Atomic Modesetting for Drivers

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Anatomy of an Atomic Modeset

1. Build up new state
2. Compute derived state and check the update
3. Commit the new state to the hardware, possibly asynchronously
State Building

- per-object states structures tracked in `struct drm_atomic_state`
- `->atomic_duplicate/destroy_*` per-object
- `->atomic_set/get_property` only for private properties
- start with pure helpers, subclass as needed
State Checking

- global ->atomic_check entry point
- plus big modular helper library
- helper supports legacy ->mode_fixup and new ->atomic_check hooks
- read the kerneldoc!
State Precomputing&Checking

• often check and commit need to compute the same values, e.g. DP link settings

⇒ subclass state structures and store derived state for reuse in the commit phase

• almosts everything ends up being subclassed, tons of examples
Cross-State Structures Checking

- `->atomic_check` hooks can look at any other state

- Always use provided functions and check errors to avoid wait/wound mutex headaches and unnecessary serialization

- `CONFIG_DEBUG_WW_MUTEX_SLOWPATH`

- Overwrite global `->atomic_check` if needed

- Tons of examples already
Handling Global State

- for shared resources across CRTCs
- use driver-private w/w mutex or dev->mode_config->connection_mutex
- ->atomic_state_alloc/clear/free to subclass global struct drm_atomic_state
- currently only i915: display core clock, shared PLLs, ...
State Committing

• global ->atomic_commit entry point
• commit not allowed to fail due to invalid state
• core guarantees to call ->atomic_check first
• helpers by default optimized for backwards compat
• modular helpers to accommodate more drivers, read docs!
Helper Design

• plane updates orthogonal to modeset changes
• no partial enables/disable, reducing complexity
• DPMS implemented entirely in helpers
• lots of old hooks deprecation, most others optional
• legacy state updated by default, but can be ignored
 ➔ much fewer boilerplate required
Atomic Commit Flow

- `-->prepare_fb` for memory alloc, pinning
- swap new state into objects (must be done synchronously)
- wait for fences and buffers
- actual hardware commit, built from helpers and driver code
- wait for vblank
- `-->cleanup_fb` to for memory release, unpin
Hardware Commit Helpers

- CRTC, encoders and bridges for modesets with just enable/disable hooks

- 3-phase plane updates:
  1. CRTC $\rightarrow$ atomic\_begin for vblank evade, blocking updates
  2. per-plane $\rightarrow$ atomic\_update/disable
  3. CRTC $\rightarrow$ atomic\_flush to set GO bit, unblock updates
Bootstrapping Atomic State

- atomic updates always incremental
- assume that software state perfectly matches hardware
- driver load and resume need to ensure matching state, use \( \rightarrow \text{reset hooks} \)
- need not actually reset, hardware state readout for fastboot also possible
Legacy Entry Points

- helpers to implement them with atomic for all of them
- allows drivers to keep old features that don't make sense to port to atomic around
Ongoing for 4.4

- suspend/resume helpers
- atomic fbdev
- active_only plane update helpers
- better support for runtime PM in general
Future Work

- generic async commit
- state readout for fastboot à la i915
- more helpers as use-cases crop up …
- generic validation tests in i-g-t perhaps
KMS Extensions

- easy to do with properties
- color manager, plane blending, ...
- should put them into core drm state structures to avoid property proliferation
- same rules as any other kernel ABI
Android Support?

- just fences missing, but:
- hardware composer wants per-buffer release fence, even before the next flip is scheduled
  - trivial fencing deadlock
- ... and no one has an open-source atomic hwc
Documentation

- conversion HOWTO for legacy drivers: http://blog.ffwll.ch/2014/11/atomic-modeset-support-for-kms-drivers.html
- LWN design overview: https://lwn.net/Articles/653071/
  https://lwn.net/Articles/653466/
- DRM DocBook: https://01.org/linuxgraphics/gfx-docs/drm/
Q & A