Everything Great About Upstream Graphics

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10 or so years ago ...

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

- 10% of the kernel + userspace
- 54 atomic modeset drivers (and more others)
- latest OpenGL, GLES, Vulkan
- smallest kernel driver 246 lines
- largest kernel driver 2.2M lines
Case Study: ST7736R

- hotunplug support
- full atomic kms + fbdev + legacy kms
- devm, w/ correct refcounting
- dma-buf w/ dma-fence support
- system suspend/resume missing, 2 functions to hook up
- 243 lines total
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
Helpers, Everywhere you look!

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

- free standing state structures are great
- hardware commit phase can't fail
- modular helpers: flexibility&experimentation
- decode/encode in the core
- locking in the core
- need tests and proper uapi specs
Case Study: Self-refresh & Manual-upload

- lots of entry points: fbdev, legacy kms, atomic modeset
- unified update path with damage helpers
- partial upload userspace API
- almost unified enable/disable path with self refresh helpers
- handful of driver lines in total
More Awesome Stuff

- bridge and panel drivers, components
- ongoing: bridge state, chaining, more flexibility
- hot(un)plug fixing
- more work needed around devm_
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
- `drm_fourcc` + modifiers
Helpers, Everywhere you render!

- gpu scheduler
- TTM refactoring and helperification
- VRAM helpers, SHMEM helpers, ...
- batteries included by default
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, vc4/v3d, nouveau
- even Intel now on board with Iris
- radv+ACO, one handful hackers vs. AMD
Open Userspace: Why

- technical necessary for review/support
- RDMA, media, ... agree
- upstream customer value: standardization
- vendor value-add: dual stack
Shipping

- dual-stack: upstream kernel w/ either open or proprietary userspace
- backport entire subsystem ...
- ... like Android GKI (rsn)
Testing

- in-kernel selftests (we need KUnit asap)
- IGT gpu tests: cross driver userspace testsuite
- CRC-based validation, writeback under review
- tests require for all new uapi
Great Community

- gitlab everywhere, Mesa3D leading
- (kernel stuck on infrastructure work)
- 150 attendees at XDC
- XDC haz (SoC!) sponsors now!
Coming Soon

- dma-buf heaps/ION destaging
- userspace allocator/modifier negotiations
- media integration, but how?
Summary

- 10,000x scaling: tiny embedded to BIG GPUs
- batteries included: modular helpers for everything
- dual-stack in userspace
- ship/backport entire subsystem