drm_hwcomposer

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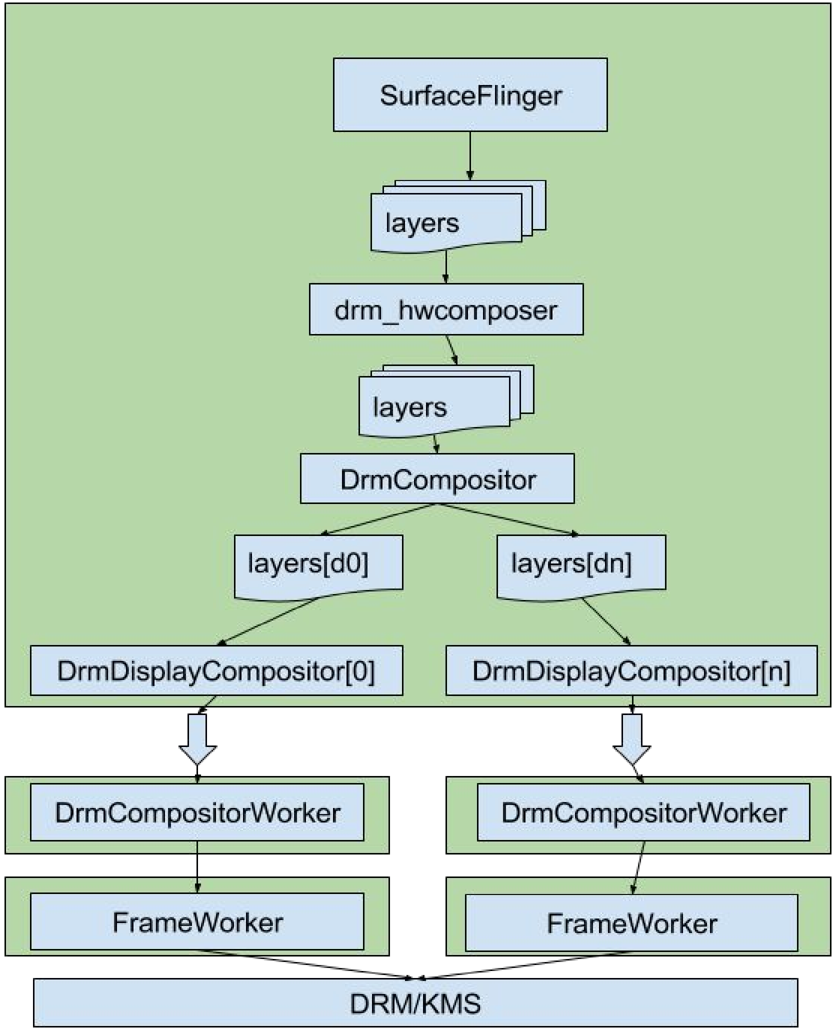
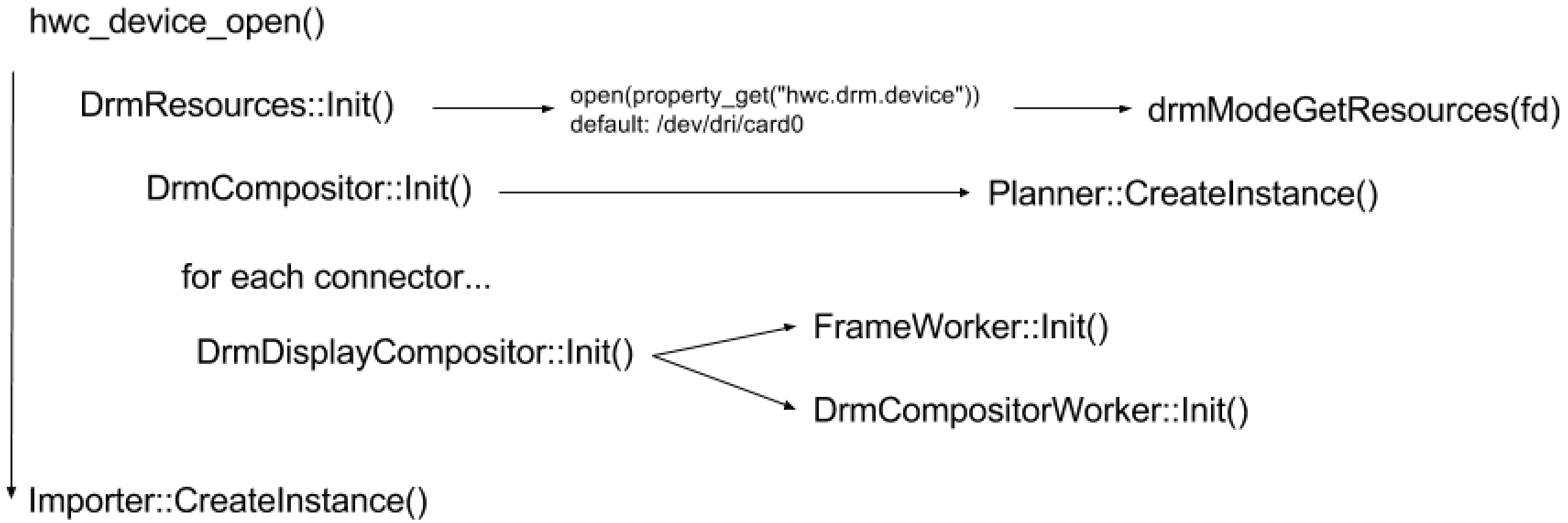
Development Timeline

- Started development January 2015
- Began with thin C implementation using legacy DRM/KMS ABI
- Converted to C++ with libdrm abstraction
- Moved to C++11 to exploit language safety features
- Added embedded GL compositor for full/partial squashing
- Shipped on Pixel C in December 2015
- Planner allows for more granular device/application specific rules
- Vulkan compositor


SurfaceFlinger
layers
drm_hwcomposer
layers
DrmCompositor
layers[d0]
layers[dn]
DrmDisplayCompositor[0]
DrmDisplayCompositor[n]
DrmCompositorWorker
DrmCompositorWorker
FrameWorker
FrameWorker
DRM/KMS

Code Overview

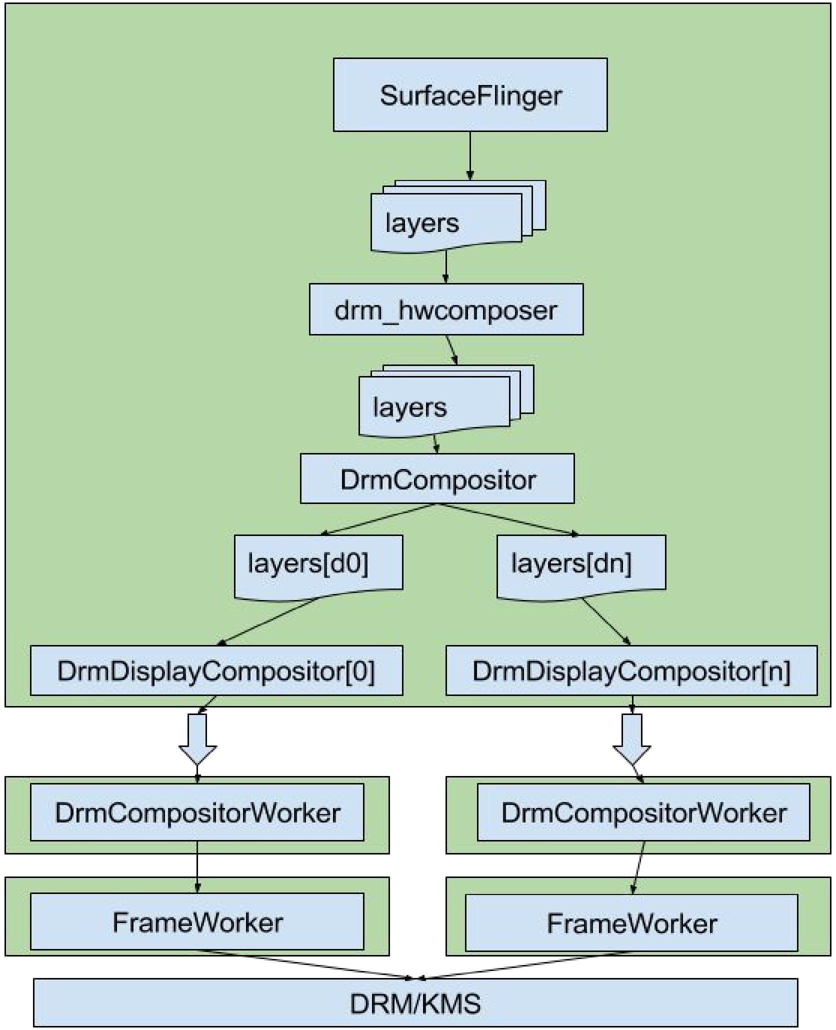


Code Overview (continued)

- hwc_set(dev, contents)
    - encapsulate everything in C+11 in case we ever fail
    - import every layer we need to composite (either with GL or overlays)
    - assign each layer a release fence
    - DrmCompositor::CreateComposition
    - DrmComposition::SetLayers(contents)
        - DrmDisplayComposition::SetLayers(display_layers)
    - DrmCompositor::QueueComposition(composition)
        - DrmComposition::Plan
            - for each display:
                - DrmDisplayComposition::Plan(squash_state, primary_planes, overlay_planes)
                    - reading and writing to squash state
                    - Planner::ProvisionPlanes
                    - DrmDisplayComposition::SeparateLayers
                    - assign fences to layers in order of completion
        - for each display:
            - DrmDisplayCompositor::QueueComposition(display_composition)
                - Push display_composition onto composition queue
    - return

Code Overview (continued)

- DrmDisplayCompositor::Composite()
    - creates GL Compositor (called pre_compositor in code) if needed
    - pops a DrmDisplayComposition off the queue
    - DrmDisplayCompositor::PrepareFrame(display_composition)
        - ApplySquash(display_comp) OR reuse the last squash
            - GLCompositor::Composite
        - ApplyPreComposite(display_comp)
            - GLCompositor::Composite
    - queue finished frame onto the frame queue
- FrameWorker::Routine()
    - pops a finished DrmDisplayComposition of the queue
    - DrmDisplayCompositor::ApplyFrame(composition)
        - DrmDisplayCompositor::CommitFrame
            - drmModeAtomicCommit
        - Blank the display on error
        - Signal composition completion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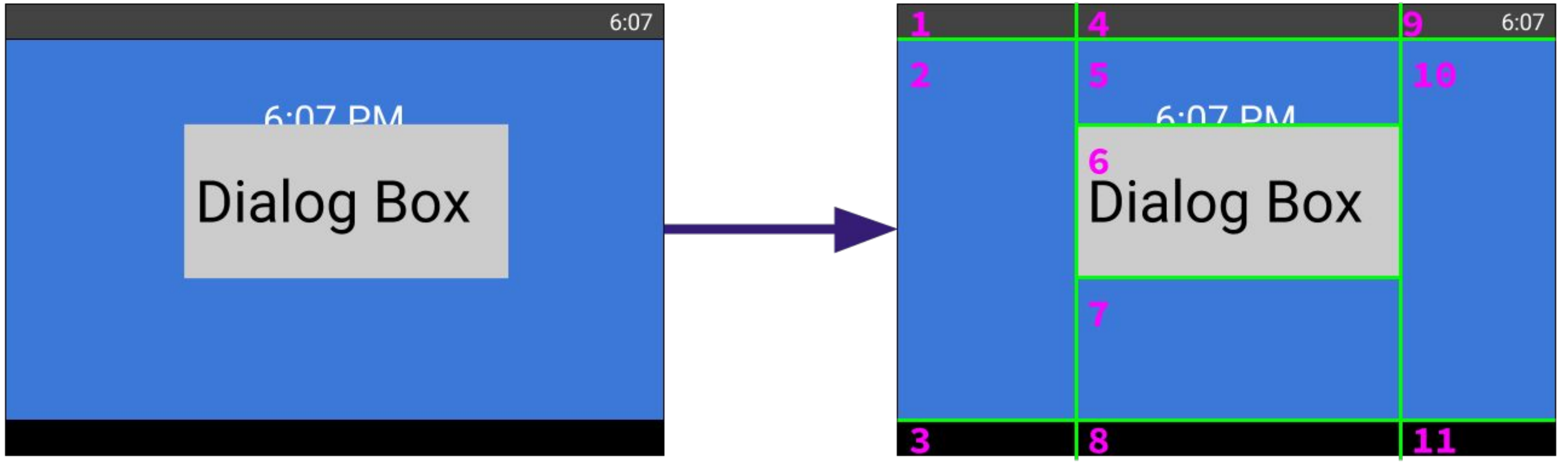
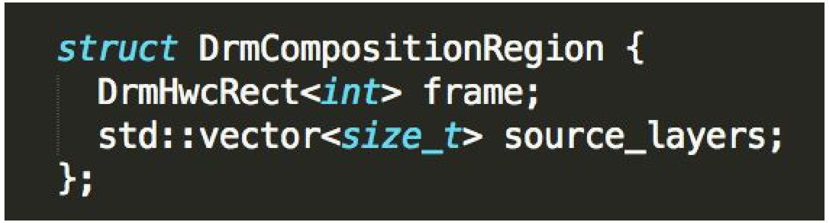
Rectangle Separator




```
struct DrmCompositionRegion {
  DrmHwcRect<int> frame;
  std::vector<size_t> source_layers;
};
```

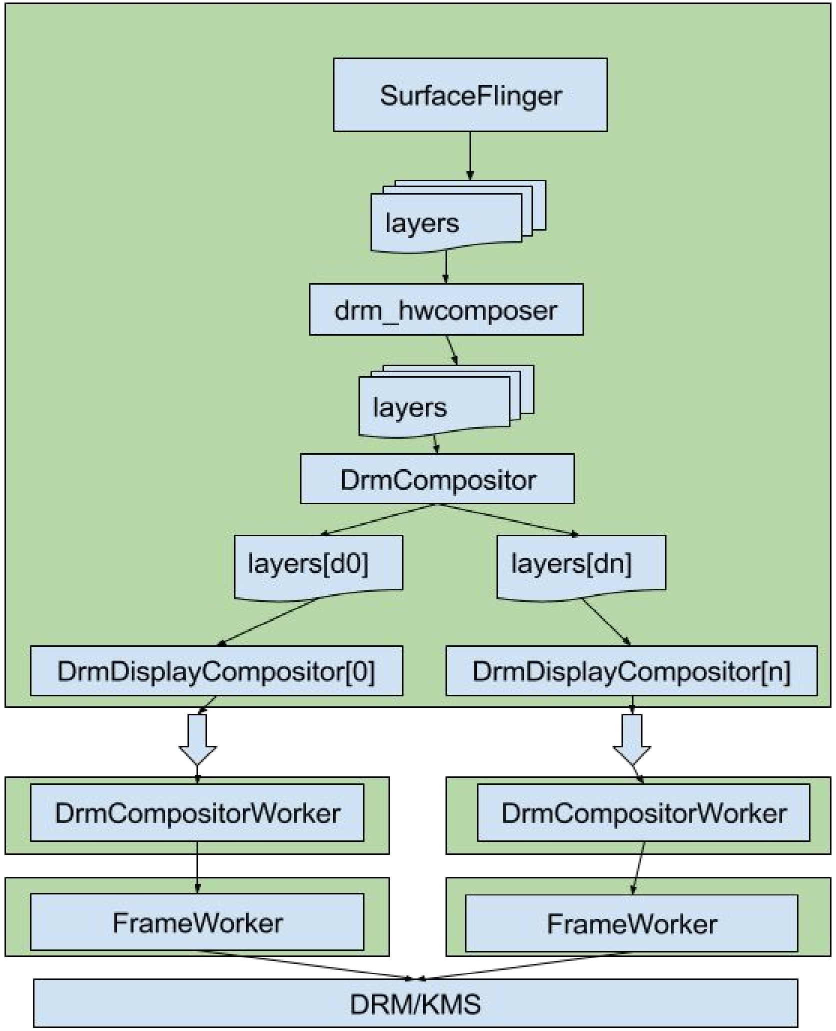
GL Compositor

- uses separated regions directly
- generates a shader for each layer depth
- renders each rectangle region with one draw call
- no blending hardware used at all
- optimization: blending done within shader
- for layer import, uses NV hack: EGL_NATIVE_HANDLE_ANDROID_NVX
- for framebuffer import, uses standard EGL_ANDROID_image_native_buffer
- optimization: cache framebuffers using weakptr

Planner

- Introduced with Android N
- Planner runs every time the composition changes
- Platform register plan stages in priority order
- Plan stages map SurfaceFlinger layers to hardware planes
- After all stages finish, all layers should be mapped

HWC2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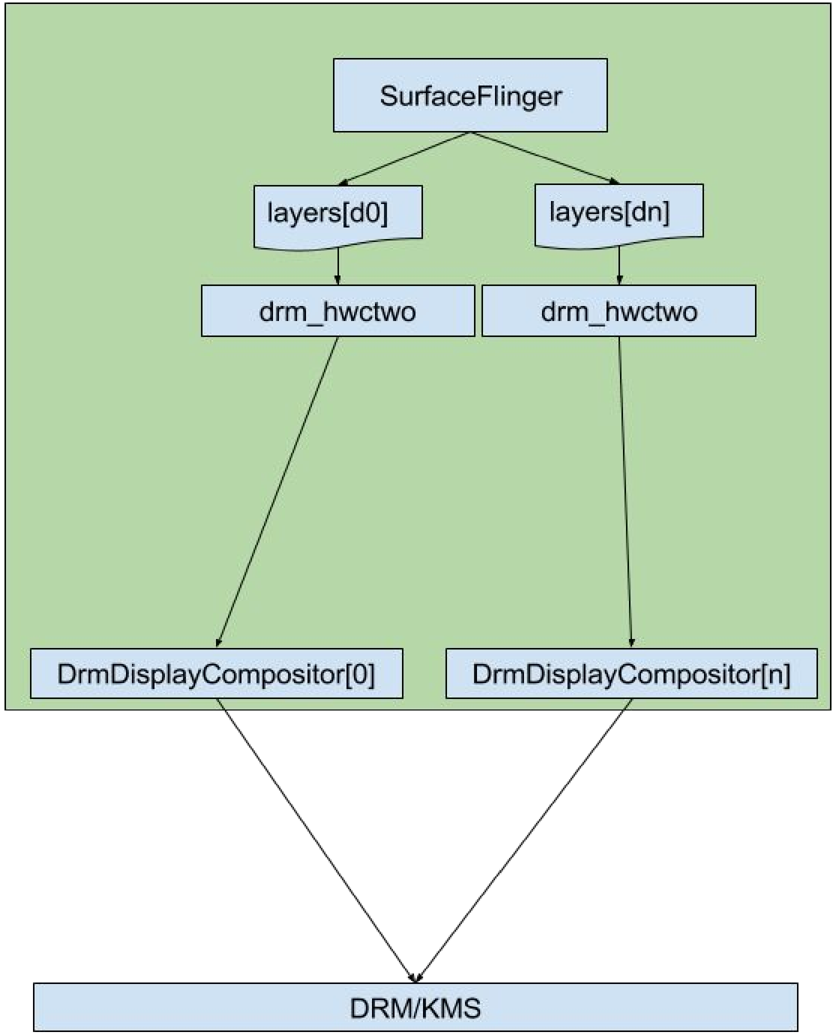
HWC2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drm_hwctwo
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DrmDisplayCompositor[n]
DRM/KMS

Contributing to drm_hwcomposer

- Upstream source hosted on chromium.org gerrit
- External contributions welcome (thanks robher!)

https://www.chromium.org/android/contributing-to-drm_hwcomposer

AMA