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Firefox & DMABuf

Martin Stránský
http://people.redhat.com/stransky/

Firefox & DMABuf

- DMABuf provides (direct) access to GPU (or other device) memory
  - Slow to write
  - Extra slow to read (if it’s even possible – AMD)
  - CPU access by mmap
    - Don’t use it
  - Tricky on x86
  - HW dependent (mem layout etc.)
  - Shared (also between processes) by fd
    - Surface size, pixel format, modifiers…
  - Use EGL as much as you can
    - Copy as EGLImage

- Firefox implementation is at:
  https://searchfox.org/mozilla-central/source/widget/gtk/DMABufSurface.cpp

DMABuf creation

- Imported from VA-API (video decoding)
  - VADRMPRIMESurfaceDescriptor
  - Owned by ffmpeg allocator
- Direct creation by gbm library (gdb_*)
  - https://searchfox.org/mozilla-central/source/widget/gtk/DMABufLibWrapper.cpp
  - Not thread safe
  - Tricky to create (DMABuf modifiers)
  - Intel/AMD
- Derived from existing EGLImage / EGL frame buffer
  - `MESA_image_dma_buf_export`
  - `NVIDIA`

Firefox & DMABuf synchronization

- DMABuf recycle vs. allocate
  - DMABuf is alive if there’s any fd open
  - GEM → more DMABuf mapping (prime handle)
- Inter-process ref counting on Linux
  - eventfd(0, EFD_CLOEXEC | EFD_NONBLOCK | EFD_SEMAPHORE);
- EGL rendering sync:
  - EGL_ANDROID_native_fence_sync

Firefox DMABuf utilization

- VA-API video decode & playback
  - ffmpeg
- WebGL rendering
  - (Vulkan WebGPU)
- Nothing else, try to avoid it

Firefox VA-API playback

- Imported from VA-API by VADRMPRIMESurfaceDescriptor
  - https://searchfox.org/mozilla-central/source/dom/media/platforms/ffmpeg/FFmpegVideoDecoder.cpp#1505
  - Owned by ffmpeg allocator, need to ref it until it's used by Firefox (ffmpeg may change content of it – frame recycle).
- Zero copy playback
  - Depends on drivers (AMD / Intel)
  - VA-API → dmabuf → IPC → EGLImage
- Copy playback – EGLImage is used
  - Mpv
  - It's more stable
  - VA-API → dmabuf → EGLImage(do copy) → dmabuf → IPC → ELGImage
- Ref counted across processes (surface recycle)
  - Decode → rendering

Firefox WebGL rendering

- WebGL process allocates EGL framebuffers backed by DMABuf
  - Direct DMABuf creation
    - gbm_bo_create_with_modifiers
    - gbm_bo_create
    - zwp_linux_dmabuf_v1 (missing modifiers on X11)
    - Intel/AMD
  - Import from EGLImage - `MESA_image_dma_buf_export`
    - NVIDIA only

- WebGL process → Renderer process → WebGL process
  - Inter-process refcounting for surface recycle

- EGL Fence (EGL_ANDROID_native_fence_sync) to track EGL refs

- https://searchfox.org/mozilla-central/source/gfx/gl/SharedSurfaceDMABUF.cpp

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