# Panfrost
## Open Source Meets Arm GPUs
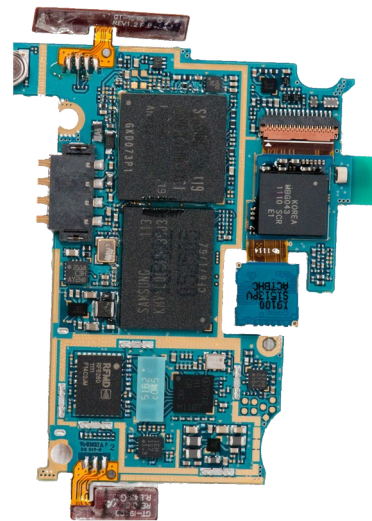
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Robert
Foss

@memcpy_io

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# Hardware

# Architectures

**Utgard**

- Mali 2/4XX GPUs
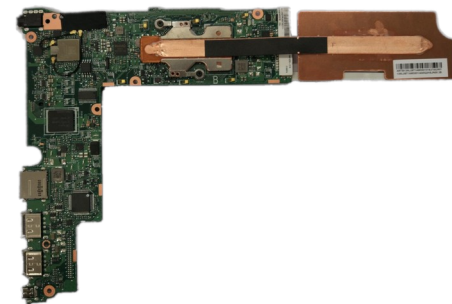- Launched 2007
- OpenGL ES 2.0
- Found in Samsung S2

# Architectures

**Midgard**

- Mali TXXX GPUs
- Launched 2012
- OpenGL ES 3.2
- OpenCL 1.2
- Vulkan 1.1
- Found in Asus C100

# Architectures
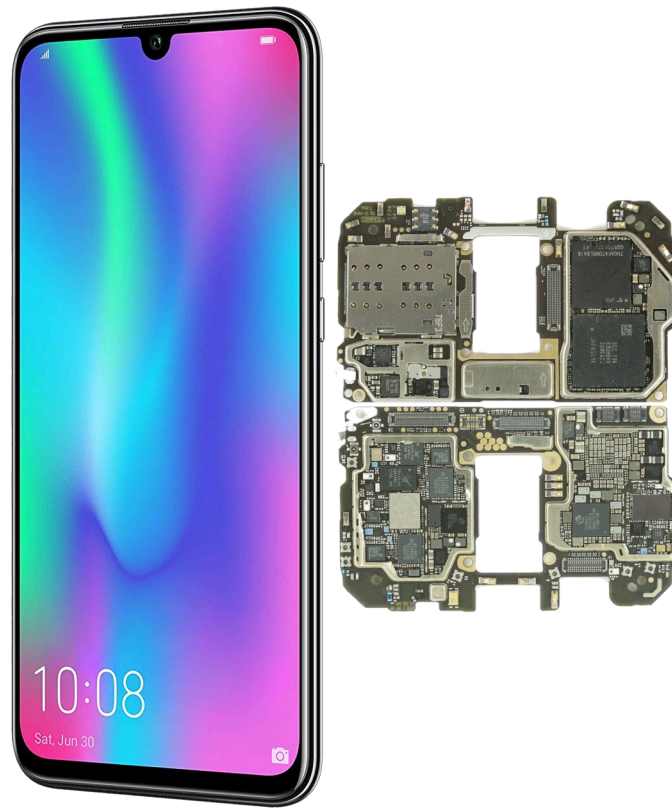## Bifrost

- Mali GXX GPUs
- Launched 2016
- OpenGL ES 3.2
- OpenCL 2.0
- Vulkan 1.1
- Found in Huawei Honor 10

# Architectures

**Valhall**

- Mali G77 GPU
- Launched 2019
- OpenGL ES 3.2
- OpenCL 2.0
- Vulkan 1.1
- Found in ???

???

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# Drivers

# Drivers

**Proprietary**

- Supports all GPUs

# Drivers
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- Supports all GPUs
- Proprietary userspace driver

# Drivers

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- Supports all GPUs
- Proprietary userspace driver
- Open Source kernel driver

# Drivers
## Proprietary

- Supports all GPUs
- Proprietary userspace driver
- Open Source kernel driver
- Kernel driver not upstreamable

# Drivers

**Lima**

- Supports Utgard

# Drivers

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- Both upstreamed to Kernel & Mesa

# Drivers

**Panfrost**

- Supports Midgard

# Drivers

**Panfrost**

- Supports Midgard
- Targets adding Bifrost support

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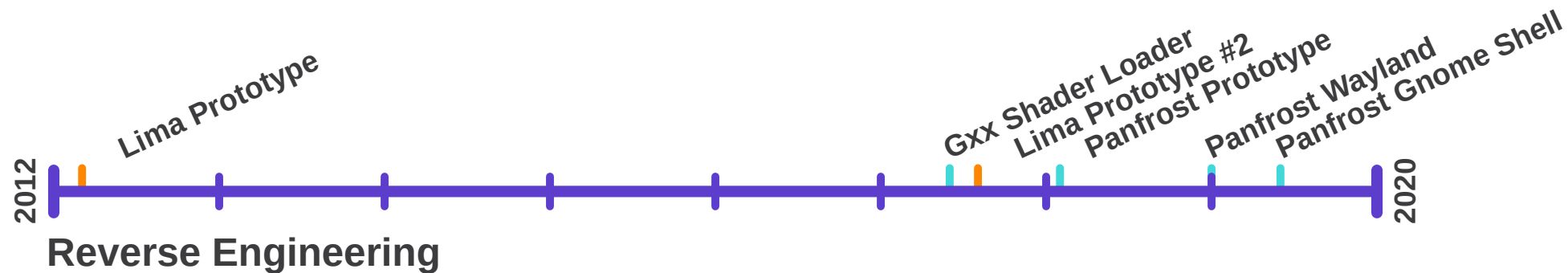- Both upstreamed to Kernel & Mesa
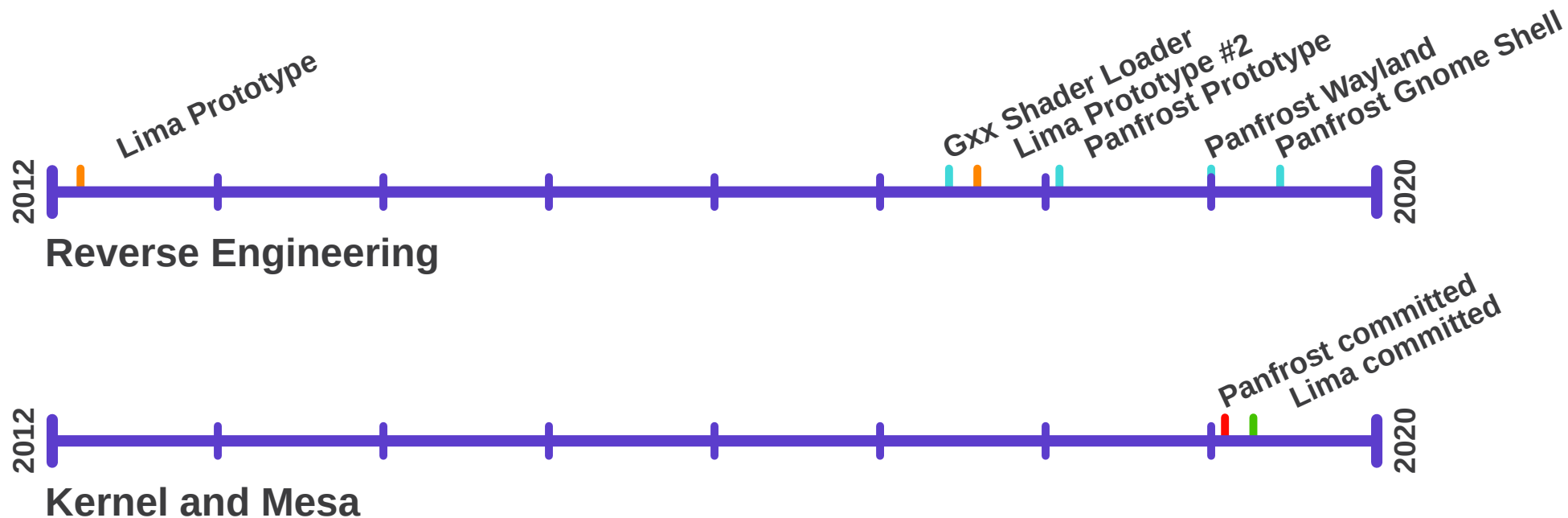
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# History

# History



2012

Lima Prototype

Gxx Shader Loader
Lima Prototype #2
Panfrost Prototype

Panfrost Wayland
Panfrost Gnome Shell

2020

**Reverse Engineering**

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# History

Lima Prototype

Gxx Shader Loader
Lima Prototype #2
Panfrost Prototype
Panfrost Wayland
Panfrost Gnome Shell

2012                                                                                          2020

**Reverse Engineering**

Panfrost committed
Lima committed

2012                                                                                          2020

**Kernel and Mesa**

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# Demo

# What Comes Next

# What Comes Next

- Improved OpenGL support
  - Desktop OpenGL, OpenGL ES 3.X

# What Comes Next
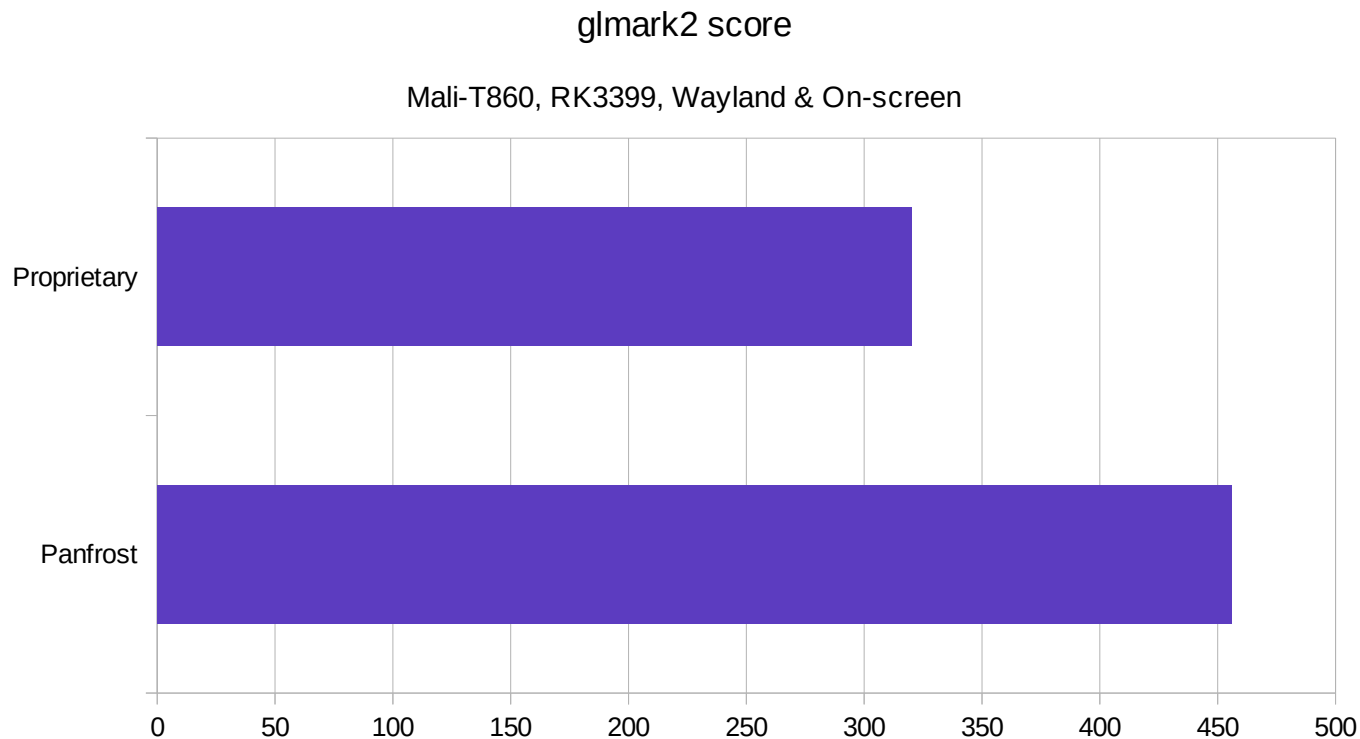
- Improved OpenGL support

- Wider hardware support

  - Currently Mali T860 best tested

  - More GPUs need enabling

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# What Comes Next

- Improved OpenGL support

- Wider hardware support

- Improved performance

# What Comes Next

glmark2 score

Mali-T860, RK3399, Wayland & On-screen

# What Comes Next

- Improved OpenGL support

- Wider hardware support

- Improved performance

  - Currently faster in *some* tests

  - Compiler intense tests often slower

# What Comes Next

- Improved OpenGL support

- Wider hardware support

- Improved performance

- OpenCL

# What Comes Next

- Improved OpenGL support

- Wider hardware support

- Improved performance

- OpenCL

- Vulkan

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# Why Open Source?

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- Long-term support

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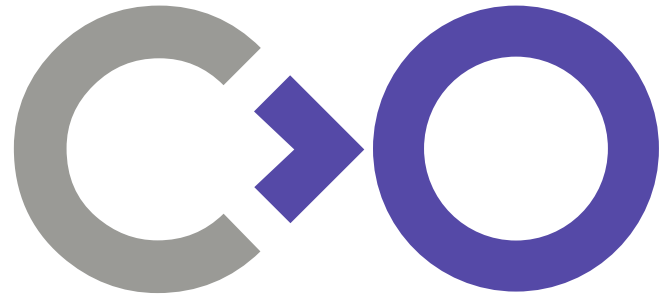- Much simpler debugging

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# Why Open Source?

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- Old hardware receives new features

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- Long-term support

- High performance & conformance

- Much simpler debugging

- Old hardware receives new features

- No vendor lock-in

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**Thank you!**