

# **Upstream Graphics: Too Little, Too Late**

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LPC 2019, Lisbon

**Everything Great About**

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# 10 or so years ago ...

- graphics execution manager
- kernel modesetting
- drm/i915, drm/radeon
- proudly celebrating OpenGL 2
- ... and a wasteland

# today

- 10% of the kernel + userspace
- 50 atomic modeset drivers (and more others)
- latest OpenGL, GLES, Vulkan
- smallest kernel driver 246 lines
- largest kernel driver 2.2M lines

# Awesome uapi: Atomic Modeset

- lots of planes for SoC
- lots of outputs for desktop
- blending, writeback, color space conversions, ...
- gracefully handling link failures
- content protection
- everything else

# Awesome APIs for Rendering

- `dma_buf`, `dma_resv`, `dma_fence` for buffer sharing
- `ww_mutex` for graph locking problems
- `drm_syncobj`, better uAPI for fences

# Helpers, Everywhere you look!

- modular atomic modeset helpers
- simple display pipe
- DisplayPort, MIPI, HDMI, EDID
- self refresh display/damage tracking
- fbdev emulation

# Helpers, Everywhere you render!

- gpu scheduler
- TTM refactoring and helperification
- VRAM helpers, SHMEM helpers, ...
- batteries included by default



# More Awesome Stuff

- bridge and panel drivers, components
- hot(un)plug fixing
- in-kernel selftests (we need KUnit asap)
- IGT gpu tests: cross driver userspace testsuite

# Awesome Stuff, in Userspace!

- gallium: GL stack to rule them all
- gpu compiler troubles settling on NIR
- r/e tools, better than the real docs
- Khronos is opening up

# Userspace drivers

- panfrost, lima, freedreno, etnaviv
- even Intel now on board with Iris
- radv+ACO, one handful hackers vs. AMD

# Great Community

- gitlab everywhere, Mesa3D leading
- (kernel stuck on infrastructure work)
- XDC running on LPC
- XDC haz sponsors now!

**NVIDIA**

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# Celebrating Vendor Lock-in

- ~20 years of desktop GL
- ~15 years of CUDA
- high margins need a moat

# NVIDIA and Linux

- libglvnd
- EGL\_display\_device
- EGL\_streams
- buffer format modifiers
- non-redistributable signed firmware
- ... not trying would be stupid (for NVIDIA)



# Open GPU Driver Business Case

- more reverse-engineered drivers than not
- only 3 hw vendors do open source GPU drivers
- fairly big teams
- need to pay the bills

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# Too Little, Too Late

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# e.g. Android, by Google

- ~half year from linux-next to release, worst case
- one year to the next LTS, worst case
- one year for Google to rebase
- add more for non-Google Android
- same story for servers, ...

# There is no LTS

- sometimes different baseline
- often different drivers/gpu
- often tons of patches
- everyone is different

# Shipping Upstream First

- `cp -R a/drivers/gpu/* b/drivers/gpu`
- cherry-pick specific patches (hundreds)
- forklift entire upstream history (thousands patches)
- DKMS + a few hundred fixups

# Stable Driver ABI

- it works in userspace, all helpers linked into drivers
- ship random upstream driver snapshot
- also: Android project treble
- defeats code sharing
- stable subsystem ABI?

# Shipping Upstream First

- refactor for upstream
- add the crap back in
- ship it
- ...
- [there is no profit]
- sounded good 10 years ago

# Linux Kernel: Upstream First

- some customers require upstream
- ... and then proceed to ignore it
- too big, too fast for stable ABI
- too little, too late for upstream first
- kernel's upstream first business case is broken



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it's a sham