

# Explicit Synchronization for Linux Display Servers

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# The Problem

- ▶ Synchronizing client rendering with presentation
- ▶ Wayland compositors need to synchronize with KMS driver
- ▶ Xwayland needs to synchronize with Wayland compositor
- ▶ Direct scan-out vs. composition
- ▶ Multiple GPUs, multiple outputs
- ▶ Screen recording, remote desktop, ...

# The Current State

Existing display servers assume GPU memory access is implicitly synchronized. This works, but it has some inherent drawbacks...

- ▶ Unnecessary synchronization in the server
- ▶ Synchronization limited to per-buffer granularity
- ▶ Overhead of tracking buffer accesses
- ▶ Limited flexibility in presentation APIs

## Moving to an Explicit Synchronization Model

Need a common, cross-process synchronization primitive. Implicit sync relies on dma-fences. These are an option, but they have limitations. DRM synchronization objects (syncobjs) may be a better candidate.

- ▶ Shareable across processes
- ▶ Timeline semantics, more expressive API
- ▶ Sync file import / export allows for interoperability with EGL and Vulkan
- ▶ Currently implemented on top of dma-fences, but not conceptually incompatible with other underlying mechanisms

NVIDIA is working to add support for dma-fences in our driver.

# Challenges

- ▶ Backwards compatibility, piecemeal adoption - Jason Ekstrand's implicit fence import / export ioctls help bridge the gap
- ▶ Safety, clients shouldn't be able to hang the display server
- ▶ Poll-like interface wait-for-submit and signal-from-CPU
- ▶ Opt-out of implicit sync for OpenGL

# Work in Progress

## Xwayland

- ▶ Proposal adding explicit GPU sync capabilities to DRI3 and Present extensions (1) and implementation for Xwayland (2)
- ▶ Possible to expand to other use-cases, e.g. Damage extension

## Wayland

- ▶ Simon Ser's proposed explicit sync protocol V2 based on DRM syncobjs (3) and implementation for wlroots (4)
- ▶ Michel Dänzer's patch for Mutter to explicitly poll client buffers' fences (5)
- ▶ Crostini and virtio-wayland

# Links

- (1) [https://gitlab.freedesktop.org/xorg/xserver/-/merge\\_requests/967](https://gitlab.freedesktop.org/xorg/xserver/-/merge_requests/967)
- (2) [https://gitlab.freedesktop.org/xorg/proto/xorgproto/-/merge\\_requests/59](https://gitlab.freedesktop.org/xorg/proto/xorgproto/-/merge_requests/59)
- (3) [https://gitlab.freedesktop.org/wayland/wayland-protocols/-/merge\\_requests/90](https://gitlab.freedesktop.org/wayland/wayland-protocols/-/merge_requests/90)
- (4) <https://github.com/swaywm/wlroots/pull/3286>
- (5) [https://gitlab.gnome.org/GNOME/mutter/-/merge\\_requests/1880](https://gitlab.gnome.org/GNOME/mutter/-/merge_requests/1880)

# Final Thoughts and Questions