Vulkanised 2026

The 8th Vulkan Developer Conference
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KosmicKrisp: Conformant Vulkan for Apple Hardware

Richard Wright, LunarG

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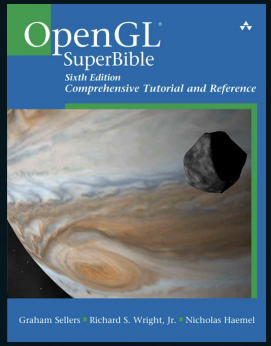

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  - Windows/macOS/Linux/iOS/Android
- Joined LunarG 6+ years ago
  - Part of the Vulkan SDK team at LunarG
  - "Apple Champion" at LunarG
  - KosmicKrisp Cheerleader

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My Agenda is to show you:

- Why you should care about the Apple market
- That Vulkan on Apple hardware works great
- Why KosmicKrisp may work for you
- How to get & use KosmicKrisp
- How to support the widest range of Apple hardware

Don’t ignore the Apple market!

- There are 1.56 billion people actively using an iPhone and about 700 million with iPads.
  (27%–28% vs 71%–73%)
- There are over 500 million people on Mac laptops/Desktops
  (15% vs 70%–22%)
- 2.35 Billion+ Active devices

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- The Mac Vulkan SDK downloads Rivals/exceeds Linux

Writing Cross Platform code has challenges

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- Wouldn’t it be nice if you didn’t have to port your rendering code?
- TADA: That’s kind of the whole point of Vulkan?

The State of Vulkan on Apple devices

- No “native” Vulkan driver on macOS?

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  - KosmicKrisp
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- We layer Vulkan over Metal instead
  - KosmicKrisp
  - MoltenVK
- This “driver” is included in your app bundle

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Hot Tips

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  - Don’t assume compute is always a win…
- Screen Scaling may be a win – you do not have to render at retina resolutions

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  - RenderDoc requires Vulkan conformant implementation
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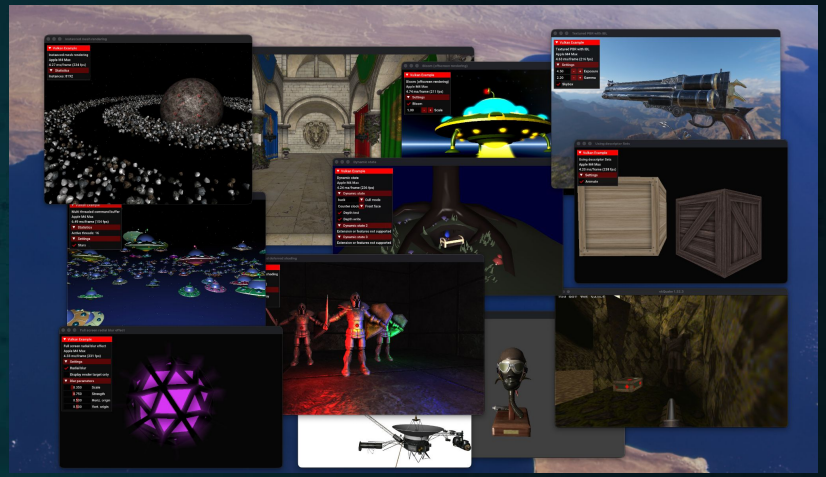
- No more Portability extension...

KosmicKrisp Roadmap

- 1.3 conformant now
- Part of Mesa 3D – so moving forward quickly
- Apple Silicon Only
- macOS 26+
- Metal 4
- 3–6 month priority list
  - Tessellation/Geometry
  - Performance
  - 1.4 Conformance
  - Shader objects and descriptor heap
- Debug features (RenderDoc!)
- iOS support



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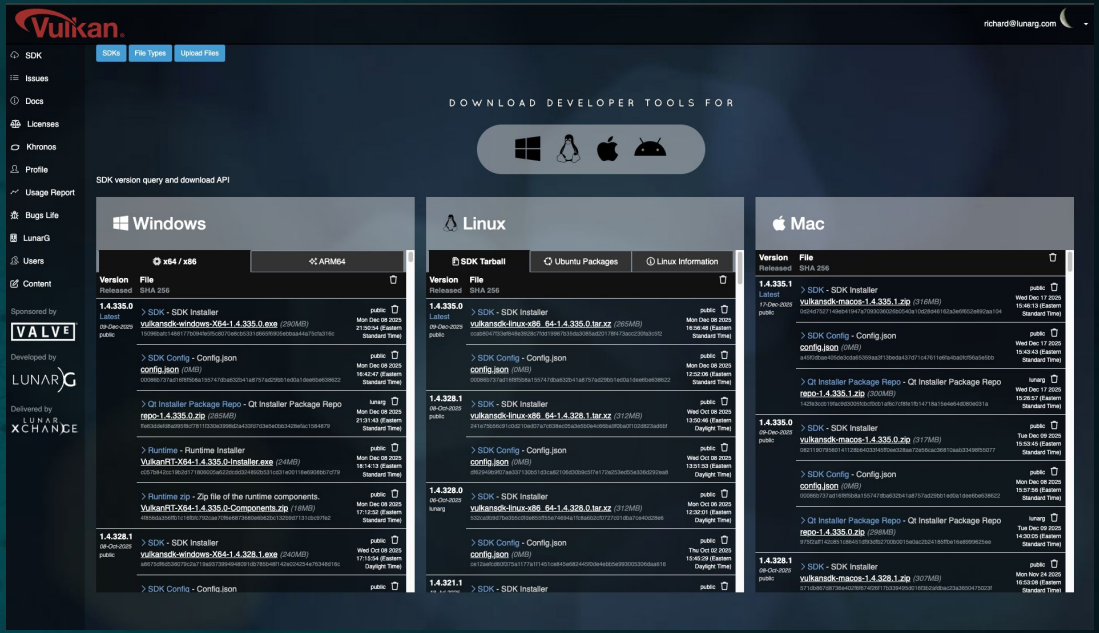
Where do we get these “drivers”?

Included in the Vulkan SDK available free at: vulkan.lunarg.org



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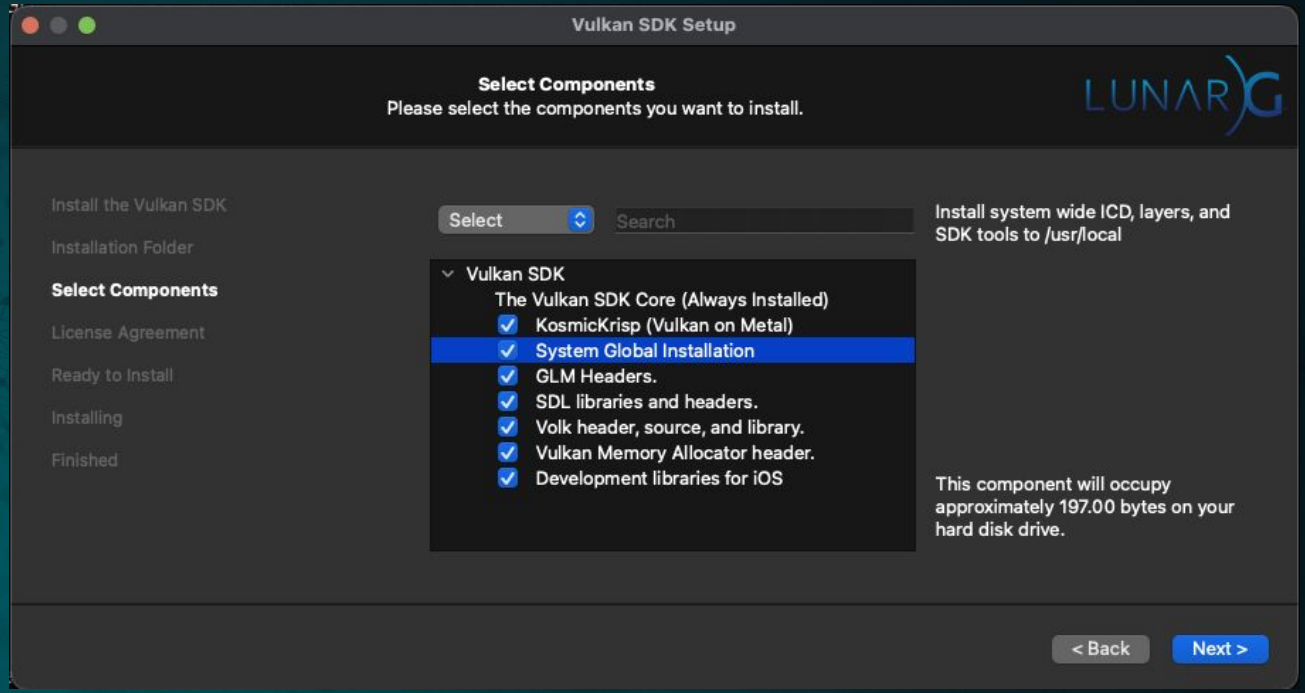
System Wide Loader/ICD*



*For developers only – not end users!

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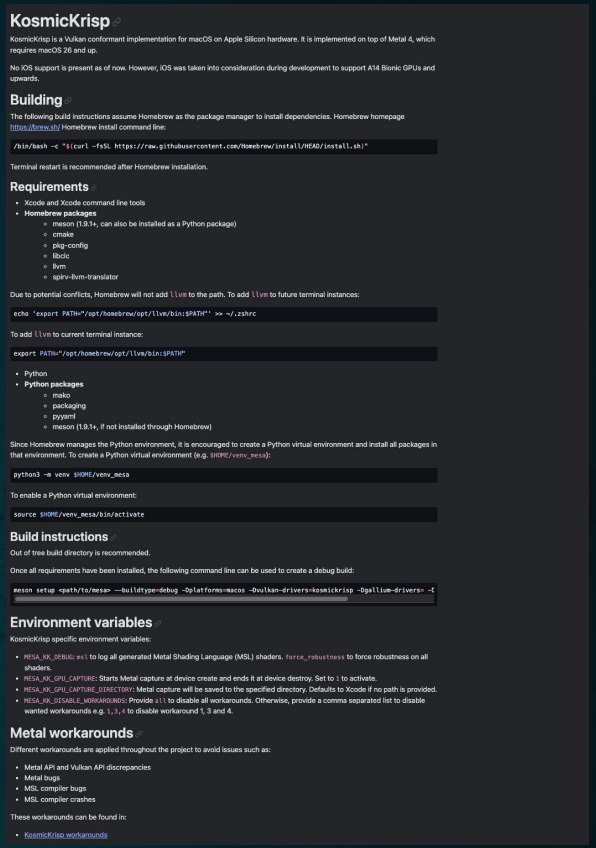
Build it yourself!

https://docs.mesa3d.org/drivers/kosmickrisp.html



KosmicKrisp

KosmicKrisp is a Vulkan conformant implementation for macOS on Apple Silicon hardware. It is implemented on top of Metal 4, which requires macOS 26 and up.

No iOS support is present as of now. However, iOS was taken into consideration during development to support A14 Bionic GPUs and upwards.

Building

The following build instructions assume Homebrew as the package manager to install dependencies. Homebrew homepage https://brew.sh/ Homebrew install command line:

```
/bin/bash -c "$(curl -fsSL https://raw.githubusercontent.com/Homebrew/install/HEAD/install.sh)"
```

Terminal restart is recommended after Homebrew installation.

Requirements

- Xcode and Xcode command line tools
- **Homebrew packages**
  - meson (1.9.1+, can also be installed as a Python package)
  - cmake
  - pkg-config
  - libclc
  - llvm
  - spirv-llvm-translator

Due to potential conflicts, Homebrew will not add `llvm` to the path. To add `llvm` to future terminal instances:

```
echo 'export PATH="/opt/homebrew/opt/llvm/bin:$PATH"' >> ~/.zshrc
```

To add `llvm` to current terminal instance:

```
export PATH="/opt/homebrew/opt/llvm/bin:$PATH"
```

- Python
- **Python packages**
  - mako
  - packaging
  - pyyaml
  - meson (1.9.1+, if not installed through Homebrew)

Since Homebrew manages the Python environment, it is encouraged to create a Python virtual environment and install all packages in that environment. To create a Python virtual environment (e.g. `$HOME/venv_mesa`):

```
python3 -m venv $HOME/venv_mesa
```

To enable a Python virtual environment:

```
source $HOME/venv_mesa/bin/activate
```

Build instructions

Out of tree build directory is recommended.

Once all requirements have been installed, the following command line can be used to create a debug build:

```
meson setup <path/to/mesa> --buildtype=debug -Dplatforms=macos -Dvulkan-drivers=kosmickrisp -Dgallium-drivers= -D
```

Environment variables

KosmicKrisp specific environment variables:

- `MESA_KK_DEBUG`: `msl` to log all generated Metal Shading Language (MSL) shaders. `force_robustness` to force robustness on all shaders.
- `MESA_KK_GPU_CAPTURE`: Starts Metal capture at device create and ends it at device destroy. Set to `1` to activate.
- `MESA_KK_GPU_CAPTURE_DIRECTORY`: Metal capture will be saved to the specified directory. Defaults to Xcode if no path is provided.
- `MESA_KK_DISABLE_WORKAROUNDS`: Provide `all` to disable all workarounds. Otherwise, provide a comma separated list to disable wanted workarounds e.g. `1,3,4` to disable workaround 1, 3 and 4.

Metal workarounds

Different workarounds are applied throughout the project to avoid issues such as:

- Metal API and Vulkan API discrepancies
- Metal bugs
- MSL compiler bugs
- MSL compiler crashes

These workarounds can be found in:

- KosmicKrisp workarounds

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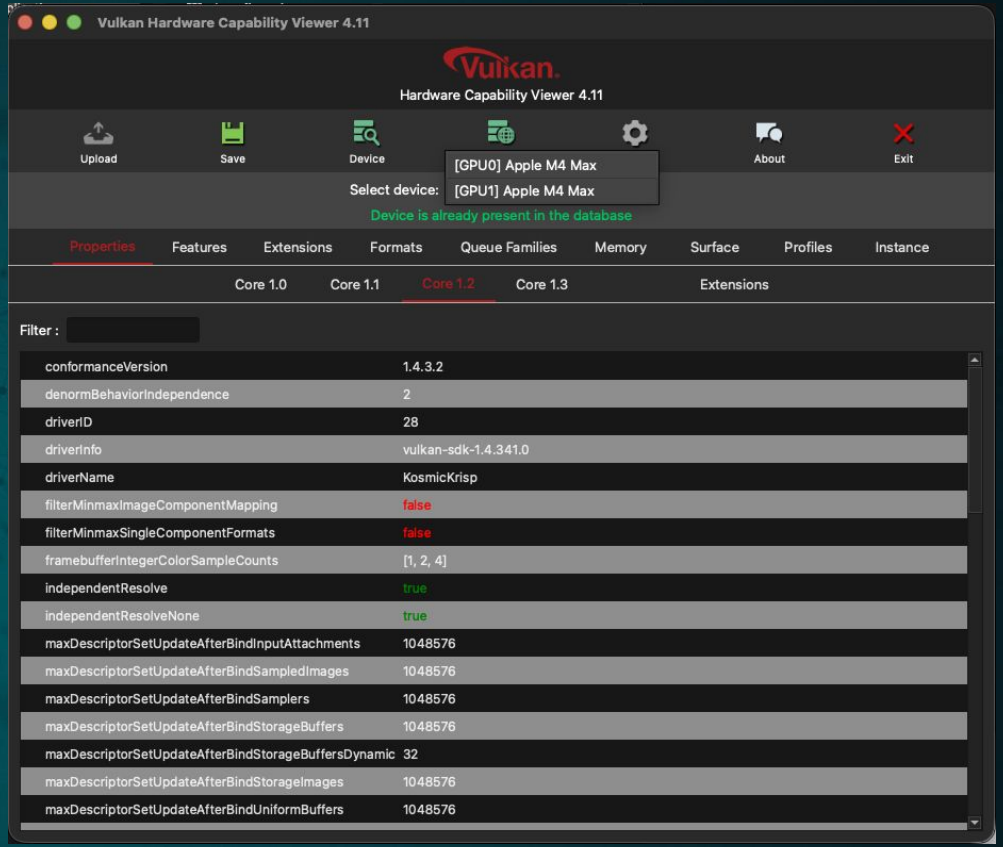
Hardware Caps Viewer



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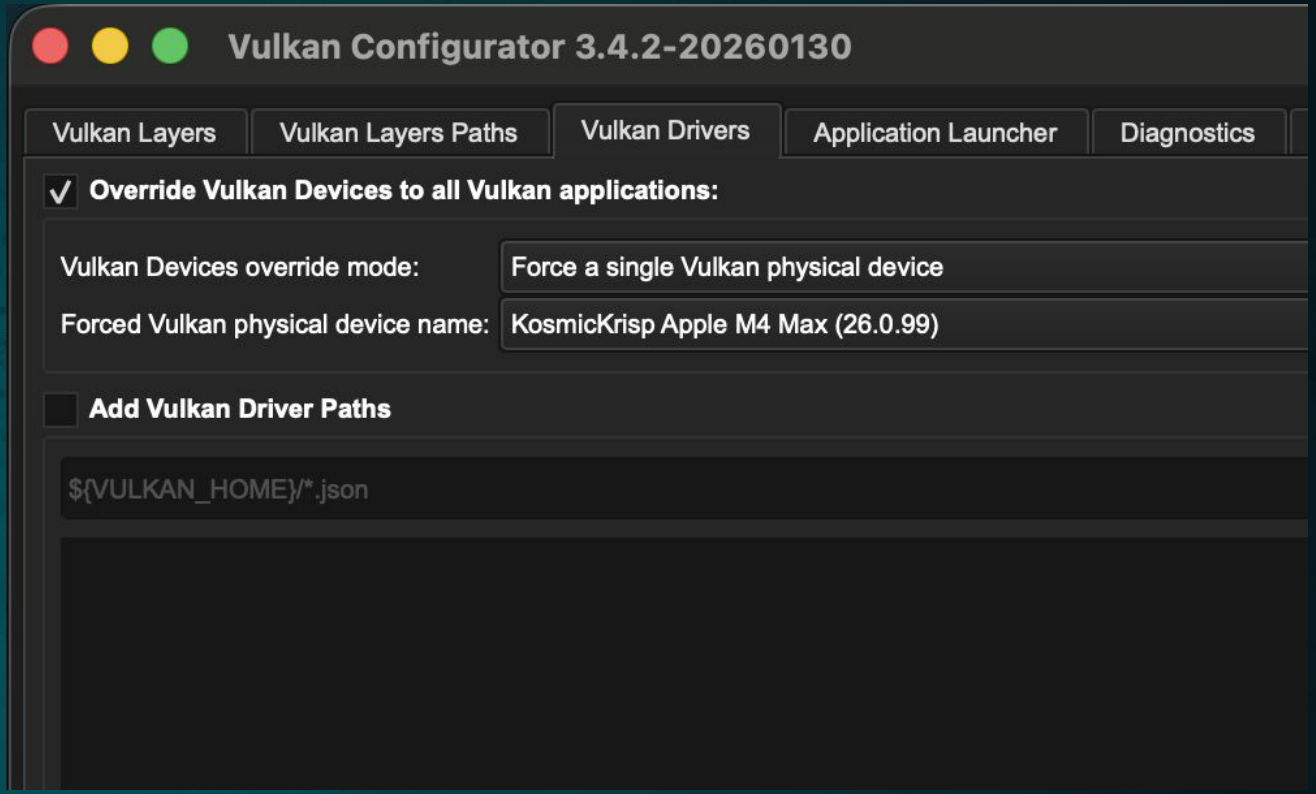
Vulkan Configurator



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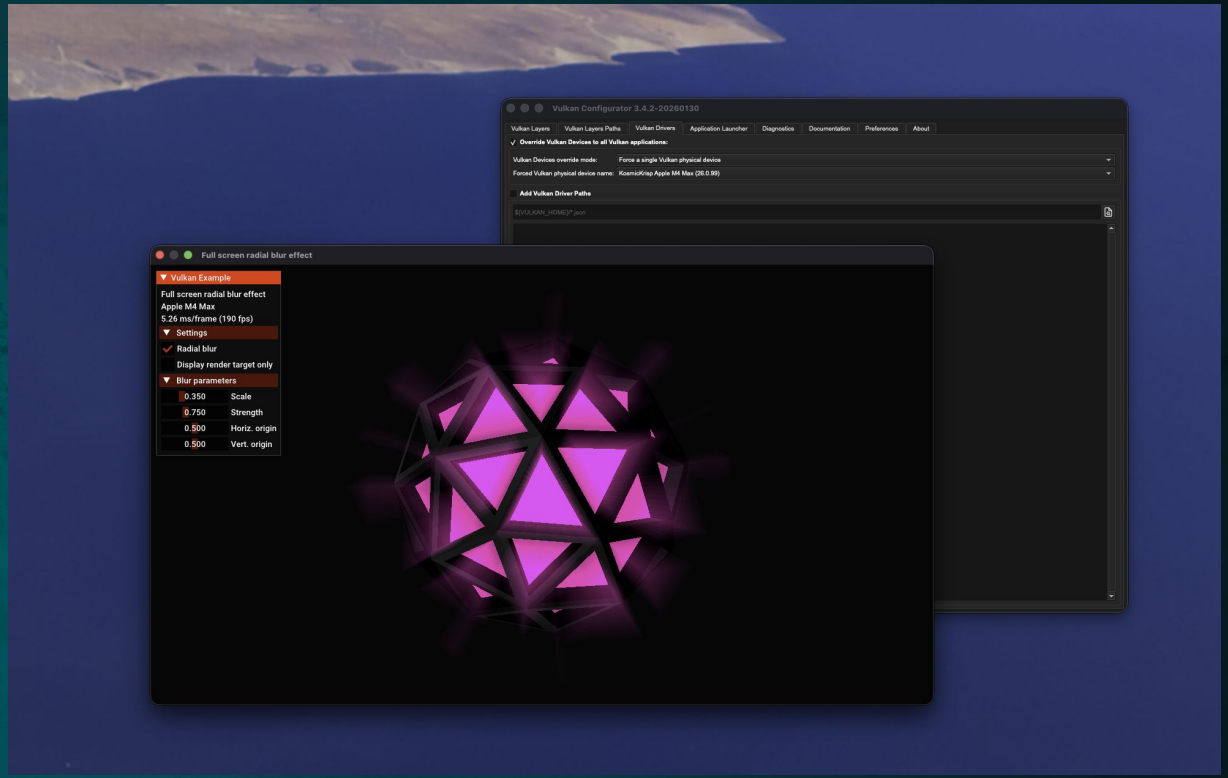

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Android Emulator*

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- Motivation? – Android Emulator on macOS

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Android Emulator*

- Primary funding is from Google
- Motivation? – Android Emulator on macOS
  - Vulkan is the deFacto graphics stack now on Android
  - Via Angle -> GUI and all OpenGL ES games are now basically Vulkan
  - For the emulator on macOS – Vulkan can be implemented by KosmicKrisp

*Not public yet

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Shipping Vulkan on Apple

```
VulkanRocks.app
    /Contents
        /Frameworks
            libvulkan_kosmickrisp.dylib
            libvulkan.1.[version number].dylib
            libvulkan.1.dylib -> libvulkan.1.[version number].dylib
        /MacOS
            VulkanRocks
        /Resources
            /vulkan
                /icd.d
                    libkosmickrisp_icd.json
```


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Shipping Vulkan(s) on Apple

```
VulkanRocks.app
    /Contents
        /Frameworks
            libvulkan_kosmickrisp.dylib
            libMoltenVK.dylib
            libvulkan.1.[version number].dylib
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Why not both?

- You could target Intel HW with MoltenVK
- Target Apple Silicon with KosmicKrisp

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- You could target Intel HW with MoltenVK
- Target Apple Silicon with KosmicKrisp
- iOS support is coming…
- Watch Portability enumeration & Portability Subset
  - KosmicKrisp implements neither of these
  - It doesn't need them

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No more of THIS!

```
VkInstanceCreateInfo inst_info = {};
std::vector<const char*> m_requiredExtensions;
        . . .
#ifdef __APPLE__

m_requiredExtensions.push_back(VK_KHR_PORTABILITY_ENUMERATION_EXTENSION_NAME);
inst_info.flags |= VK_INSTANCE_CREATE_ENUMERATE_PORTABILITY_BIT_KHR;

#endif
        . . .
        . . .
```

Why not both?

VK_KHR_portability_enumeration

VK_KHR_portability_subset

If you do not include these extensions, the loader will only see KosmicKrisp. This is normal behavior outside macOS, but MoltenVK is a “portability implementation”. Enable this only if present and no more #ifdef __APPLE__

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- There are TWO good Vulkan implementations for Apple
- KosmicKrisp is likely to be the defacto standard soon for Apple Silicon on all devices
- MoltenVK will remain relevant for quite some time – and you can eat your cake and have it too – ship both of them!

Worms in the Apple?

Report issues to Mesa3D repository

Prefix “kk: title” so it stands out

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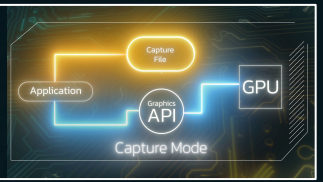
POWER YOUR SUCCESS

Thank you –
KHRONOS GROUP

KosmicKrisp

Come to the LunarG Table!

See KosmicKrisp & GFXReconstruct



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