puneet Kumar
  - Marissa Wall
drm_hwcomposer

Project Hosting

- Previously hosted within ChromiumOS
- Now hosted on Freedesktop.org
- GitLab instance on Freedesktop.org soon!
Current Status
Current status
Tested platforms
Current status

Tested platforms

- iMX6
  - GPU: Vivante GC3000
Current status

Tested platforms

- Dragonboard 410c
  - GPU: Adreno 306
Current status
Under Development

- HiKey 960
  - GPU: Mali G71
Big Picture
Big Picture
Merge Android Features
Big Picture
Merge Android Features

• A new feature is introduced in Android
Big Picture
Merge Android Features

• A new feature is introduced in Android
• Slowly migrated into the kernel
Big Picture
Merge Android Features

- A new feature is introduced in Android
- Slowly migrated into the kernel
- This does not apply to all subsystems
Big Picture
Merge Android Features

Qualcomm v4.9 Diff

- arch/arm64/ 11.90%
- arch/ 11.90%
- drivers/clk/ 13.40%
- drivers/gpu/ 5.00%
- drivers/media/ 6.50%
- drivers/platform/ 5.40%
- drivers/power/ 3.50%
- drivers/soc/qcom/ 7.10%
- include/ 3.30%
**Big Picture**

**Merge Android Features**

- A new feature is introduced in Android
- Slowly migrated into the kernel
- This does not apply to all subsystems
- The diff for drivers seem fairly constant
Big Picture
Merge Android Features

Qualcomm diff with mainline, # lines
Big Picture
Push industry towards Open Source
Big Picture
Push industry towards Open Source

- Increase device development speed
Big Picture
Push industry towards Open Source

- Increase device development speed
- Lower driver development costs
Big Picture
Push industry towards Open Source

- Increase device development speed
- Lower driver development costs
- Increase driver quality
Big Picture
Push industry towards Open Source

• Increase device development speed
• Lower driver development costs
• Increase driver quality
• Push Open Source adoption forward
Running Android on the Mainline Graphics Stack

Any questions?