Vulkanised 2025

The 7th Vulkan Developer Conference
Cambridge, UK | February 11-13, 2025

Vulkan SDK and Ecosystem: Enhancements Over the Last Year

Karen Ghavam, CEO
LunarG, Inc.

Who am I?

Karen Ghavam, CEO
LunarG, Inc.

Who is LunarG?

- An Independent, private company with Khronos membership
  - GPU Software Specialists
- Developing Vulkan Ecosystem components since 2015
  - Generous sponsorship from Valve and Google
- Vulkan Ecosystem Projects
  - Vulkan SDK
  - Vulkan Loader
  - Vulkan Validation Layers
  - Vulkan Profiles Toolset
  - Vulkan Extension Layer
  - GFXReconstruct
  - glslang
  - ...

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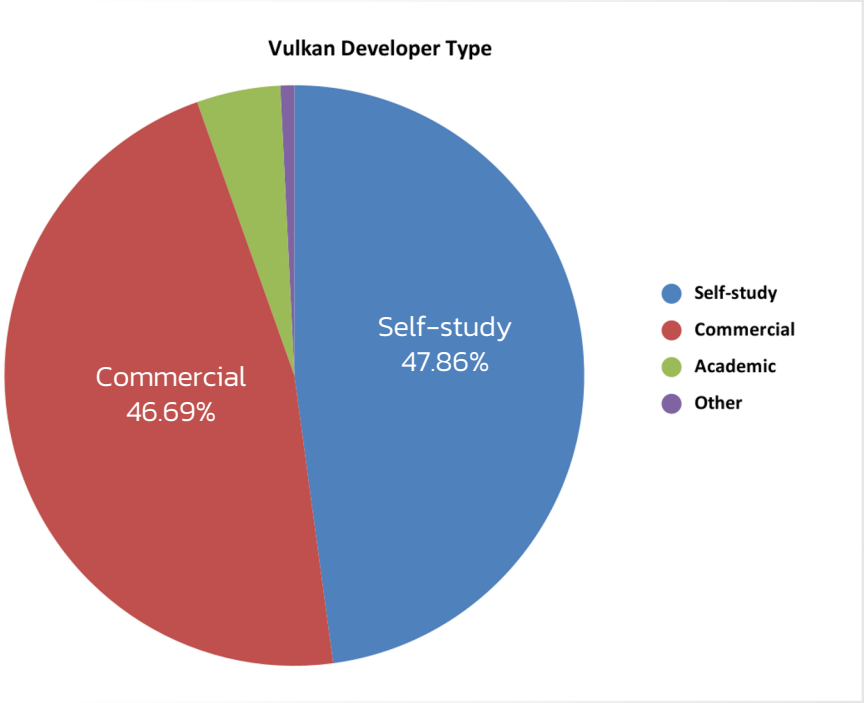
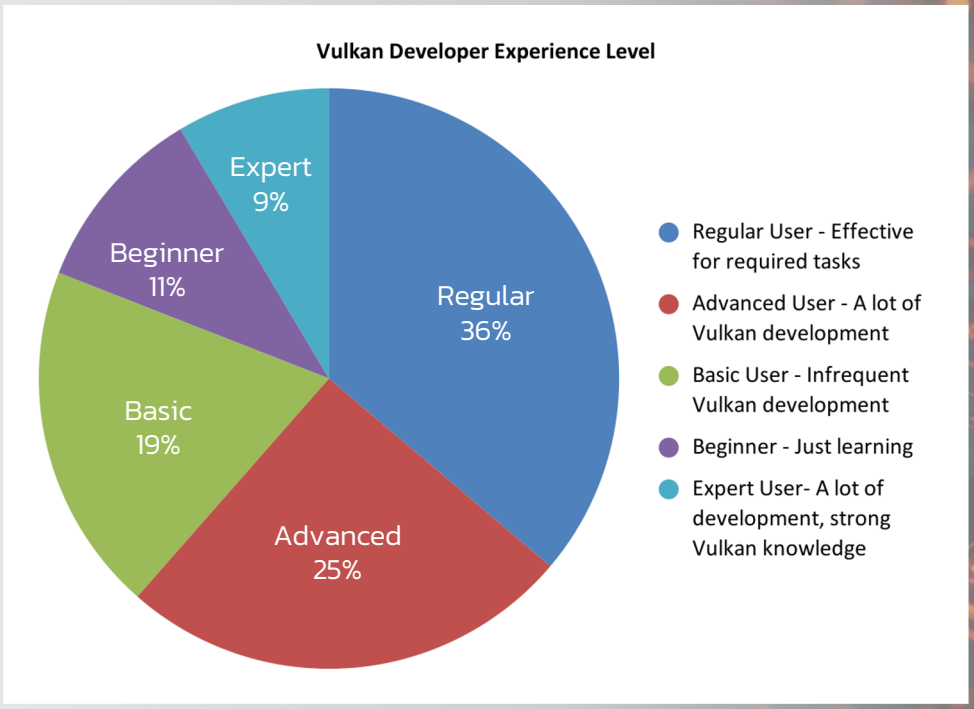
2024 Ecosystem Survey - Highlights





- 258 respondents
- 47%/48% commercial/non-commercial
- 70%/30% (regular, advanced, expert developers)/beginner developers

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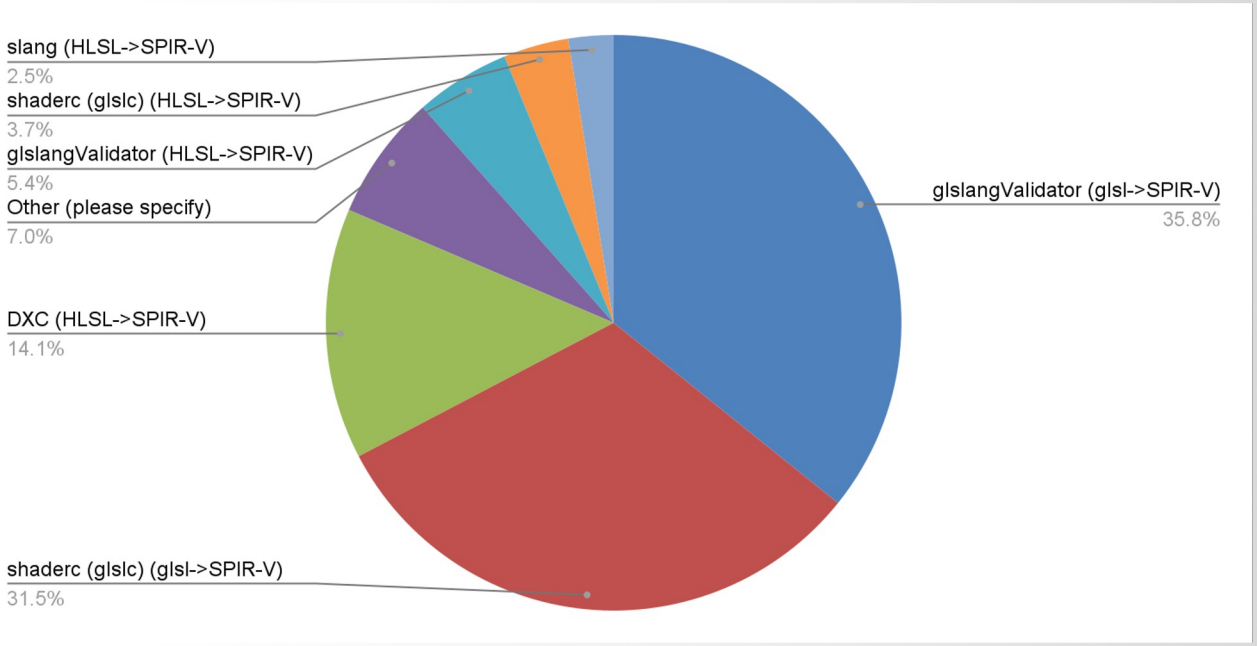
2024 Survey – Themes

- People rely on the validation layer
  - More trust that there are not defects in the validation
- Validation of synchronization extremely useful for finding application bugs
- Synchronization validation for Timeline semaphore is in high demand
- DebugPrintF is used a lot, but has not been maintained at the same level as GPU-AV recently
- Error messages can be very verbose, poorly formatted, or poorly worded
- Specific complaints about the ray tracing extension missing a lot of validation
- More timely delivery of validation layer support for new extensions
- Validation Layer error messages link to the HTML spec. SLOW TO LOAD!
- GPU crashes and timeouts very difficult to debug

2024 Survey – Shader Compiler Themes



- Shader toolchain improvements needed
  - Better options
  - Improved HLSL support
  - Next generation languages
  - DXC – complicated code base with bugs

- GLSL->SPIR-V usage is most common
  - ~67%

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2024 Survey – End of Year Progress

https://www.lunarg.com/2024-ecosystem-survey-progress-report-released/

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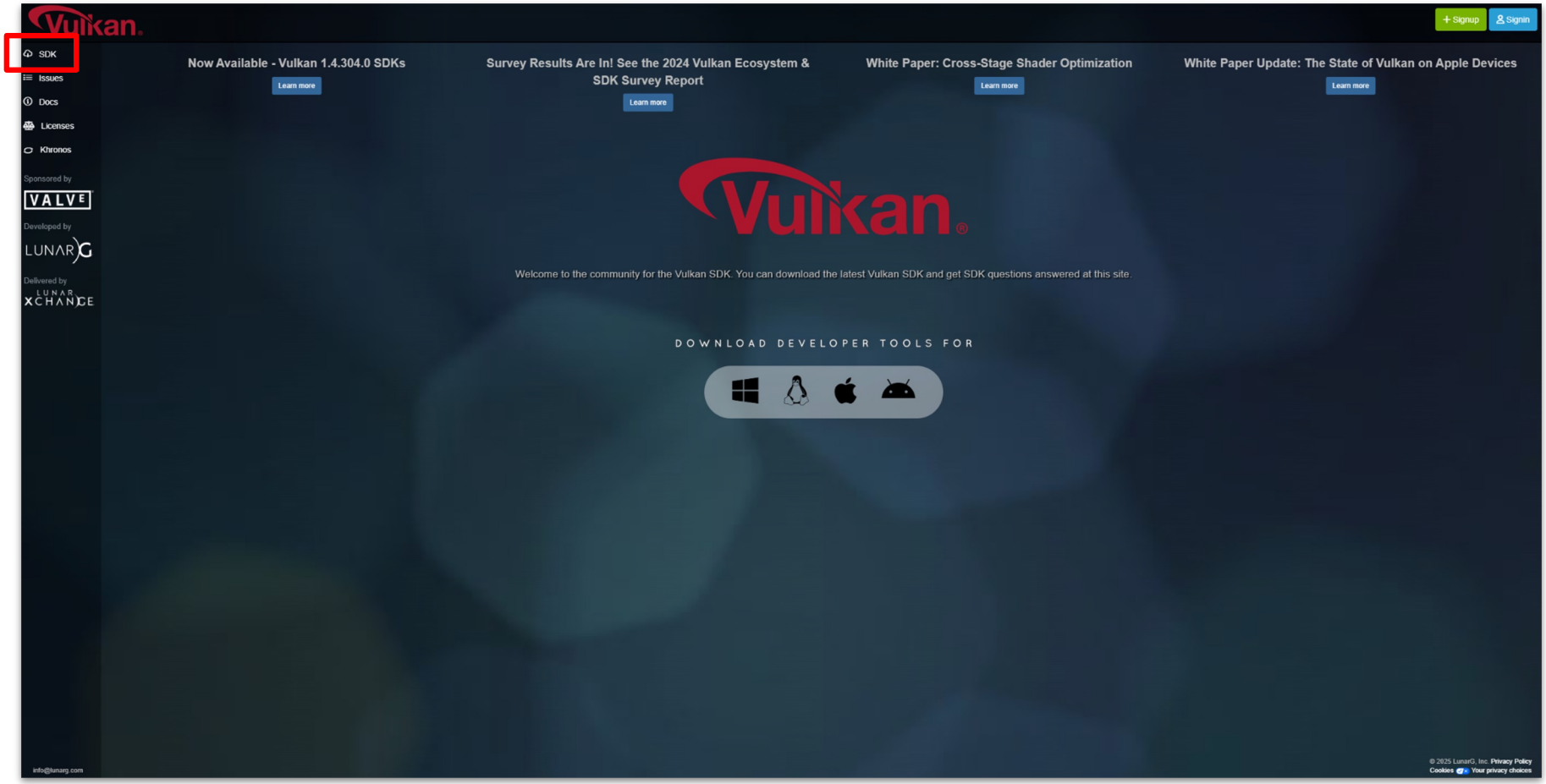
2025 Ecosystem Survey is Live!

Take the Annual Developers Survey

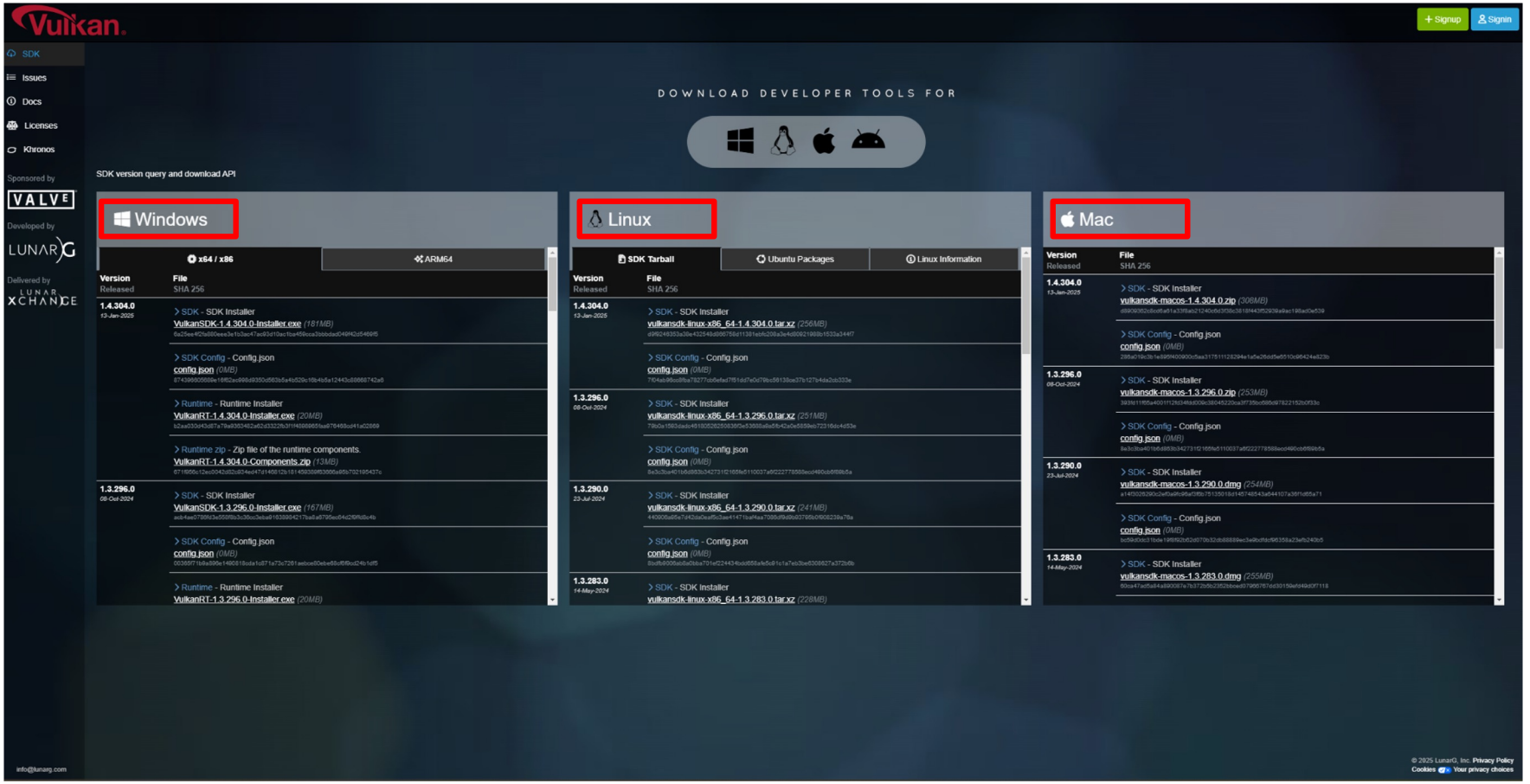
https://khr.io/1cq

The Vulkan SDK (Vulkan.lunarg.com)



Delivered by LunarG in close coordination with the Khronos Vulkan working group

The Vulkan SDK (Vulkan.lunarg.com)



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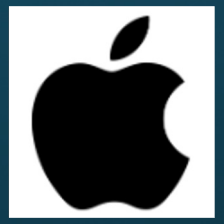
The Vulkan SDK



	Vulkan Loader	vkconfig	Validation Layer	
SPIR-V Optimizer	SPIR-V Tools	Crash Diagnostic Layer	vulkaninfo	Extension Layers
shaderc	SPIR-V Validator	Profiles Toolset	GPUInfo	VOLK
DXC	SPIR-V Reflect	glslang	SLANG	SPIR-V Cross
VKVIA	apidump	Vulkan-HPP	Screenshot	VMA
MoltenVK	SPIR-V Visualizer	SDL & GLM	Monitor	GFX Reconstruct

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Why Use the SDK?

- An installation process that is easy and fast
  - Windows (x86 & ARM), Linux, and macOS versions
- Pre-built tools installed into system locations, ready for use.
  - Tools from 22 repositories!
- Vetted and curated content to ensure compatibility and seamless integration
- Ready-to-use versions of the Vulkan Configurator
- SDK release notes and user documentation
- License Registry
  - Details ALL of the open-source licenses present in the SDK

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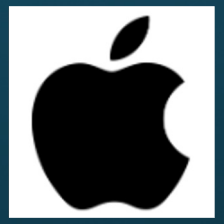
The Vulkan SDK – Windows 11 on ARM



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- Windows SDK install: "copy only" option

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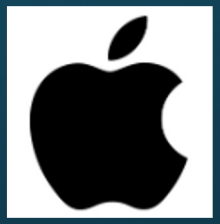
The Vulkan SDK – Ubuntu Version Upgrade

Windows

Ubuntu 22.04 & 24.04



Windows On arm

	Vulkan Loader	vkconfig	Validation Layer	
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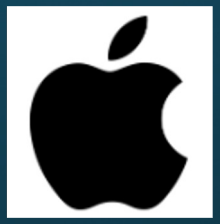
The Vulkan SDK – iOS as a Target

Windows

Ubuntu 22.04 & 24.04



iOS Support

Windows On arm

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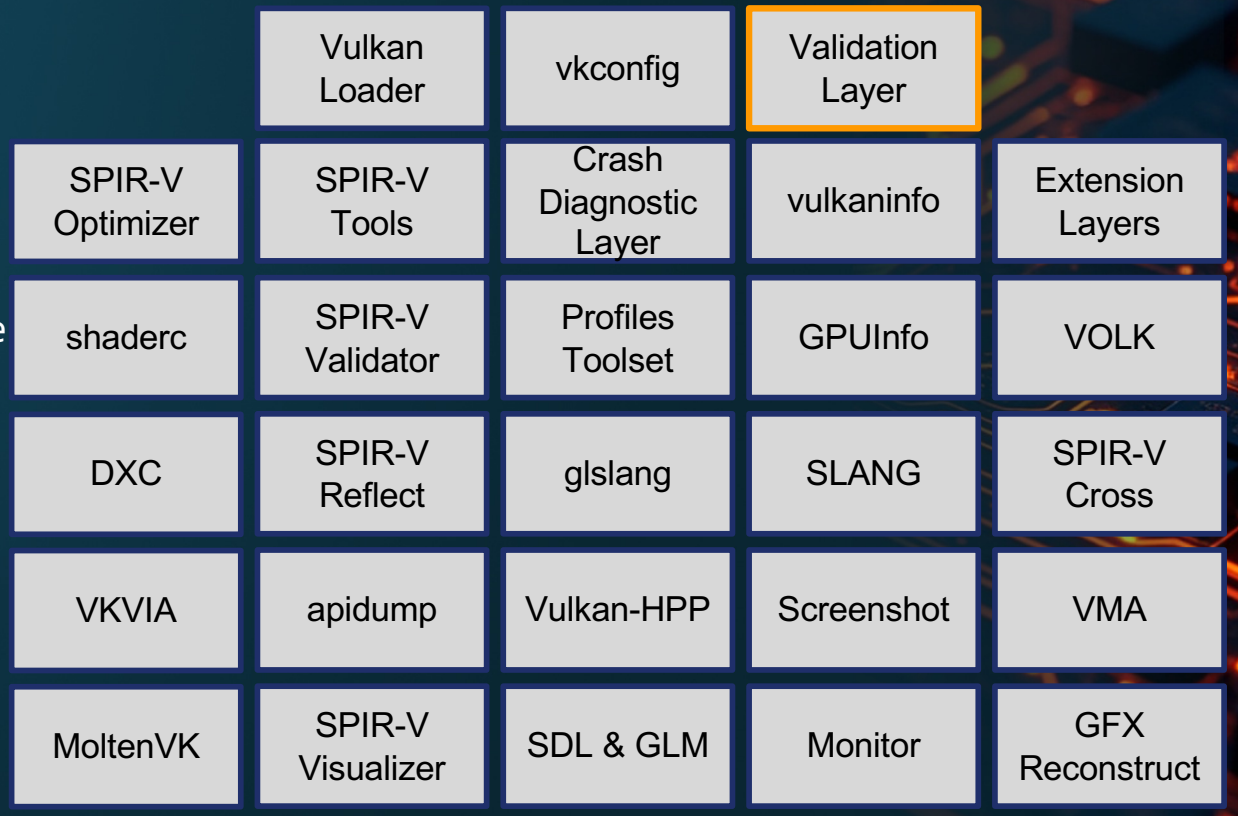
The Vulkan SDK – Validation Layer

- Synchronization Validation for VK_KHR_timeline_semaphore



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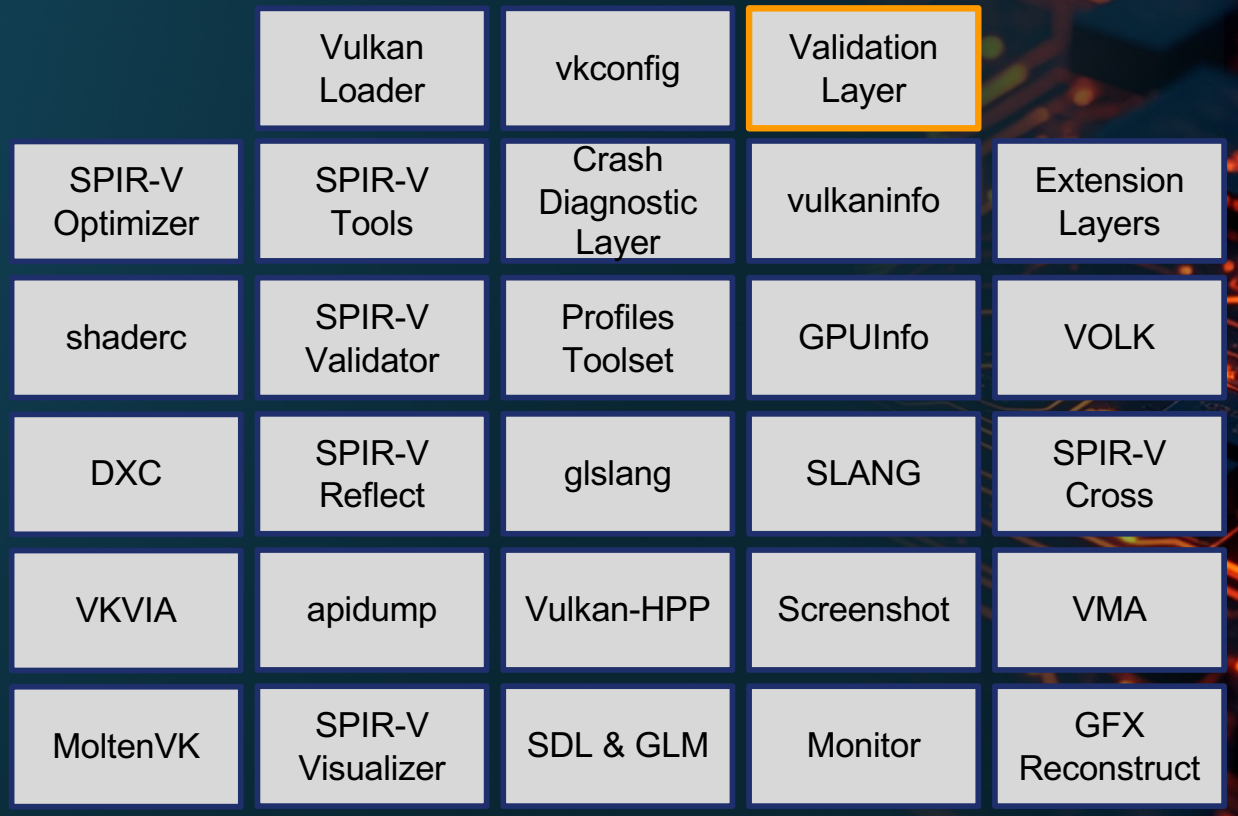
The Vulkan SDK – Validation Layer

- debugPrintf and GPU-AV can now be used simultaneously



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The Vulkan SDK – Validation Layer

- All the core validation for 1.0, 1.1, and 1.2 completed
- All CPU based ray tracing validation completed

	Vulkan Loader	vkconfig	Validation Layer	
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The Vulkan SDK – Validation Layer

- Validation support "coincident" for any new extensions

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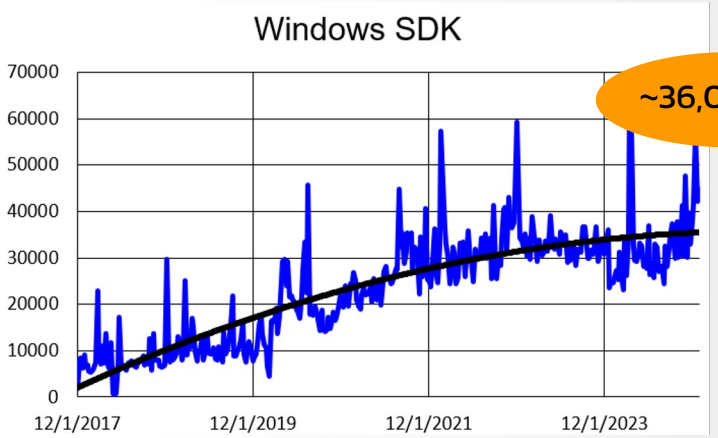
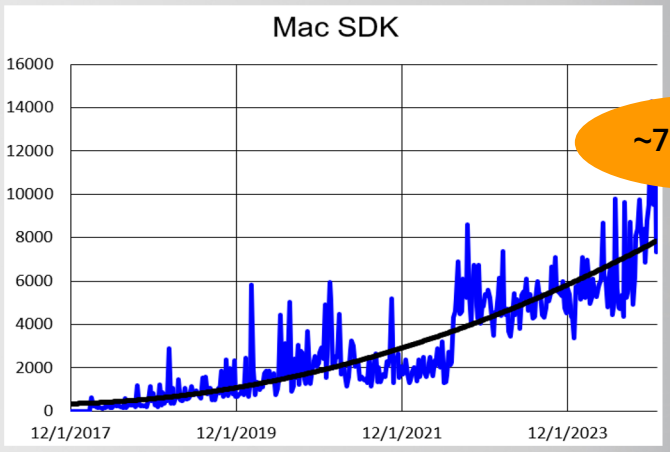
SDK Download Rates



~36,000/wk



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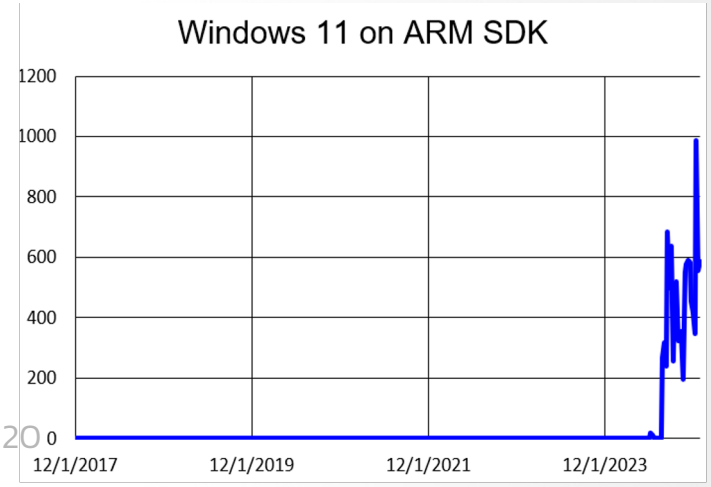

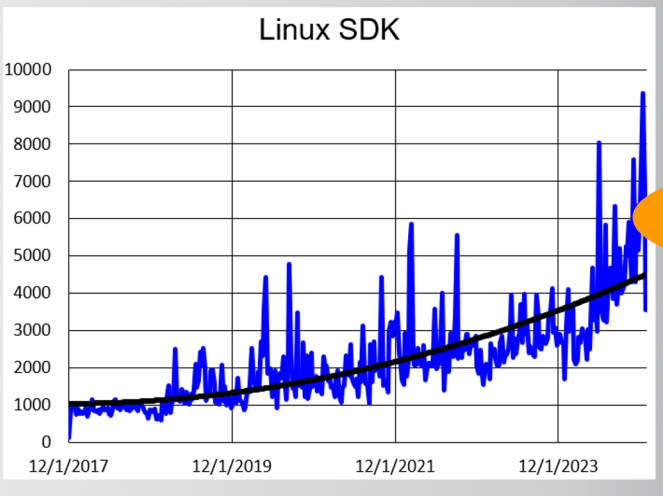

~4500/wk

Consistent Vulkan SDK Layer Settings

- Enables configuring any layer programmatically from the Vulkan application
- Three approaches to layer configuration
  - Vulkan Configurator
  - Environment variables
  - Programmatically with VK_KHR_layer_settings
- Consistent behavior across SDK Layers
  - Validation layer
  - Extension Layers
  - Profiles Layer
  - LunarG utility layers (apidump, etc)

Documentation: https://github.com/KhronosGroup/Vulkan-Utility-Libraries/blob/main/README.md

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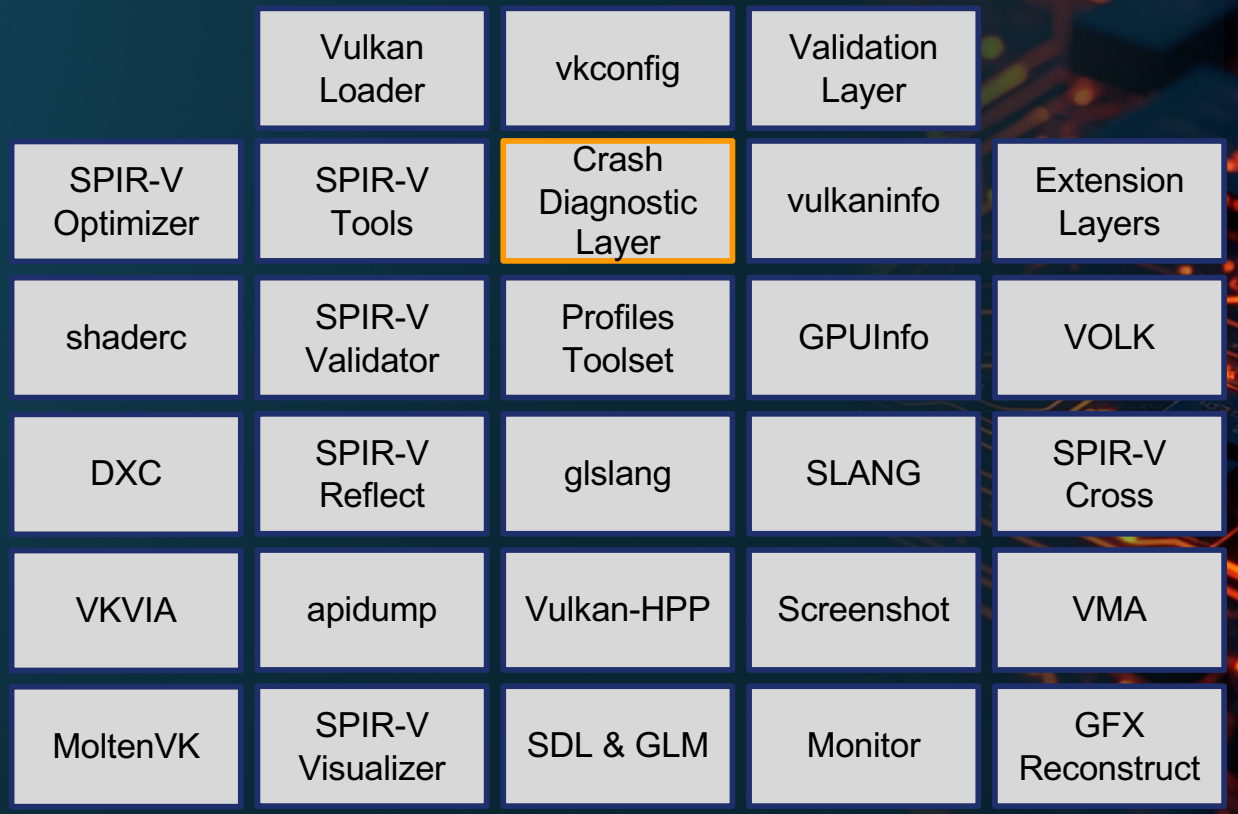
The Vulkan SDK – Crash Diagnostic Layer

- GPU crash and hang debugging
- Command buffer instrumentation with completion checkpoints
- Dump file
- Strong user demand
  Debugging Device Lost errors very difficult!



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The Vulkan SDK – SLANG

- Slang shading language and compiler
  - SPIR-V
  - HLSL
  - GLSL
  - WGSL for WebGPU
  - Metal Shading Language

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Compiler Explorer (Godbolt.org)

- Online tool
  - Write code in various programming languages
  - See the resulting assembly code in real-time
- LunarG (Spencer) added support for
  - GLSL
  - spirv-opt
  - spirv-val
  - spirv-reflect
  - slang!

Blog post:
https://shader-slang.com/blog/2024/12/17/slang-support-in-godbolt/

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1.4.304.0 Vulkan SDK

- Live January 14, 2025
- Windows – Automatic installation of SDK version of Vulkan Loader
- glslang shared library
- Addition of GFXReconstruct to the macOS SDK
- 32-bit versions of the Vulkan layers have been removed
  - A 32 bit runtime (Vulkan Loader, vulkaninfo) is still included

1.4.304.1 Vulkan SDK

- Just Released!
- Three really cool enhancements:
  - Portable Ray tracing support in GFXReconstruct
  - Fast loading of Vulkan Specification from SDK Validation Layer
  - Vulkan Configurator 3

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Portable Ray Tracing

- What is Portable Ray Tracing?
  - Tracking at capture time, then translated at replay time for device independence:
    - Buffer Device Addresses
    - Shader Group Handles
    - Acceleration Structures
- How is this useful for the Vulkan application developer?
  - Bug-reporting across different vendors/drivers
- Additional benefit of portable raytracing work:
  - Other GPU-centric commands result in device independent address translations
    - Buffer Device Addresses increasingly used:
      - in shader-code
      - gpu-centric extensions like Device-Generated Commands
- White paper: https://www.lunarg.com/portable-raytracing-with-gfxreconstruct

Demo at the LunarG table!

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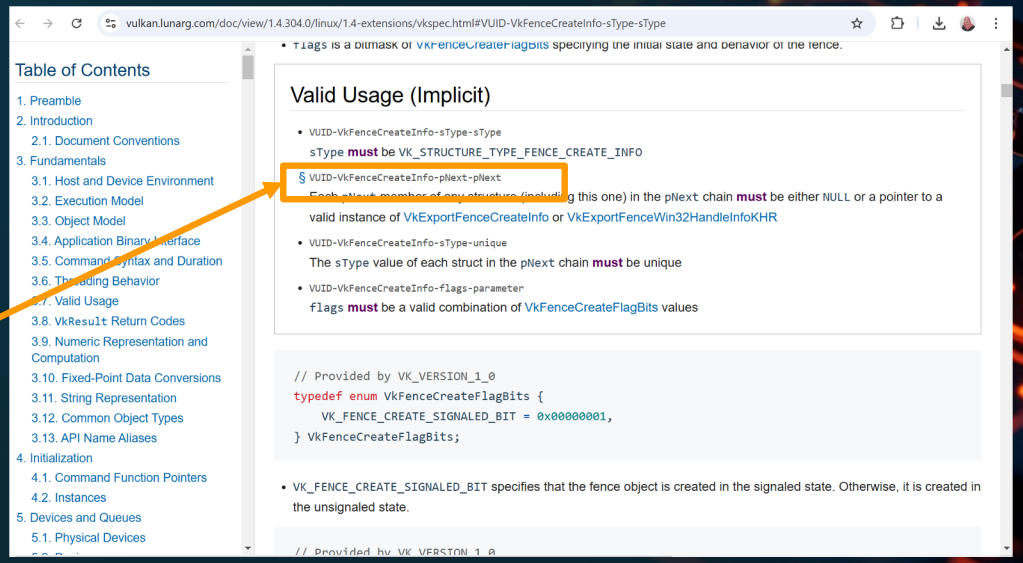
Slow Vulkan Spec Load Times!

- SDK Validation Layer Error Messages
  - Linking to specific violated VUID in the specification
  - Referencing the HTML single file version
    - SLOW to LOAD in your browser!

SDK Validation Layer Error:

VUID-VkImageViewCreateInfo-pNext-pNext(ERROR / SPEC): msgNum: 151814321 - Validation Error: [VUID-VkImageViewCreateInfo-pNext-pNext] | MessageID = 0x90c80b1 | vkCreateImageView(): pCreateInfo->pNext chain includes a structure with unexpected VkStructureType VK_STRUCTURE_TYPE_IMAGE_CREATE_INFO. This error is based on the Valid Usage documentation for version 304 of the Vulkan header. It is possible that you are using a struct from a private extension or an extension that was added to a later version of the Vulkan header, in which case the use of pCreateInfo->pNext is undefined and may not work correctly with validation enabled.
The Vulkan spec states: Each pNext member of any structure (including this one) in the pNext chain must be either NULL or a pointer to a valid instance of VkExportMetalObjectCreateInfoEXT, VkImageViewASTCDecodeModeEXT, VkImageViewMinLodCreateInfoEXT, VkImageViewSampleWeightCreateInfoQCOM, VkImageViewSlicedCreateInfoEXT, VkImageViewUsageCreateInfo, VkOpaqueCaptureDescriptorDataCreateInfoEXT, or VkSamplerYcbcrConversionInfo (https://vulkan.lunarg.com/doc/view/1.4.304.0/linux/1.4-extensions/vkspec.html#VUID-VkImageViewCreateInfo-pNext-pNext)
VUID-VkFenceCreateInfo-sType-sType(ERROR / SPEC): msgNum: 913590280 - Validation Error: [VUID-VkFenceCreateInfo-sType-sType] | MessageID = 0x36744808 | vkCreateFence(): pCreateInfo->sType must be VK_STRUCTURE_TYPE_FENCE_CREATE_INFO.
The Vulkan spec states: sType must be VK_STRUCTURE_TYPE_FENCE_CREATE_INFO (https://vulkan.lunarg.com/doc/view/1.4.304.0/linux/1.4-extensions/vkspec.html#VUID-VkFenceCreateInfo-sType-sType)

HTML Single File Specification:



NO MORE Slow Vulkan Spec Load Times!

- SDK Validation Layer Error Messages
  - Now referencing Antora build of Vulkan specification

SDK Validation Layer Error:

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(https://vulkan.lunarg.com/doc/view/1.4.304.1/linux/antora/spec/latest/chapters/resources.html#VUID-VkImageViewCreateInfo-pNext-pNext)
VUID-VkFenceCreateInfo-sType-sType(ERROR / SPEC): msgNum: 913590280 - Validation Error: [VUID-VkFenceCreateInfo-sType-sType] | MessageID = 0x36744808 | vkCreateFence(): pCreateInfo->sType must be VK_STRUCTURE_TYPE_FENCE_CREATE_INFO.
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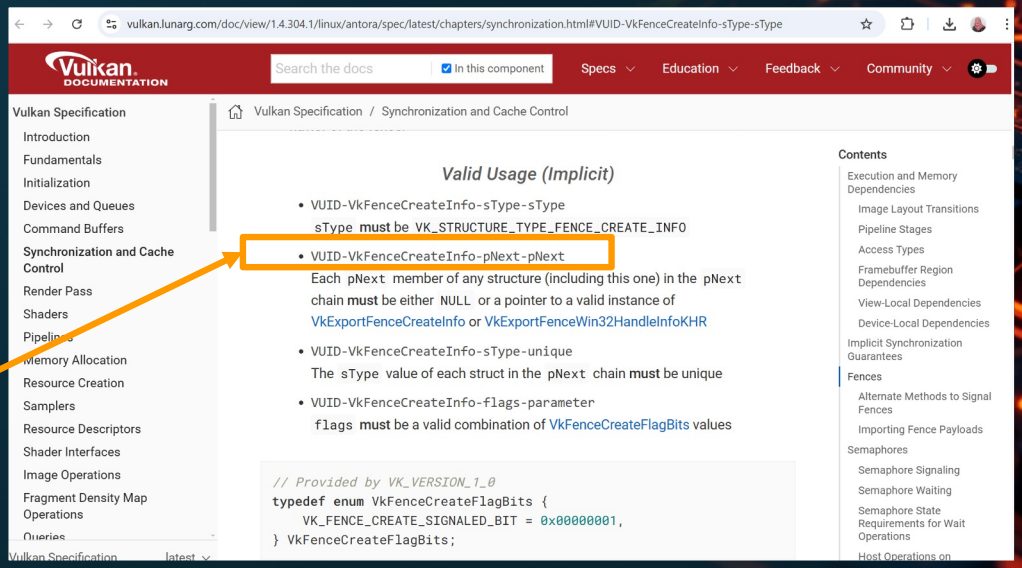
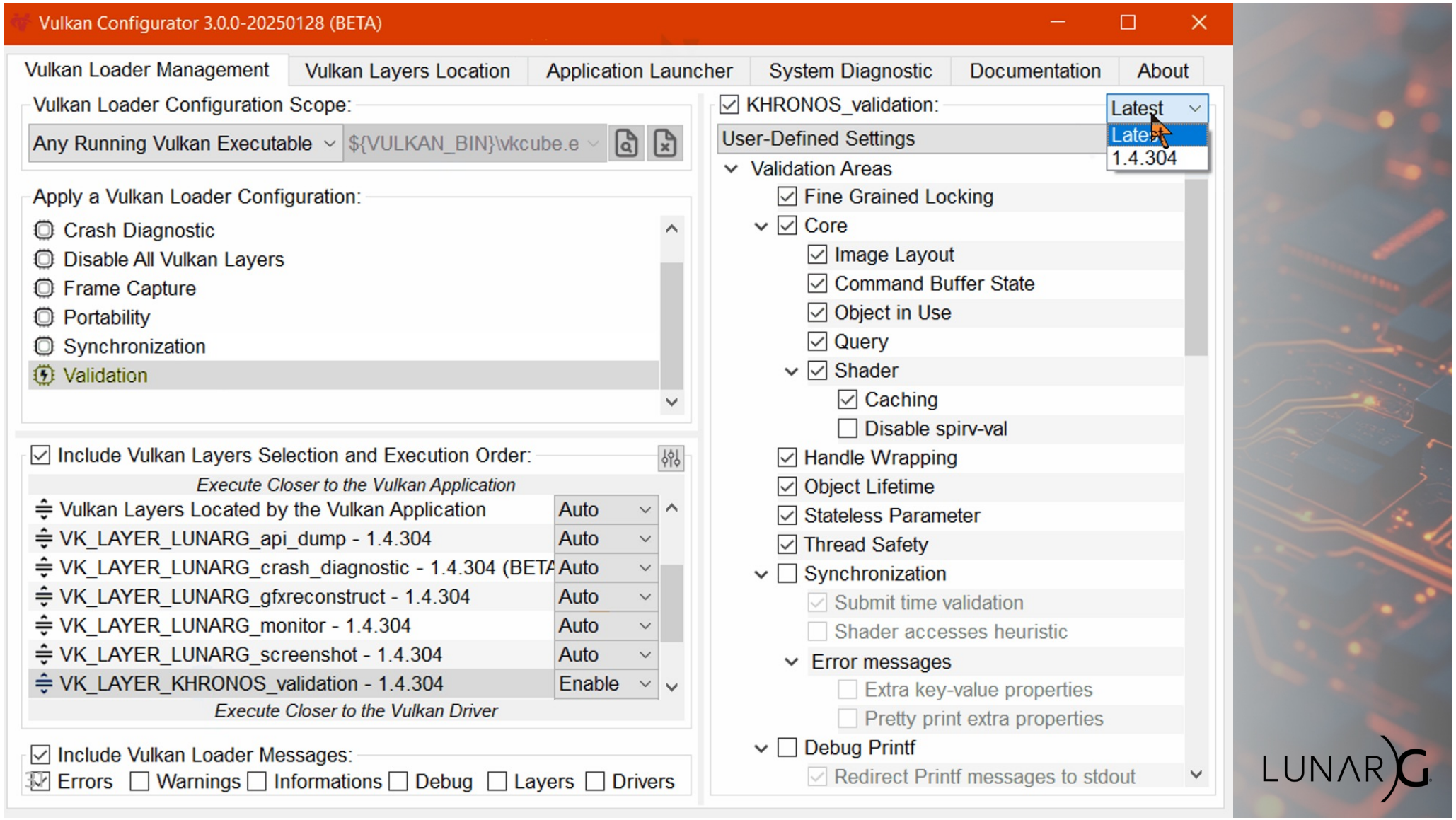
(https://vulkan.lunarg.com/doc/view/1.4.304.1/linux/antora/spec/latest/chapters/synchronization.html#VUID-VkFenceCreateInfo-sType-sType)

Antora built specification:



Vulkan Configurator – Version 3

- Improved layers loading and selection
  - Loading multiple versions of the same layer
  - Explicit selection of the layer version used by a configuration
  - Per-layer enabling of layer settings
- Improved layers ordering
  - Ordering of all layers executed by Vulkan application
- Improved executable list
  - Multiple set of options per executable
  - Per-application layers configuration
- *Vulkan Loader* logging enhancements
  - Aids in system diagnosis


Vulkan Configurator 3.0.0-20250128 (BETA)
Vulkan Loader Management
Vulkan Layers Location
Application Launcher
System Diagnostic
Documentation
About
Vulkan Loader Configuration Scope:
Any Running Vulkan Executable
${VULKAN_BIN}\vkcube.e
Apply a Vulkan Loader Configuration:
Crash Diagnostic
Disable All Vulkan Layers
Frame Capture
Portability
Synchronization
Validation
Include Vulkan Layers Selection and Execution Order:
Execute Closer to the Vulkan Application
Vulkan Layers Located by the Vulkan Application
VK_LAYER_LUNARG_api_dump - 1.4.304
VK_LAYER_LUNARG_crash_diagnostic - 1.4.304 (BETA
VK_LAYER_LUNARG_gfxreconstruct - 1.4.304
VK_LAYER_LUNARG_monitor - 1.4.304
VK_LAYER_LUNARG_screenshot - 1.4.304
VK_LAYER_KHRONOS_validation - 1.4.304
Auto
Enable
Execute Closer to the Vulkan Driver
Include Vulkan Loader Messages:
Errors
Warnings
Informations
Debug
Layers
Drivers
KHRONOS_validation:
Latest
1.4.304
User-Defined Settings
Validation Areas
Fine Grained Locking
Core
Image Layout
Command Buffer State
Object in Use
Query
Shader
Caching
Disable spirv-val
Handle Wrapping
Object Lifetime
Stateless Parameter
Thread Safety
Synchronization
Submit time validation
Shader accesses heuristic
Error messages
Extra key-value properties
Pretty print extra properties
Debug Printf
Redirect Printf messages to stdout
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Gratitude for their support

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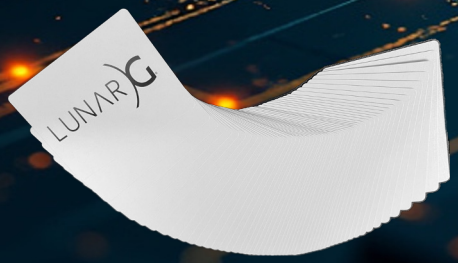
Thank you!

Actions

Download this Presentation

https://khr.io/1cr

Talk to us and get Swag!



Visit the
LunarG Sponsor Table

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https://khr.io/1cq

Your Feedback Matters!

Survey Results
- ➔ Are shared with the Khronos Vulkan Working Group
- ➔ Are used to drive development priorities throughout 2025

Survey Closes
Wednesday, Feb. 19, 2025
(GMT−7)