Google

KHRONOS GROUP

SwiftShader

Reference Implementation and Fallback

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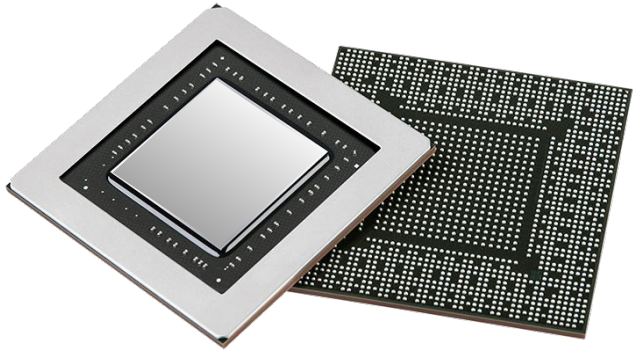
Introduction

- Graphics driver for the CPU
- Accelerated by
  - Multi-core
  - SIMD vectors
  - Specialized instructions

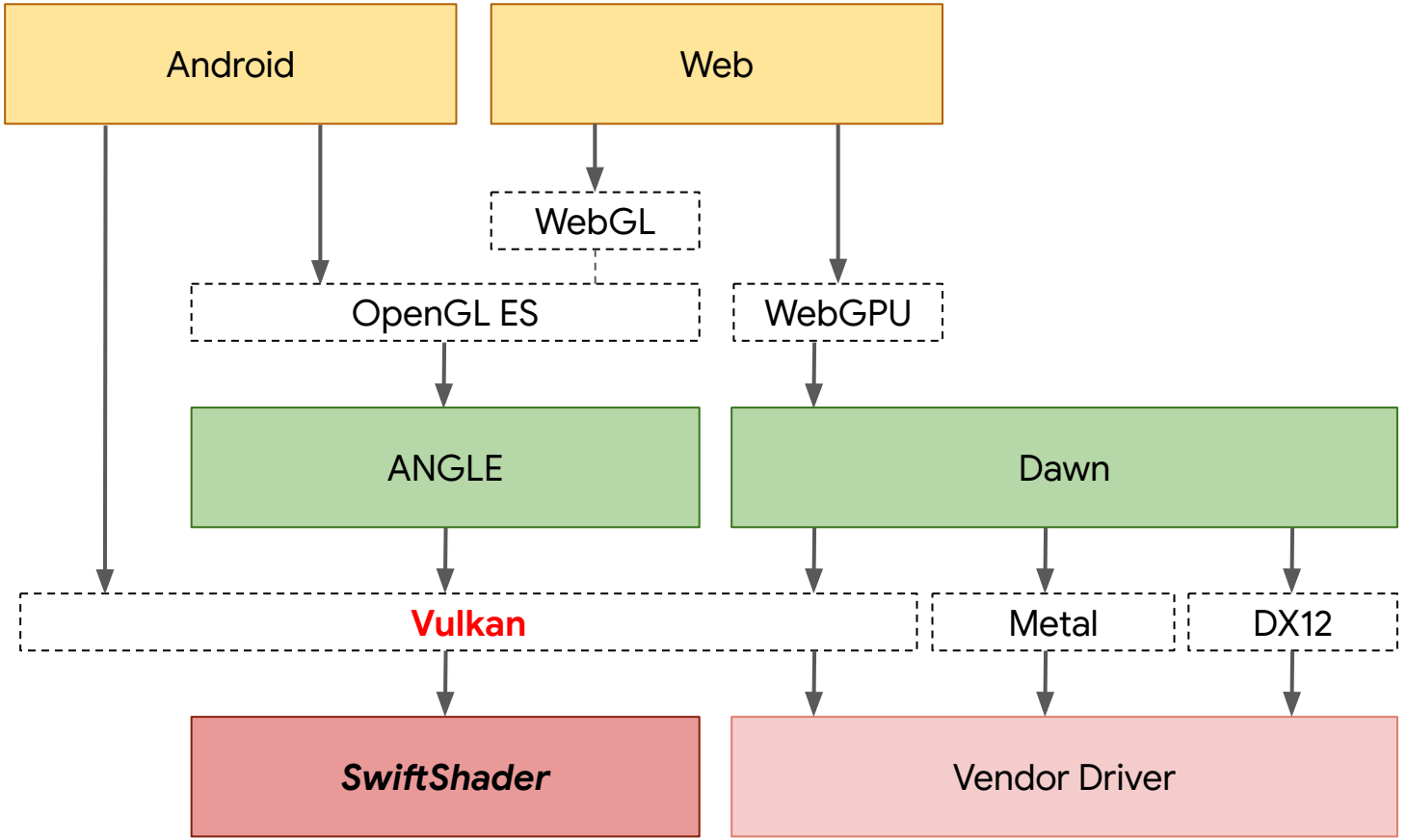
vs.



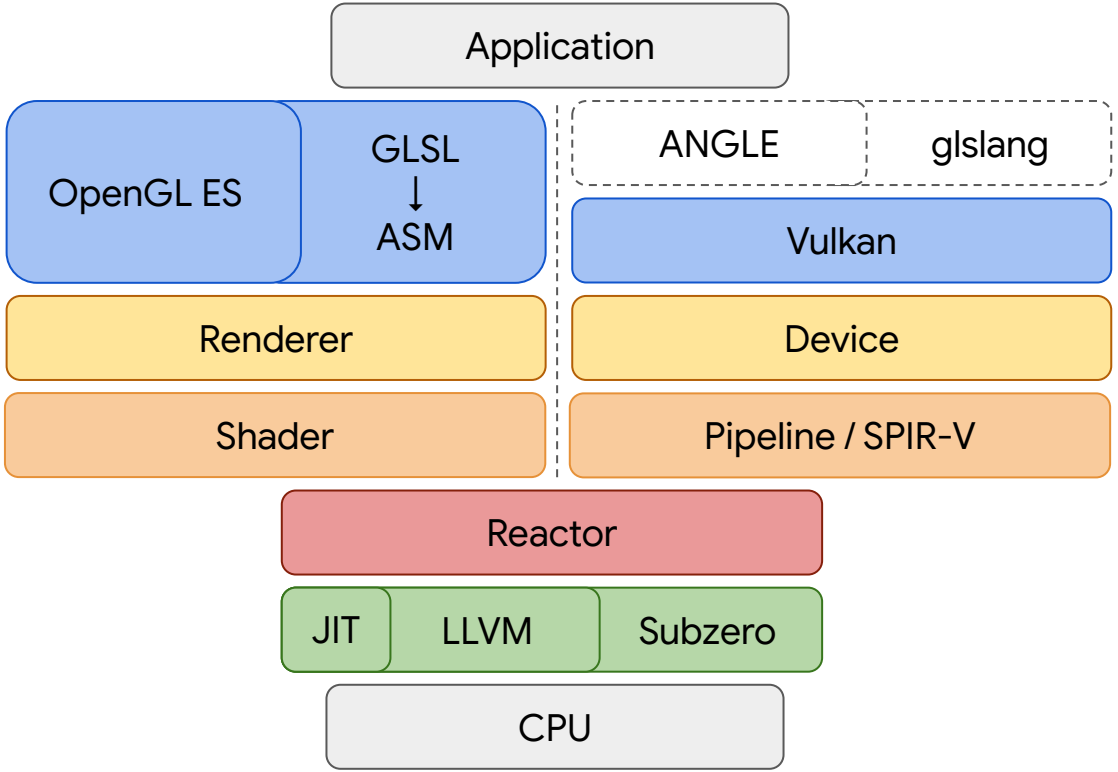
Google all-in on Vulkan

- High performance is key
- Mandatory for Android Q phones, except in extreme low-end
- Stadia uses Vulkan on Linux
- Chrome is adding Vulkan support
- The Skia graphics library has a Vulkan backend
- Dawn (WebGPU) also has a Vulkan backend

Making 3D Universally Accessible



SwiftShader's Transition to Vulkan-only



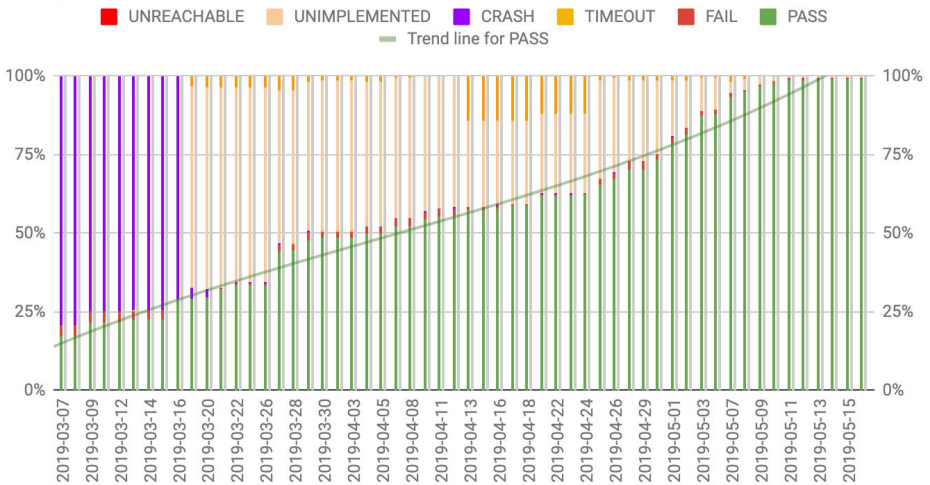
Reactor

- High level C-like language for code generation of low level CPU operations
- Produces code for a JIT compiler rather than executing that code
- Example:

```
                                    // Regular “if()” selects whether instructions are generated,
if(condition)                       // no branch in resulting JITed code
{
    Int a = computeSomething();     // “a” is a Reactor integer object
                                    // “If()” is evaluated at runtime and results
    If(a == Int(0))                 // in a dynamic branch inside the JITed code
    {
        a += Int(10);               // The “+=” operator generates the necessary instruction(s)
                                    // for this operation to be evaluated in the JITed code
    }
}
```

SwiftShader Vulkan driver

- Passes 100% of dEQP-VK conformance test suite
- Vulkan 1.1 mandatory features only
- x86 and ARM, 32 bit and 64 bit
- WSI for desktop and mobile



Future directions

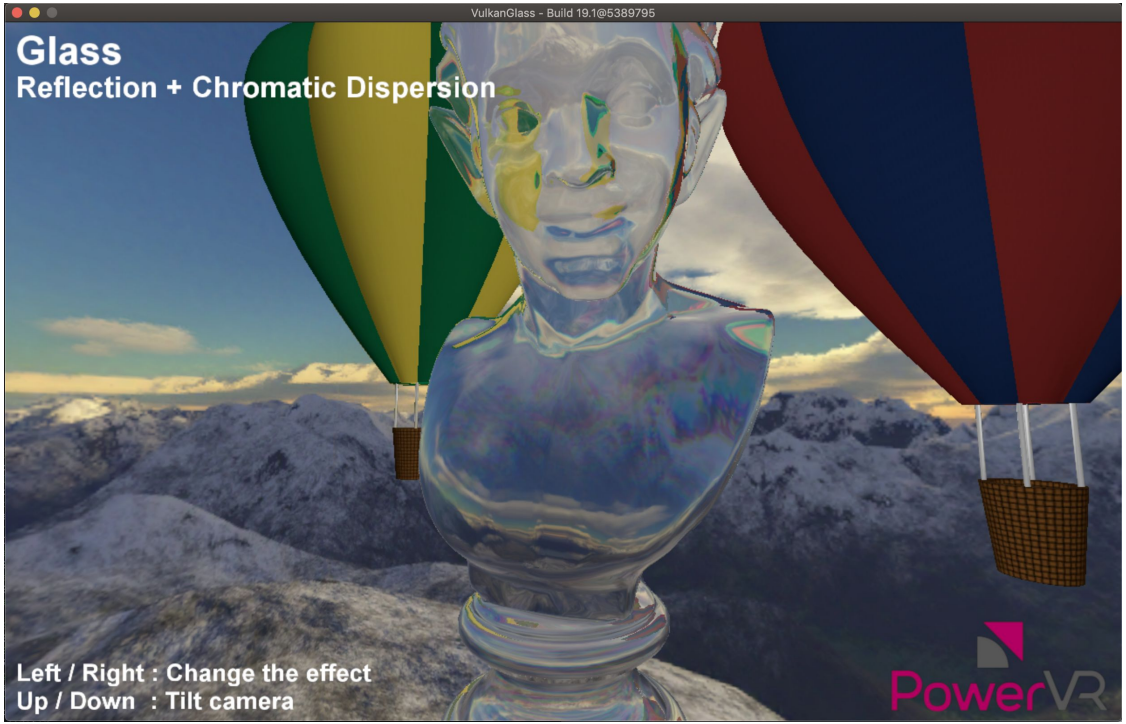
- PERFORMANCE!
- Tight integration with ANGLE
  - Short term, Vulkan features required by ANGLE for OpenGL ES 2.0 and 3.0 translation
  - Longer term, adding features required for OpenGL ES 3.1 and 3.2
- Integration into Chromium
  - Chromium Vulkan backend tests on build bots
  - ANGLE on SwiftShader Vulkan as WebGL fallback
  - SwiftShader Vulkan as Dawn (WebGPU) fallback
- Android
  - Tests on SwiftShader Vulkan

Highlights of using SwiftShader Vulkan

- Rapid prototyping of a new Vulkan feature
- Building with sanitizers (like ASAN or TSAN) to let fuzzers find cracks in the implementation/spec and improve test coverage
- Platform-independent shader debugging
- Finding bugs in applications making assumptions about available features
- macOS support
- Ability to test dEQP in under 15 minutes on a single (powerful) workstation

Conclusion

Conformant, consistent, hardware-independent results on Windows, Linux, macOS, Android, Fuchsia on x86, ARM, and more



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