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Mainline Explicit Fencing

A new era for graphics

Gustavo Padovan

Open First

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Agenda

- Intro to Fencing
- Implicit Fencing
- Explicit Fencing
- Android Sync Framework
- Mainline Explicit Fencing
- struct fence
- Sync de-stage
- fence_array
- DRM
- Mesa
- Current Status

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Fencing

- Ensure ordering between operations
- Synchronize buffer sharing
  - e.g.: Between GPU and Display drivers
- Implicit fencing: userspace not aware
- Explicit fencing: userspace aware

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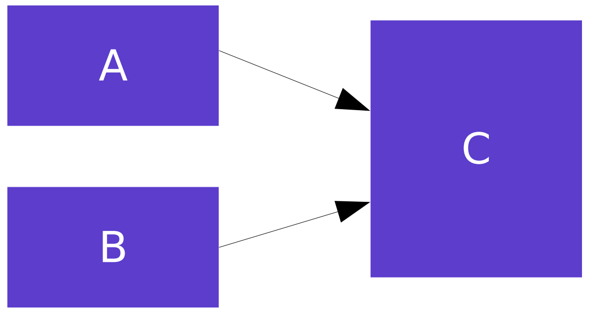
Fences

- Promise from the kernel
- Work has been queued
- Signal when finished
- Userspace and drivers wait for the signal

Implicit Fencing

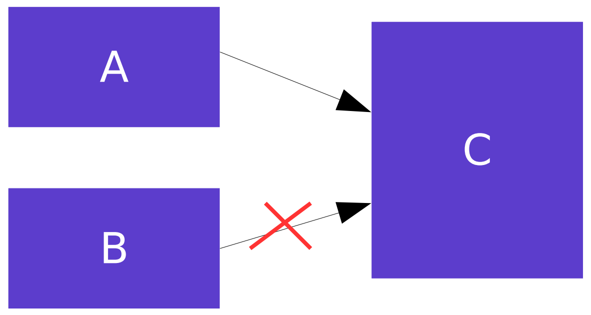
- No userspace knowledge/interference
- Simple/Dumb compositors
  - No buffer state information
- But it can freeze the whole desktop!

Implicit Fencing



- Buffer C will be composed of A and B
- Buffers A and B can render in Parallel
- Compositor notified only when both finishes

Implicit Fencing



- A is fast and B takes too long
- C is blocked waiting for both to render
- The entire desktop freezes!

Explicit Fencing

- Fences goes to userspace
- Userspace can control synchronization
- Smart decisions on compositors
- Avoid blocking the entire desktop

Explicit Fencing

- No need to wait/block in userspace
- Better for traceability/debuggability
- Vulkan requires it
  - Part of the API
  - Efficient Sub-buffer processing

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Android Sync Framework

- Android Explicit Fencing implementation
- Use fd for fence passing
- Consumer-Producer queue
- **Sync Timeline** to control ordering
- **Sync Point** to represent a fence
- **Sync Fence** for fd passing

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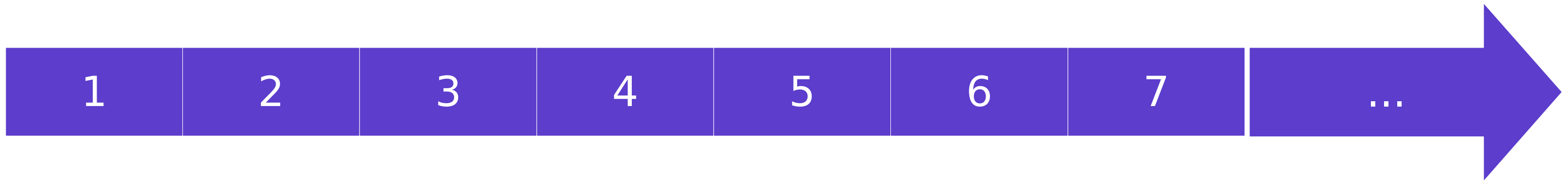
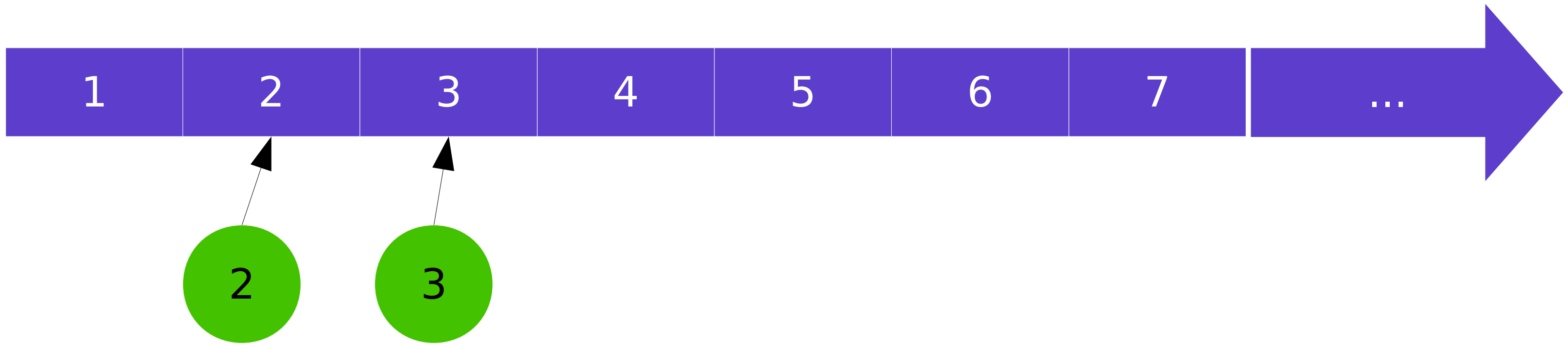
Sync Timeline



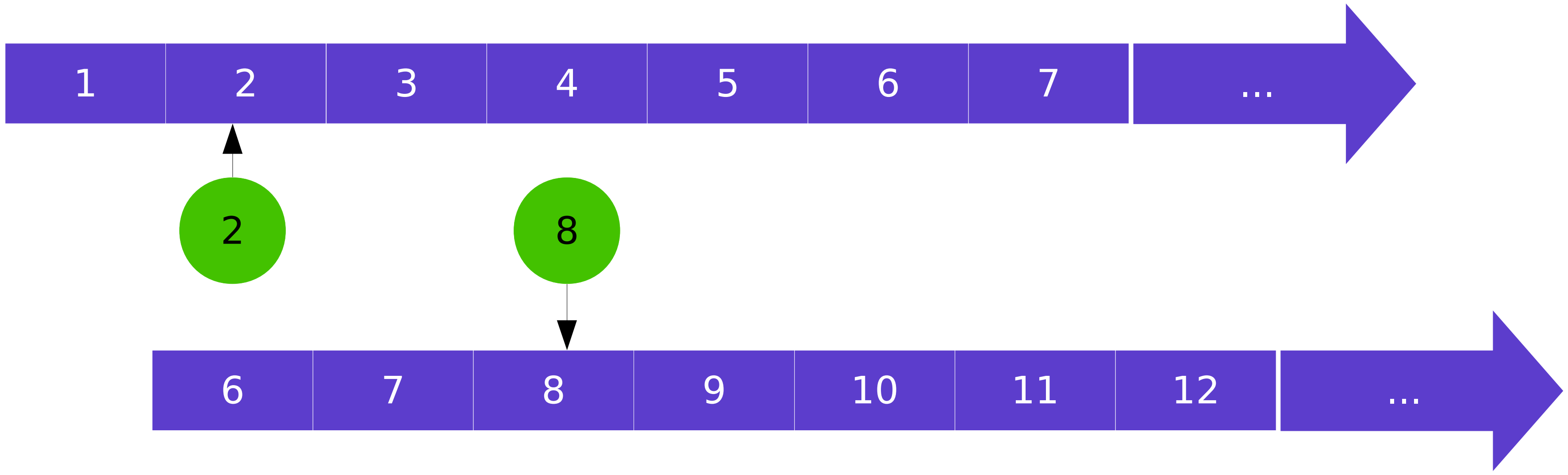
- Monotonically increasing counter
- Usually one timeline per driver context

Sync Point



- It is the fence
- Represents a value on the timeline
- Three states: active, signaled and error

Sync Point



- Multiple timelines!

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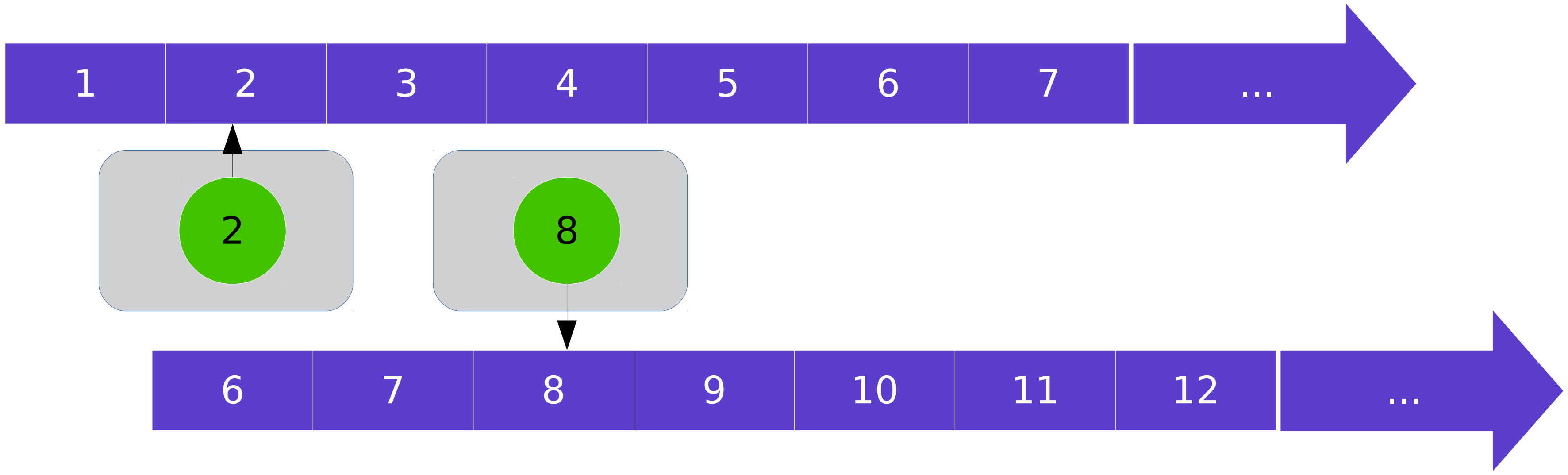
Sync Fence



- Wrap Sync Point into a file
- Also have active and signaled states
- Shared via fd-passing to/from userspace

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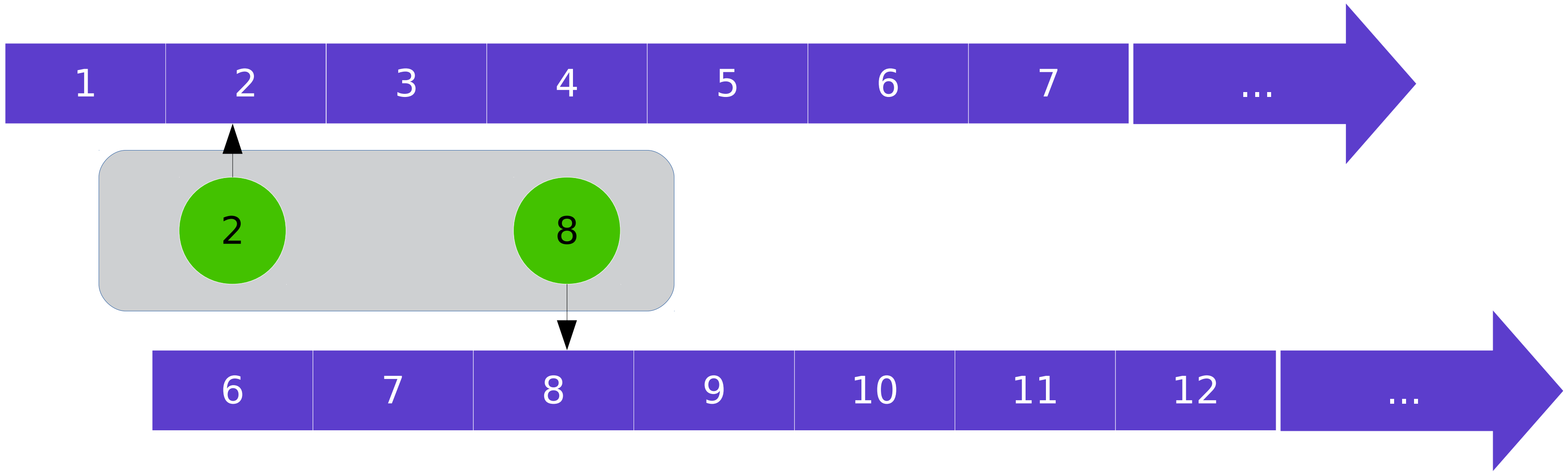
Sync Fence



- Sync fence can be merged!
- It can contain many Sync Points

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Android Sync Framework - ioctls

- sync_wait(fd)
- sync_merge(fd1, fd2)
- sync_fence_info(fd)

Mainline Explicit Fencing

- Started with the fence synchronization mechanism by Maarten Lankhorst
- Buffer synchronization between drivers

struct fence

- struct fence
- fence->context
- fence_signal()
- fence_wait()
- fence_add_callback()

Sync Framework de-staging

- Add Android Sync to staging in 2013
- Mainly need for fd-passing
- Removed Sync Timeline
- Removed Sync Point
- Reworked Sync Fence

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Sync File

- Renamed Sync Fence to Sync File
- Changed ioctl API
  - Provided patch to Android's libsync
- Removed internal kernel API
- Used strictly for fd-passing
  - sync_file = sync_file_create(fence)
  - fence = sync_file_get_fence(fd)

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fence_array

- Subclass of struct fence
- Store multiple fences
- Useful for merged Sync File
- Hide complexity from the drivers

DRM/KMS

- Only available for Atomic Modesetting
- Receives fences from userspace
- Wait for fence signal before scanout
- Create new fences to return buffer to pipeline
- Signal created fences at scanout
  - It means **previous** buffer can be reused
- Entirely in DRM Core

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DRM/KMS: in-fences

- in-fences: fences received from userspace
- FENCE_FD property on each DRM Plane
- Receives sync_file fds carrying fences
- drm_atomic_helper_wait_for_fences() helper

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DRM/KMS: out-fences

- out-fences: fences sent to userspace
- One fence per DRM CRTC
- Extended the DRM Atomic ioctl args
- Userspace need to ask for out-fence
  - DRM_MODE_ATOMIC_OUT_FENCE flag
  - libdrm: drmModeAtomicAddOutFences()
- get_unused_fd() + sync_file_create() + fd_install()

DRM/renderer

- Similar to KMS side
- Extends execbuffer ioctl args on each driver
- Every driver needs sync_file/fences support
- WIP on freedreno, i915 and virgl

Mesa

- EGL_ANDROID_native_fence_sync
  - Create Android fence fd
- EGL_ANDROID_wait_sync
  - Make the GPU wait for fence to signal
- WIP by Rob Clark

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Current Status Summary

- Sync File syncronization de-stage: DONE
- SW_SYNC validation de-stage: DONE
- fence_array: DONE
- DRM/KMS: WIP
- DRM/renderer: WIP
- MESA: WIP
- intel-gpu-tests: WIP
- Wayland: TODO

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Thank you!

Gustavo Padovan
gustavo@padovan.org
www.padovan.org
www.collabora.com