

Vulkanised 2026

The 8th Vulkan Developer Conference
San Diego, USA | February 9-11, 2026

KosmicKrisp: Conformant Vulkan for Apple Hardware

Richard Wright, LunarG

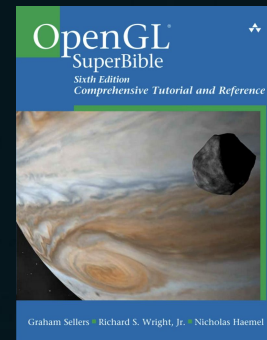


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 - Windows/macOS/Linux/iOS/Android
- Joined LunarG 6+ years ago
 - Part of the Vulkan SDK team at LunarG
 - "Apple Champion" at LunarG
 - KosmicKrisp Cheerleader



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%–72%)
- 2.35 Billion+ Active devices

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- 2.35 Billion+ Active devices
- The Mac Vulkan SDK downloads Rivals/exceeds Linux

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- Programming languages
- All sorts of OS/Device idiosyncrasies
- 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
 - MoltenVK
- This “driver” is included in your app bundle



Hot Tips

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 - See if you can't accomplish what you want in the vertex/fragment shaders
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- Screen Scaling may be a win – you do not have to render at retina resolutions

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 - Apple hardware consumes MSL
 - SPIRV → MSL becomes much more sane
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- Bindless design from the outset
- 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

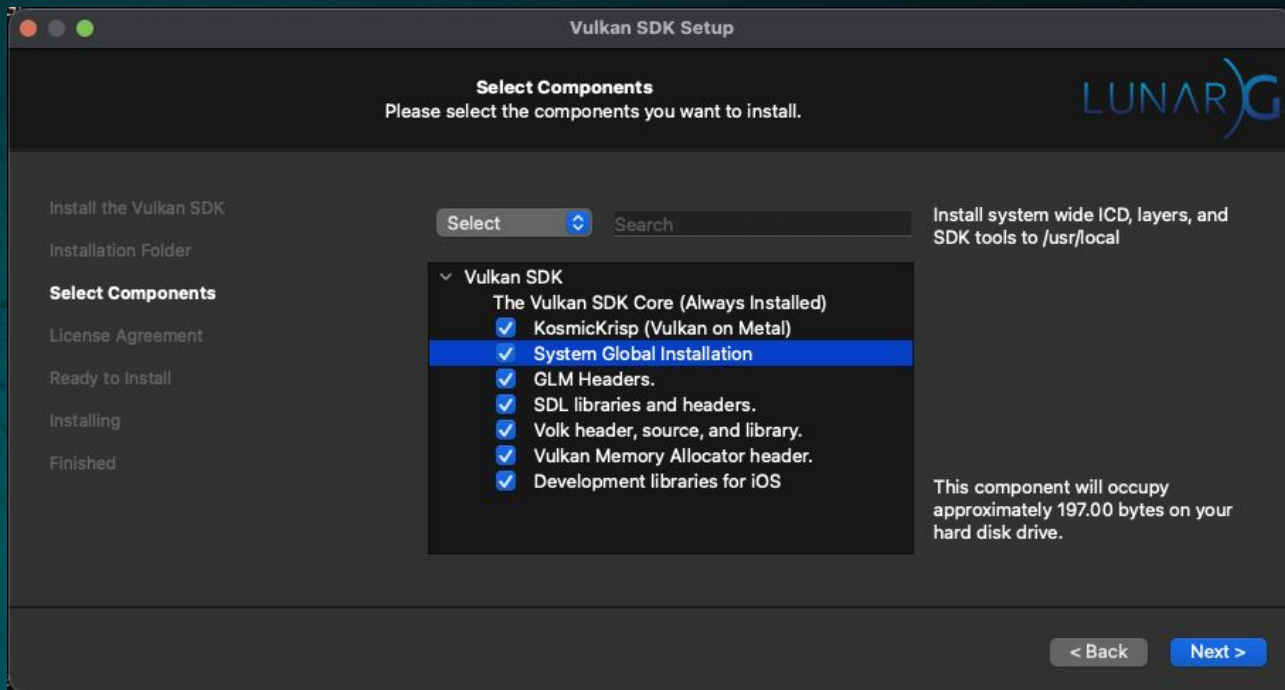


Where do we get these "drivers"?

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

The screenshot shows the Vulkan SDK website interface. At the top, there's a navigation bar with 'SDKs', 'File Types', and 'Upload Files'. Below that, a section titled 'DOWNLOAD DEVELOPER TOOLS FOR' features icons for Windows, Linux, and Mac. The main content area is divided into three columns: Windows, Linux, and Mac. Each column contains a table of available SDK versions with columns for 'Version', 'File', 'Released', and 'SHA 256'. The Windows column lists versions like 1.4.335.0 and 1.4.328.1. The Linux column lists versions like 1.4.335.0 and 1.4.328.1. The Mac column lists versions like 1.4.335.0 and 1.4.328.1. The website also includes a sidebar with navigation options like 'Issues', 'Docs', 'Licenses', and 'Users', and a footer with the LUNAR logo.

System Wide Loader/ICD*



*For developers only – not end users!

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 (3.9+, can also be installed as a Python package)
 - cmake
 - pkg-config
 - libdc
 - bin
 - 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=\"$PATH:/opt/homebrew/opt/llvm/bin:$PATH" >> ~/.zshrc
```

To add LLVM to current terminal instance:

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

- Python
 - meso
 - packaging
 - PyYAML
 - meson (3.9+, 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. `SHIMVENV_MESA`):

```
python3 -m venv $SHIMVENV_MESA
```

To enable a Python virtual environment:

```
source $SHIMVENV_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=/mesa --buildtype=debug --platform=macos --vulkan-drivers=kosmickrisp --gallium-drivers=--C
```

Environment variables

KosmicKrisp specific environment variables:

- `MESA_KK_DEBUG=1` 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 a 1 to disable all workarounds. Otherwise, provide a comma separated list to disable wanted workarounds (e.g. 1,3). 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:

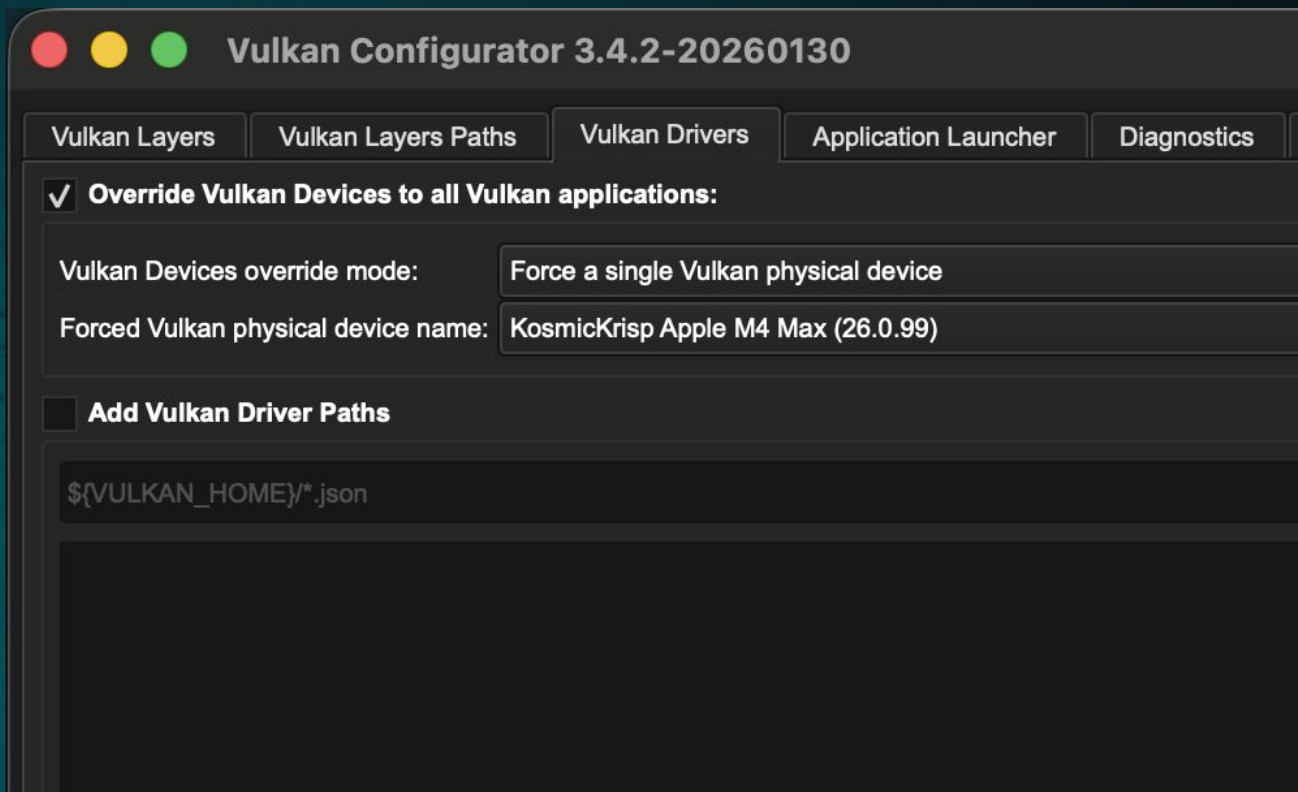
- `KosmicKrisp/workarounds`

Hardware Caps Viewer

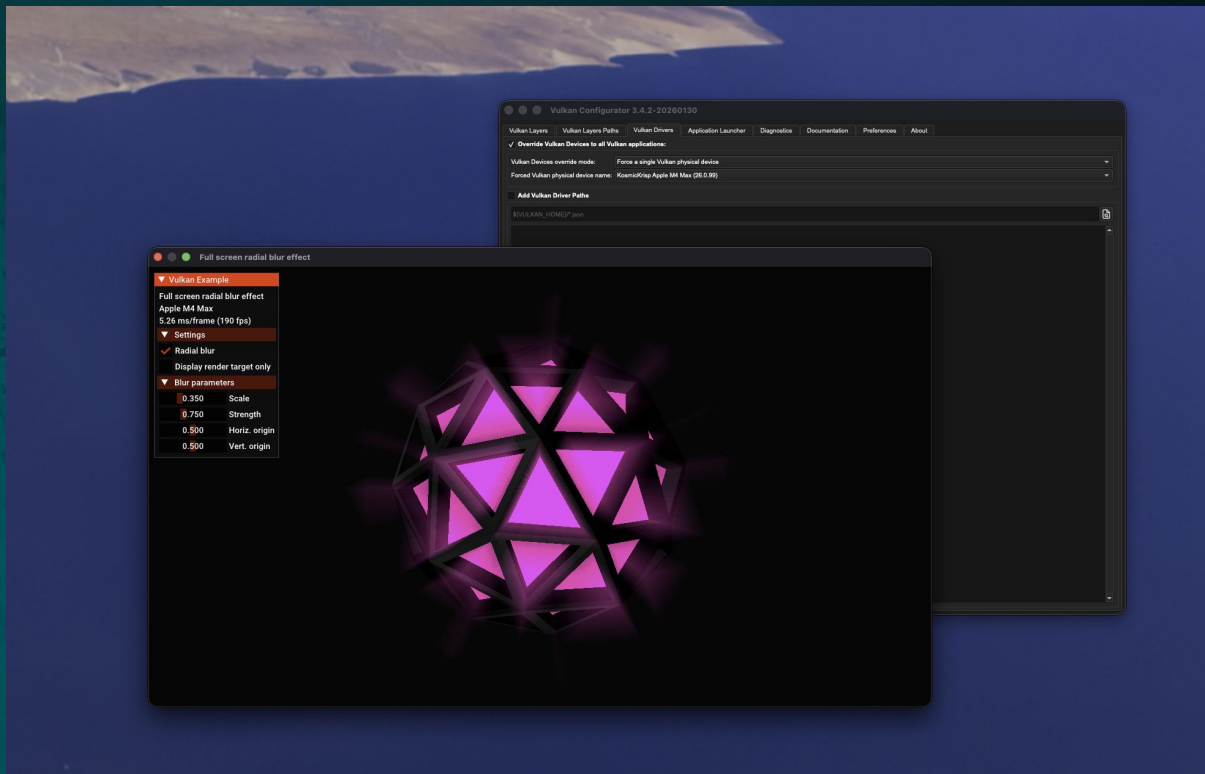
The screenshot shows the Vulkan Hardware Capability Viewer 4.11 application. The title bar reads "Vulkan Hardware Capability Viewer 4.11". The main window features the Vulkan logo and the text "Hardware Capability Viewer 4.11". A toolbar contains icons for Upload, Save, Device, a globe icon, Settings, About, and Exit. The "Device" menu is open, showing two options: "[GPU0] Apple M4 Max" and "[GPU1] Apple M4 Max". A tooltip below the menu states "Device is already present in the database". Below the toolbar is a navigation bar with tabs: Properties (selected), Features, Extensions, Formats, Queue Families, Memory, Surface, Profiles, and Instance. Under "Features", "Core 1.2" is selected. A "Filter:" input field is present. The main content area displays a list of hardware capabilities with their values:

conformanceVersion	1.4.3.2
denormBehaviorIndependence	2
driverID	28
driverInfo	vulkan-sdk-1.4.341.0
driverName	KosmicKrisp
filterMinmaxImageComponentMapping	false
filterMinmaxSingleComponentFormats	false
framebufferIntegerColorSampleCounts	[1, 2, 4]
independentResolve	true
independentResolveNone	true
maxDescriptorSetUpdateAfterBindInputAttachments	1048576
maxDescriptorSetUpdateAfterBindSampledImages	1048576
maxDescriptorSetUpdateAfterBindSamplers	1048576
maxDescriptorSetUpdateAfterBindStorageBuffers	1048576
maxDescriptorSetUpdateAfterBindStorageBuffersDynamic	32
maxDescriptorSetUpdateAfterBindStorageImages	1048576
maxDescriptorSetUpdateAfterBindUniformBuffers	1048576

Vulkan Configurator



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Android Emulator*

- Primary funding is from Google



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- 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

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
```

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 KosmickKrisp
- iOS support is coming...
- Watch Portability enumeration & Portability Subset
 - KosmickKrisp implements neither of these
 - It doesn't need them



The slide features a dark orange background with a subtle pattern of interconnected nodes. At the top, the text 'Vulkanised 2024' is displayed in a white, stylized font. To the right, smaller text reads 'The 6th Vulkan Developer Conference Sunnyvale, California | February 5-7, 2024'. The main title 'Vulkan Development for Apple Desktops & Devices' is centered in white. Below this, the speaker's name 'Richard Wright, LunarG' is listed. A QR code is positioned to the left of the presentation URL 'https://bit.ly/3Hngbm9'. A small portrait of Richard Wright is shown on the right side of the slide.

Vulkanised 2024 The 6th Vulkan Developer Conference
Sunnyvale, California | February 5-7, 2024

Vulkan Development for Apple Desktops & Devices

Richard Wright, LunarG

QR Code

Presentation:
<https://bit.ly/3Hngbm9>



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__`

Kosmic Conclusion

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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!

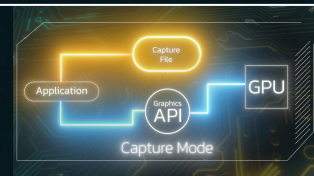
Worms in the Apple?

Report issues to Mesa3D repository

Prefix "kk: title" so it stands out



Come to the LunarG Table!
See KosmicKrisp & GFXReconstruct



Take the 2026 Vulkan
Ecosystem Survey!



LunarG Presentations
Vulkanised 2026



LunarG Presentations
**Shading Languages
Symposium 2026**



