SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

ANARI OpenXR WebGL 3DCommerce glTF Vulkan

Khronos Fast Forward

Neil Trevett, VP Developer Ecosystems, NVIDIA
Khronos President

Welcome to Khronos Fast Forward!

Highlights of the latest in Khronos APIs plus where to go for more details

https://www.khronos.org/events/2023-siggraph

Khronos Connects Software to Silicon

Founded in 2000
~ 200 Members | ~ 40% US, 30% Europe, 30% Asia

KHRONOS® GROUP

Open, royalty-free interoperability standards to harness the power of GPU, XR and multiprocessor hardware

3D graphics, augmented and virtual reality, parallel programming, inferencing and vision acceleration

Non-profit, member-driven standards organization, open to any company

Proven multi-company governance and Intellectual Property Framework

Khronos Active Standards

3D Graphics
Desktop, Mobile and Web

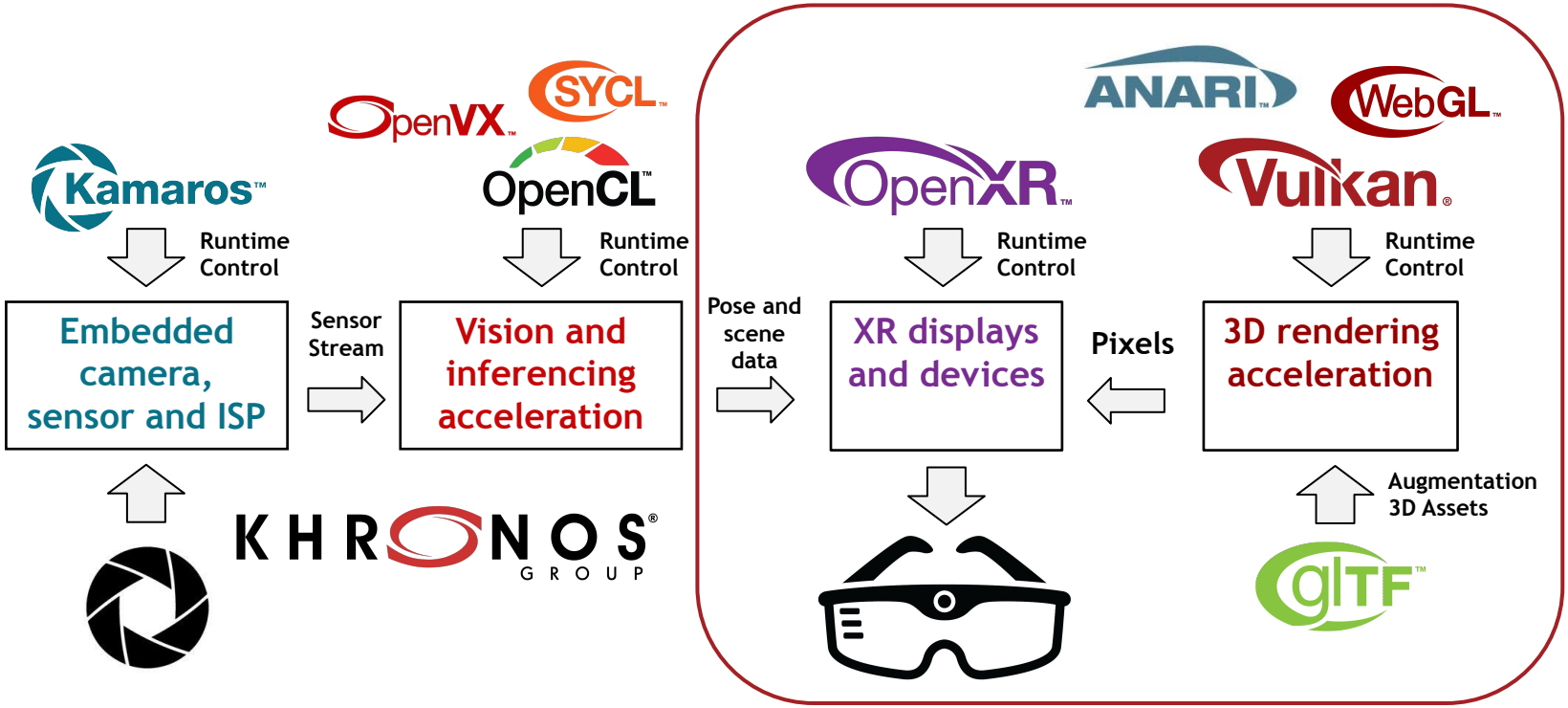
3D Assets
Authoring and Delivery

Portable XR
Augmented and Virtual Reality

Parallel Computation
Vision, Camera, Inferencing, Machine Learning

Safety Critical APIs

Khronos Standards for Spatial Computing



Khronos and W3C: Bringing XR to the Web

XR Applications and Engines
use an API from both the 3D and XR Stacks

three.js babylon.JS unity UNREAL ENGINE GODOT **Engines**

WebGL WebGPU WebXR W3C®

OpenGL ES Vulkan OpenXR KHRONOS GROUP

3D Stack
Driving GPUs to render scenes and augmentations

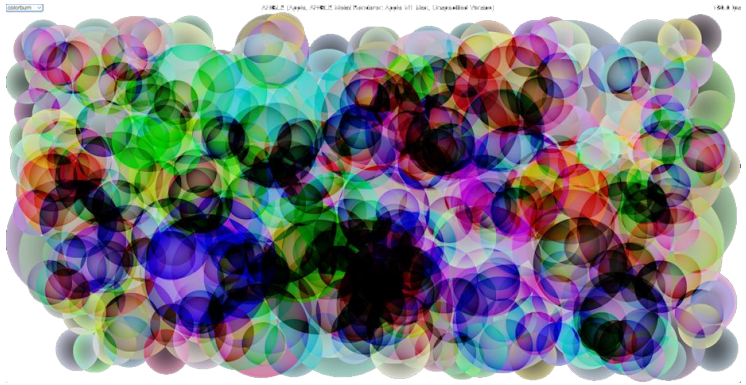
XR Stack
Handling XR Devices for creating UI

WebGL Update

- **Khronos is fully supporting development of WebGPU at W3C**
  - Working for a smooth transition for developers between WebGL and WebGPU
  - WebGPU brings GPU Compute to the Web using Vulkan/DX12/Metal backends
- **WebGL is pervasive and will be used by many applications for many years**
  - Khronos will evolve the WebGL specification and support multiple implementations
  - ANGLE's Metal backend supports WebGL 2.0 in Safari on macOS/iOS
  - Coming soon to Chromium on macOS
  - display-p3 support is in progress in Firefox

WebGL 2.0 is available on 95% of browsers

New WebGL Extensions

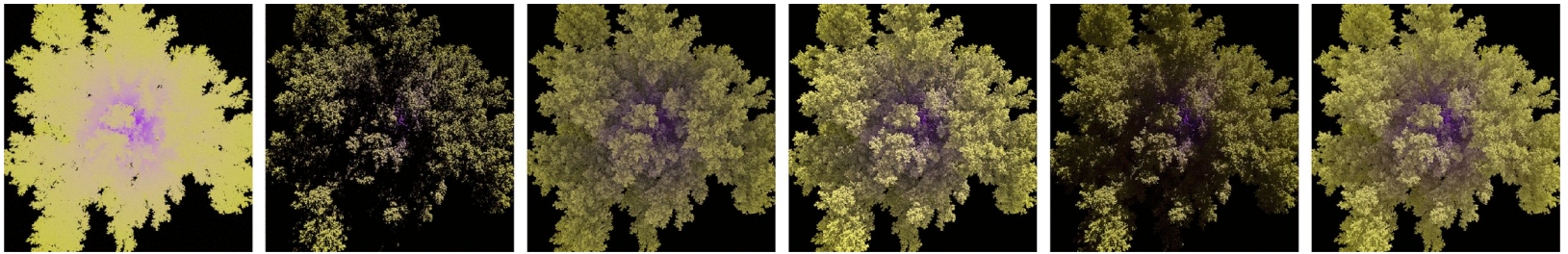


- Pixel Local Storage Extension
  - Developed by Chris Dalton from Rive
  - Programmable blending and other use cases
  - In Draft in Chrome Canary
    - Enable WebGL draft extensions in about:flags
  - Live demo implements blend_equation_advanced
    - (source code)
- **Multiple useful extensions are being ported from OpenGL ES**
  - EXT_blend_func_extended
  - EXT_clip_control
  - EXT_conservative_depth
  - EXT_depth_clamp
  - EXT_polygon_offset_clamp
  - EXT_render_snorm
  - EXT_texture_mirror_clamp_to_edge
  - NV_shader_noperspective_interpolation
  - OES_sample_variables
  - OES_shader_multisample_interpolation
  - WEBGL_clip_cull_distance
  - WEBGL_polygon_mode
  - WEBGL_render_shared_exponent
  - WEBGL_stencil_texturing

Visualization, Rendering and ANARI

Many new 3D rendering technologies are available to scientific visualization applications

Techniques such as path tracing provide significant visualization enhancements



Ray casting of surface color | Directional lighting and shadows | Ambient occlusion lighting | Directional lighting with ambient occlusion | Directional lighting with path traced indirect lighting | Directional lighting with ambient occlusion and path traced indirect lighting

BUT can be complex and time-consuming for domain experts to use low-level rendering APIs

Rendering engines can hide that complexity - and a rich diversity of vendor and open-source rendering engines are now available - BUT every rendering engine uses a different API

ANARI™

Cross-Platform 3D Rendering Engine API

Simplified application development

Application portability to any engine supporting ANARI

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ANARI 1.0 Launched Last Week!

Simplified Application Development

High-level API to describe
WHAT is to be rendered not HOW

Application Portability

Common API for ANY rendering-engine
independent of vendor, platform or ecosystem

Cross-Platform 3D Rendering Engine API

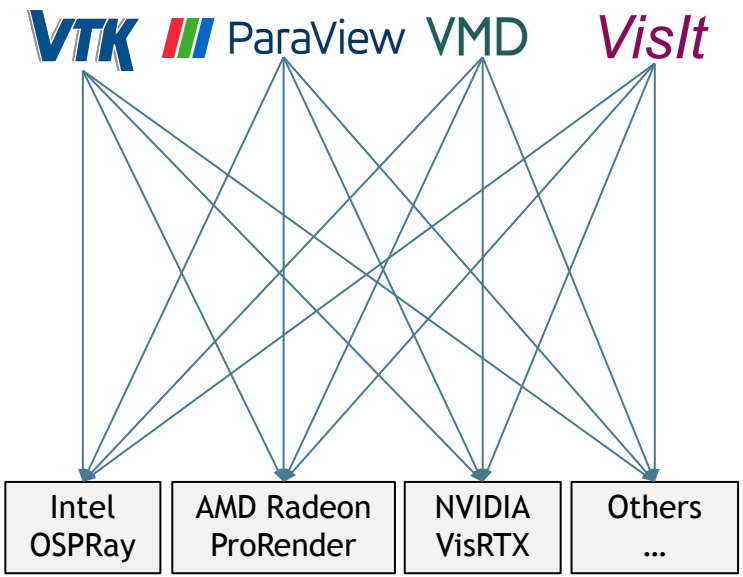
ANARI 1.0 Finalized

Multiple implementations shipping and
open-source SDK available

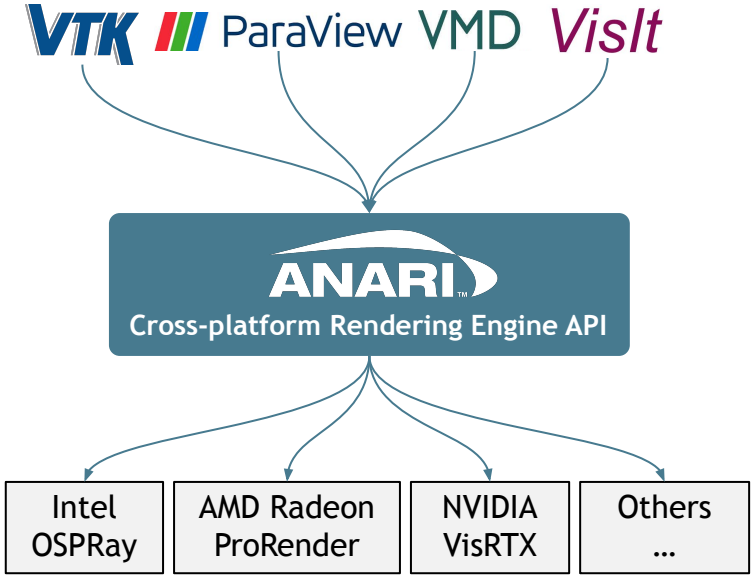
Scientific Visualization Beachhead

Many types of application
will benefit from ANARI

Scientific Visualization Before and After ANARI



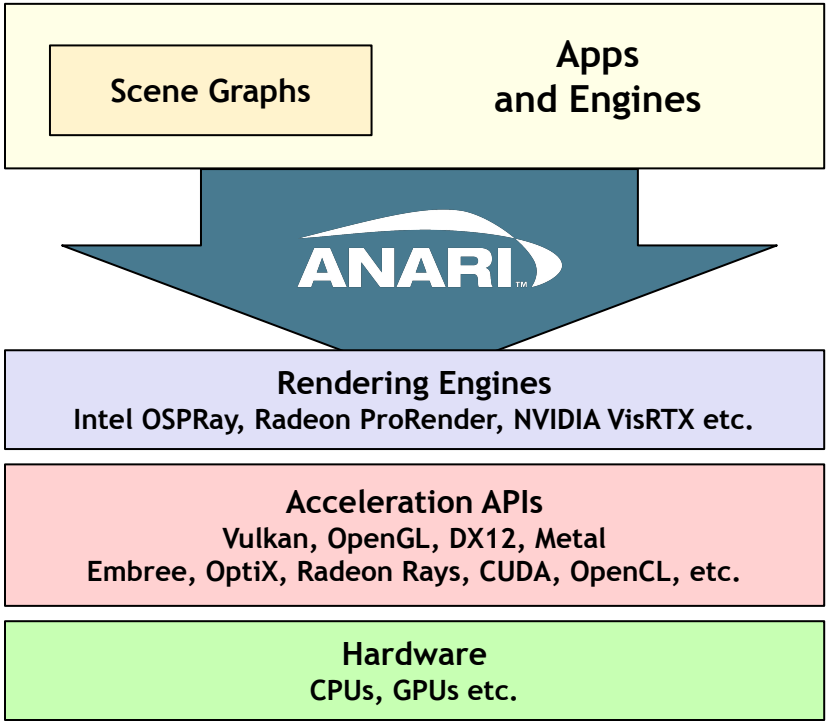
Before ANARI



After ANARI

ANARI applications are portable to any engine supporting the ANARI API
Independently of vendor, platform or ecosystem

ANARI Development Stack

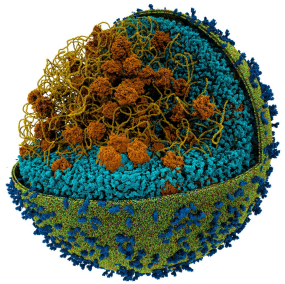


Processing to construct a scene description with application-specific structures, traversals, and metadata

ANARI API used to build in-memory scene representation
- NO rendering details prescribed
- C99 frontend API dispatch library with C++ type-safe wrappers
- Extensible API design with installable development layers

Engines use in-memory scene representation to drive rendering operations

Explicit control over hardware resources and operations



VMD Rendering using ANARI
Minimal Cell, 87M Beads
Martini v3 force field, U. Illinois

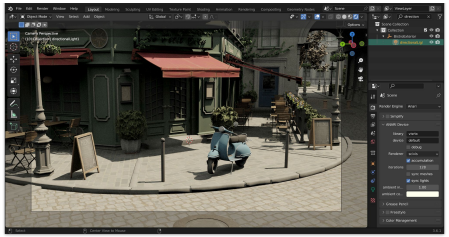
ANARI - Try It Today!

- **Open-source ANARI SDK**
  - Loadable debug and trace layers
  - Example applications demonstrating ANARI concepts
- **Implementations shipping now on rendering engines from AMD, Intel and NVIDIA**
  - AMD Radeon ProRender
  - Intel OSPRay
  - NVIDIA VisRTX + VisGL

AMD intel NVIDIA

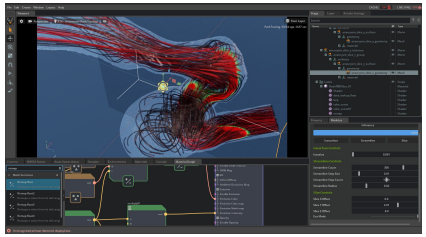
- **ANARI beyond Scientific Visualization**
  - Blender and Omniverse

blender



Proof-of-concept Blender Add-On
Amazon Lumberyard Bistro
NVIDIA Open Research Content Archive (ORCA) 2017

NVIDIA OMNIVERSE



ANARI-USD Brings ANARI applications to USD/Omniverse
NVIDIA OmniGraph geometry processing

Give us your feedback and requirements on ANARI GitHub

What rendering features important to your application domain?

For what new application domains and use cases would you use ANARI?

https://www.khronos.org/anari
https://github.com/KhronosGroup/ANARI-Docs
https://github.com/KhronosGroup/ANARI-SDK

ANARI BOF
Khronos BOF DAY, Wednesday 10AM
JW Marriott Platinum Salon D

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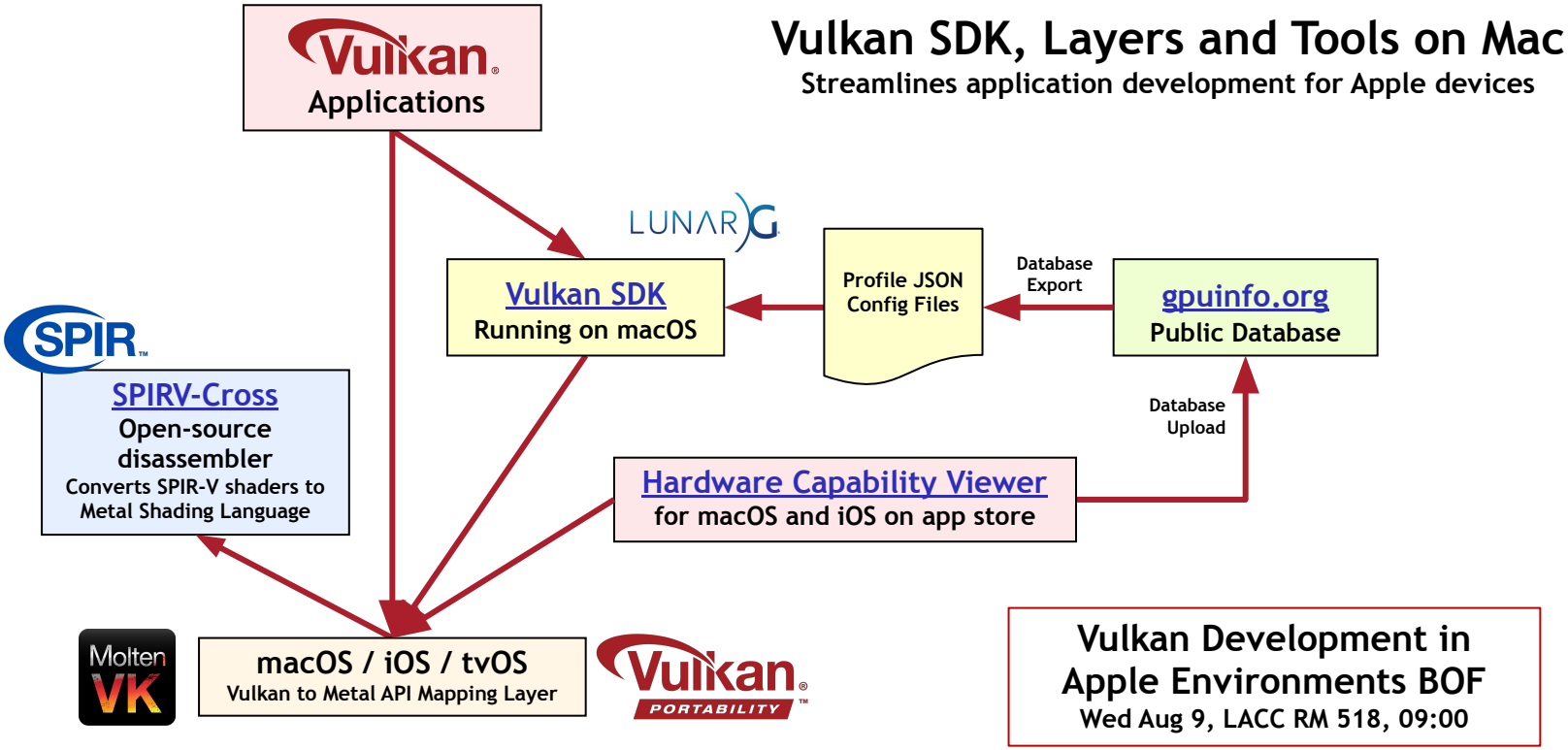
Vulkan Development on Apple



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Vulkan

Vulkan Update

Tom Olson, Arm
Vulkan Working Group Chair

Vulkan

A modern API for graphics and compute on GPUs

- Descended from OpenGL / OpenGL ES
- Radically cross-platform
- One API across desktop and mobile

No-compromise focus on performance

- Driving use case is AAA games

Developer has control / responsibility for

- Memory and object management
- Scheduling and synchronization
- Multithreading
- Error checking

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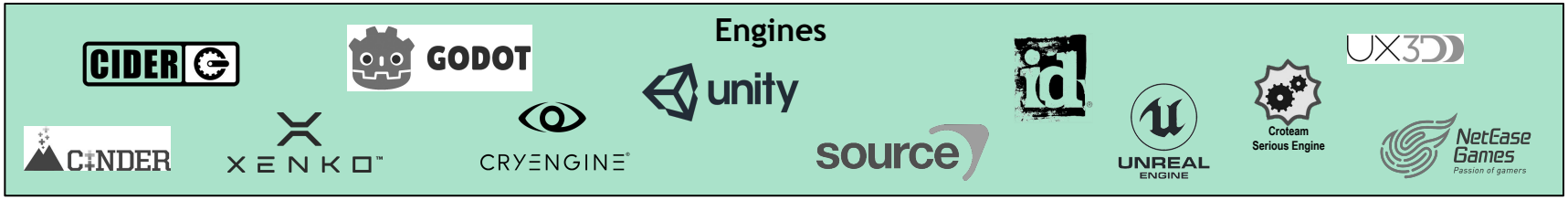
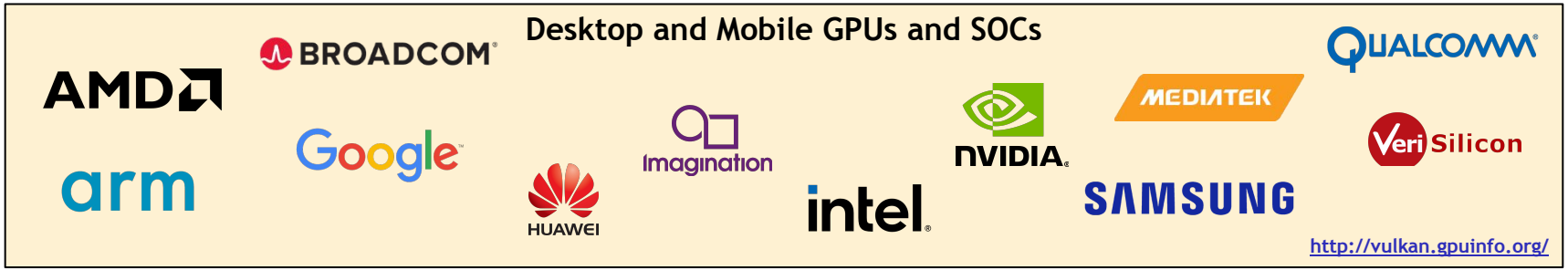
Vulkan Adoption





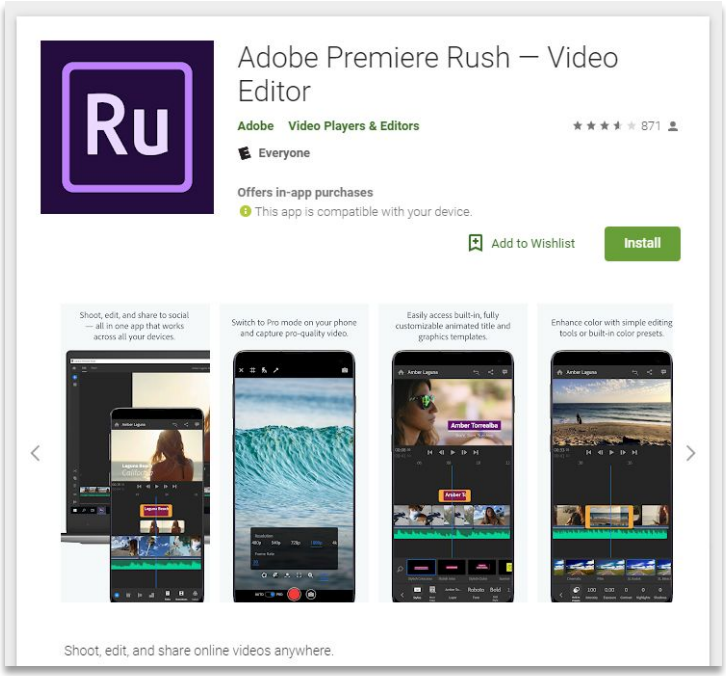
Note: The version of Vulkan available will depend on platform and vendor

Vulkan Adoption: Games

Desktop Games

Mobile Games

Vulkan Adoption: Non-Games

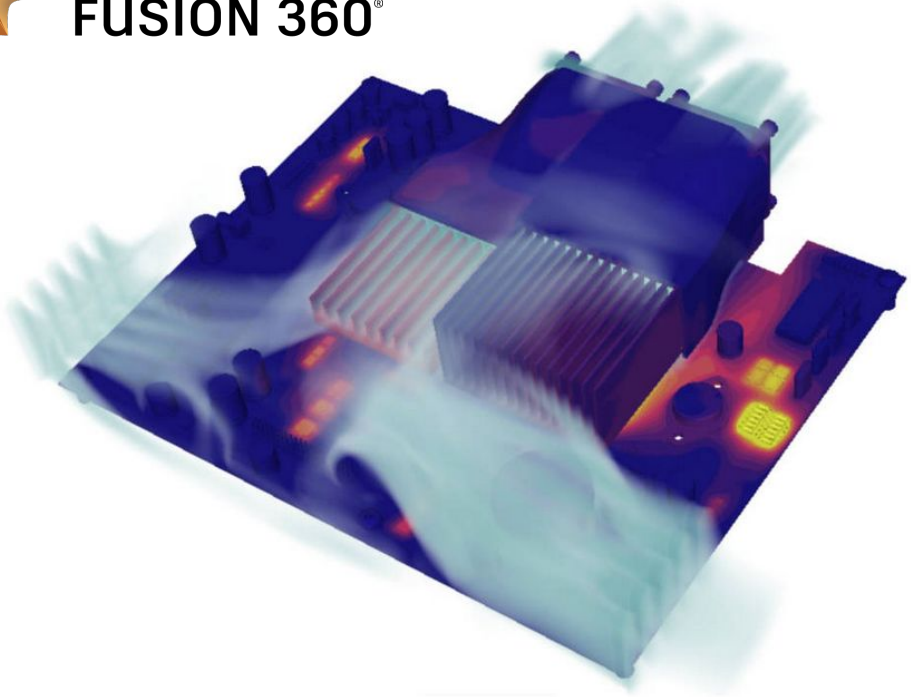


Adobe Substance 3D Stager

Artwork by Emily Bisset, courtesy of Adobe

Vulkan Adoption: Non-Games

AUTODESK®
FUSION 360®

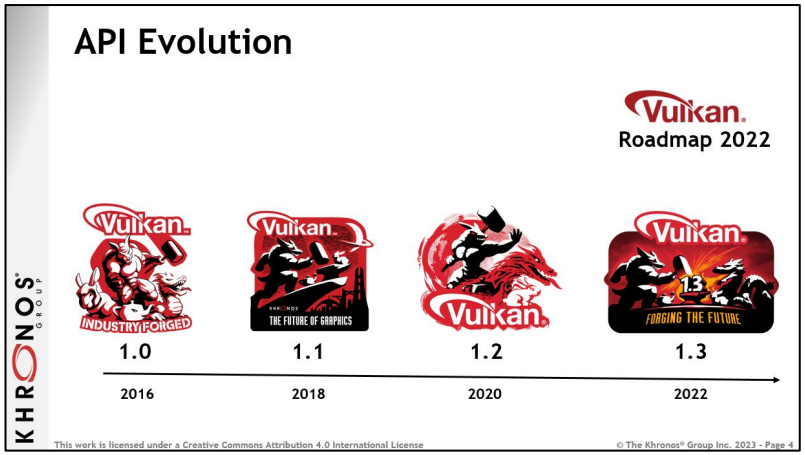


Autodesk Fusion 360 uses Vulkan for cross-platform post-processing and display of simulation results

See https://www.khronos.org/blog/vulkan-for-cloud-based-transient-compute

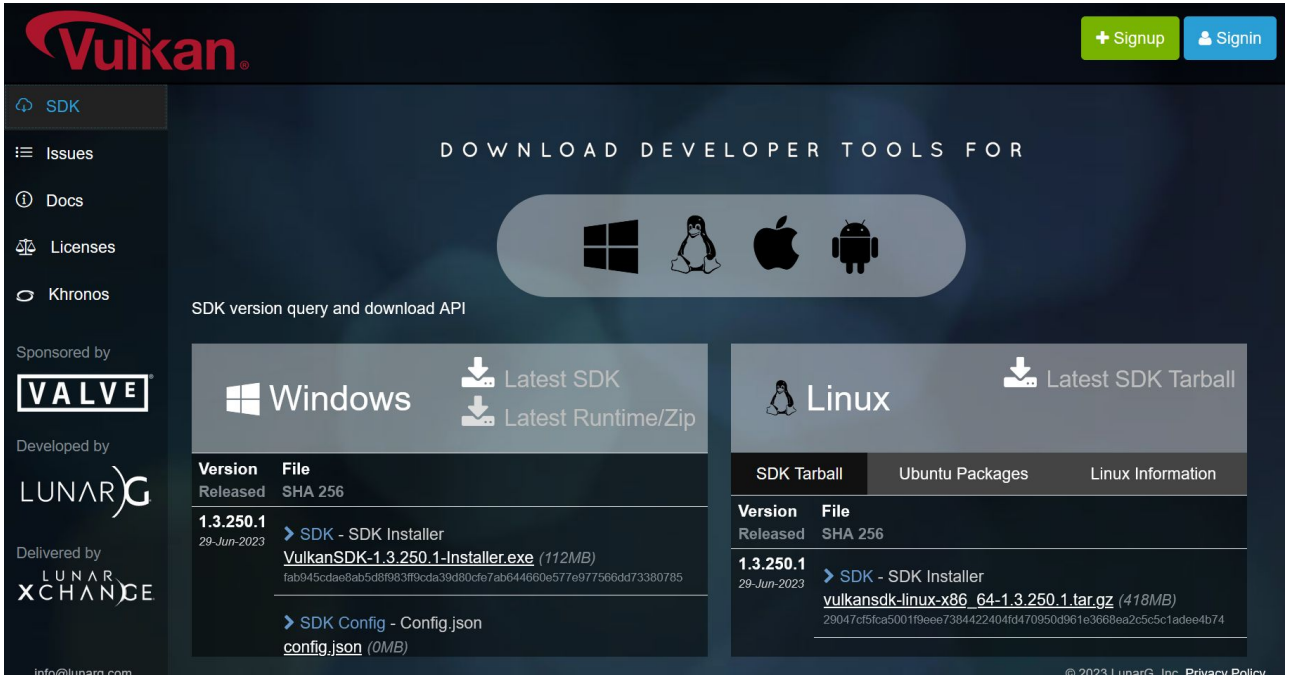
Vulkan: Forging Ahead

Vulkan Update - Tom Olson, Arm / Vulkan WG chair



Vulkan: Forging Ahead

Vulkan SDK Progress - Karen Ghavam, LunarG CEO / Engineering Mgr



Vulkan: Forging Ahead

Teaching Vulkan – Lukas Lipp (TU Wien), Bernhard Kerbl (INRIA)

Vulkan: Forging Ahead

Vulkan at Autodesk – Henrik Edström, Mauricio Vives, Vipul Kapoor, Jasmin Roy

- Vulkan and Open Source Graphics at Autodesk
- Vulkan Ray Tracing in Aurora: An Open-Source Real-Time Path Tracer
- Vulkan for Cross-Platform Viewing of Large AEC Models
- Porting Autodesk Flame from OpenGL to Vulkan

Vulkan: Forging Ahead

Debugging Vulkan Ray Tracing - Hai Nguyen, independent

Image by Gilles Tran - http://www.oyonale.com - Public Domain

Vulkan: Forging Ahead

Vulkan Update - Tom Olson, (Arm / Vulkan WG)

Vulkan SDK Progress - Karen Ghavam (LunarG)

Teaching Vulkan - Lukas Lipp (TU Wien), Bernhard Kerbl (INRIA)

(break)

Vulkan at Autodesk

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Thank You!

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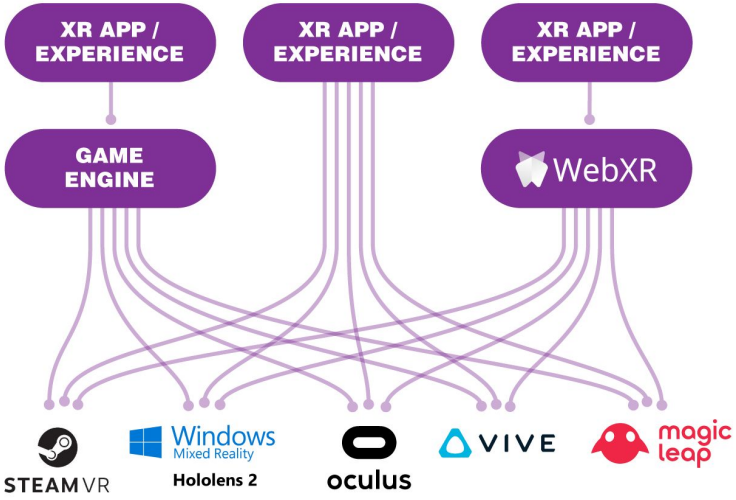
OpenXR™

OpenXR Update

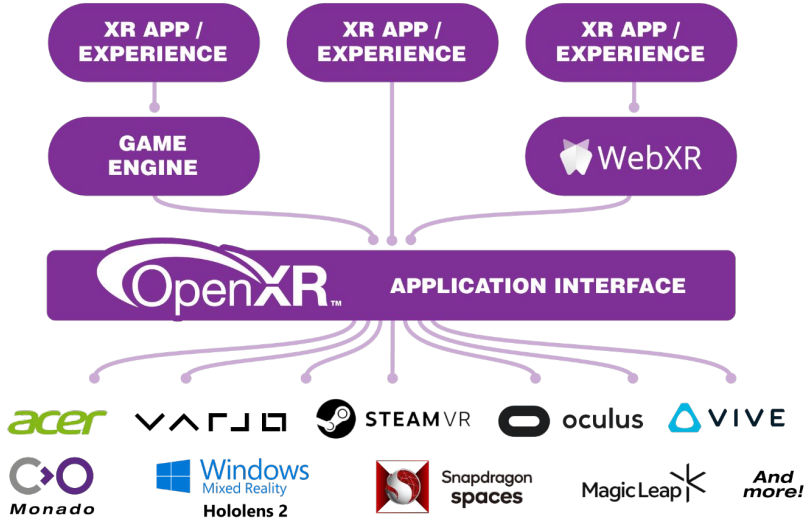
Cristina Scheibler, Dimenco

OpenXR Cross-Platform Portability

Applications and engines can portably access any OpenXR-conformant hardware



Before OpenXR: Applications and engines needed separate proprietary code for each device on the market.



OpenXR provides a single cross-platform, high-performance API between applications and all conformant devices.

OpenXR Adopters

 Microsoft	 Meta	 htc
HoloLens and Mixed Reality Headsets. Hand and eye tracking extensions	Rift S, Quest, Quest 2 and Quest Pro. Meta Deprecated own API for OpenXR	Vive Focus 3, Vive Cosmos, Vive XR Elite, Vive Wave Runtime
STEAMVR™ VALVE	 VARJO	MONADO
Valve Deprecated OpenVR APIs in favor of OpenXR	All Varjo Headsets are fully compliant (VR-1, XR-1, XR-3, VR-3)	Collabora's Monado open-source OpenXR Implementation
 Magic Leap	 XREAL	 Snapdragon spaces
Magic Leap 2	XREAL Light and XREAL X	Qualcomm Snapdragon Spaces XR Development Platform
 acer	 ByteDance	 SONY
Spatial Labs Display Series	Neo 3 and Pico 4	Spatial Reality Display (Conformance expected summer 2023)

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Engines and Browsers with OpenXR Support

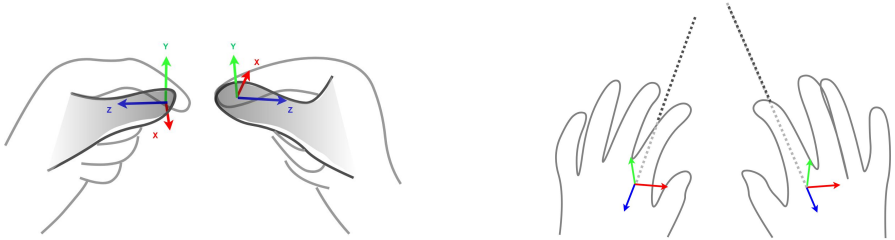
Unreal has been providing support since 4.24. UE 5.0 support OpenXR	Unity's OpenXR plugin available since 2020 LTS	Godot provides OpenXR support since March 20233 (Core 4.0 Alpha 4)
Open source mixed reality library for building HoloLens and VR applications	NVIDIA Omniverse and CloudXR Platforms	WebXR in Chrome, Edge and Firefox uses OpenXR as the default backend

OpenXR Games and Applications

Blender uses OpenXR for native scene inspection in VR	Adobe Substance 3D Modeller uses OpenXR for VR support	Kitware's Paraview uses OpenXR for VR support	Meta Horizon Workrooms	OpenBrush uses OpenXR for Desktop and Quest support
War Thunder now uses OpenXR	Cubism uses OpenXR for VR support	Vermillion uses OpenXR for VR support	The Light Brigade uses OpenXR for VR support	XPlane12 uses OpenXR for VR support
Minecraft uses OpenXR for desktop VR support	Microsoft Flight Simulator uses OpenXR for VR support	Supports over 27 devices thanks to OpenXR	Phasmophobia switched from OpenVR to OpenXR	Beat Saber Alpha branch uses OpenXR

OpenXR SDK 1.0.28 - July 2023

- Hand tracking and interaction improvements



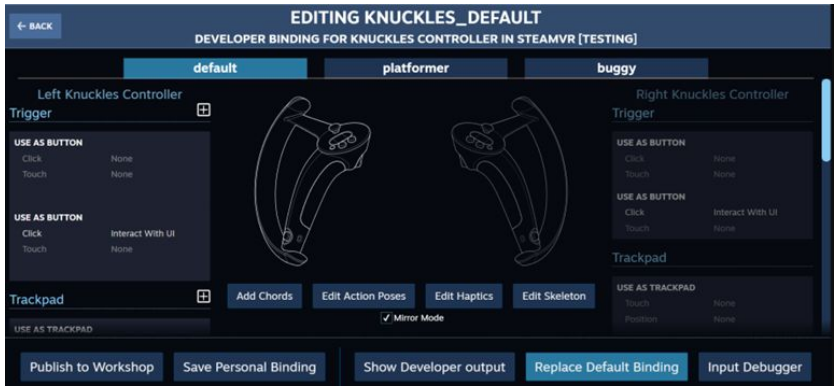
- Improved support for Android-based devices
- Mac development support
- New Meta extensions: face tracking and virtual keyboard

OpenXR CTS 1.0.27 - May 2023

- Improvements for Android
- Tests for all supported rendering formats (Vulkan, D3D12, etc)
- Console Only Testing

Coming soon…

- Increased accessibility
- Expanded haptics support
- Controller render models (glTF)
- New extensions
- Tutorials



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glTF™ 3DCommerce™

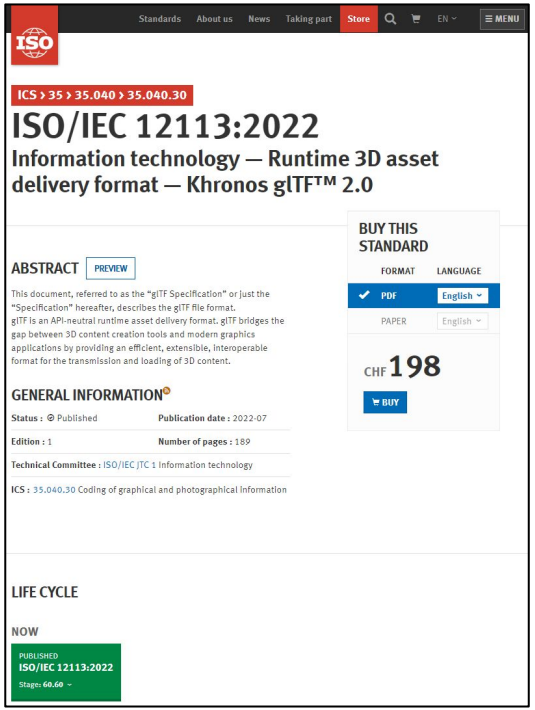
glTF Update

Alexey Medvedev, Meta
Chair, 3D Formats Working Group

glTF

- PBR
- Interactivity
- Composition Format
- Physics
- Geospatial
- Tooling
- Tutorials
- KTX/Texture Compression

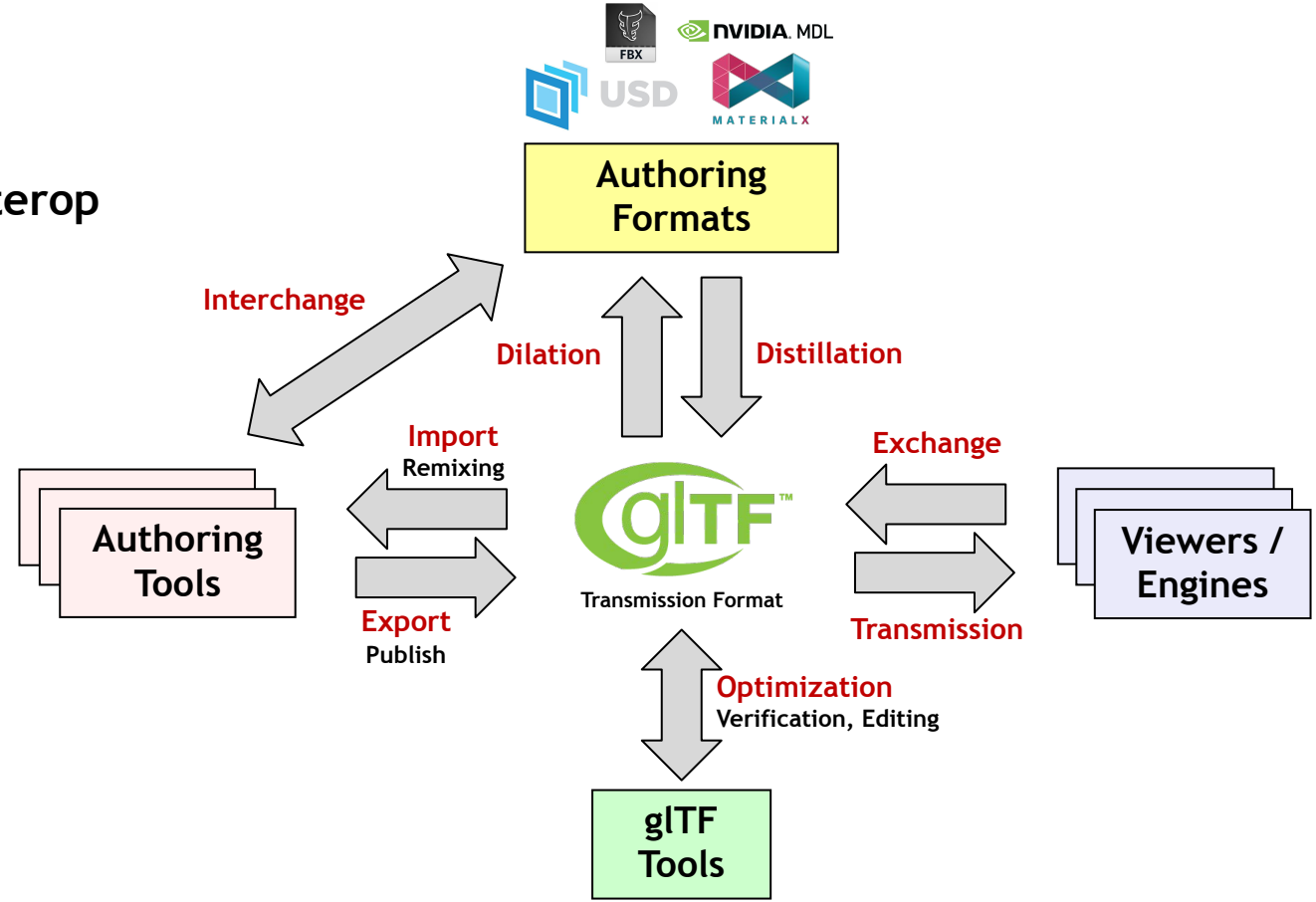
glTF 2.0 is an
ISO/IEC International Standard



Encouraging broad adoption, including for 3D functionality in PDF and MPEG

glTF

- JPEG of 3D
- glTF<->USD interop



The Evolution of PBR in glTF

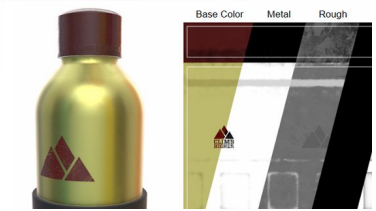
Clearcoat

Volume

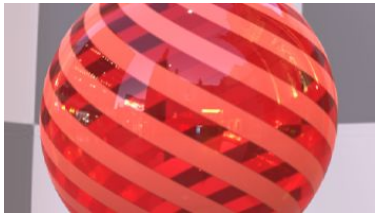
Sheen

Index of Refraction

Metal / Rough



Transmission

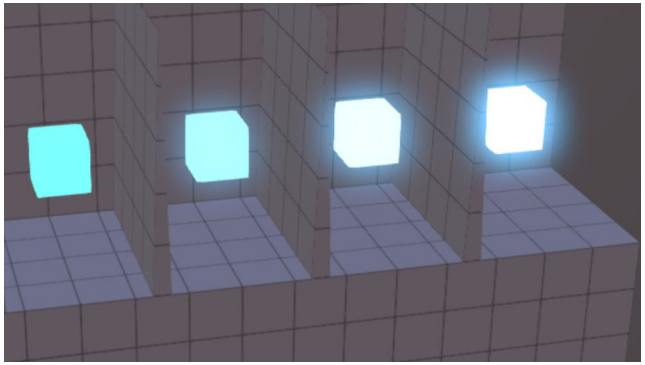


Specular

2017 2020 2021

The Evolution of PBR in glTF

Emissive Strength



Anisotropy

Iridescence

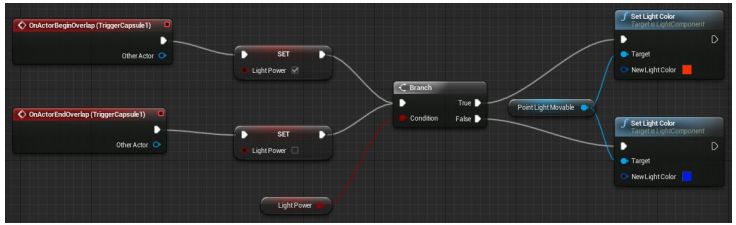
2022

2023

Interactivity

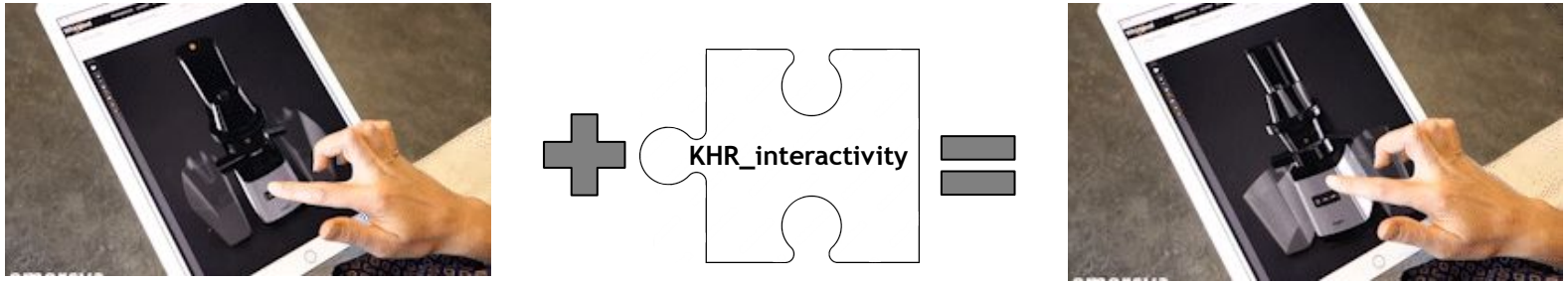
- *A Portable* way of describing how the content should *respond to user actions or events*.

Node based graph



Bringing Interactivity to glTF

Interactivity = User input + dynamic changes of the scene state



glTF 2.0

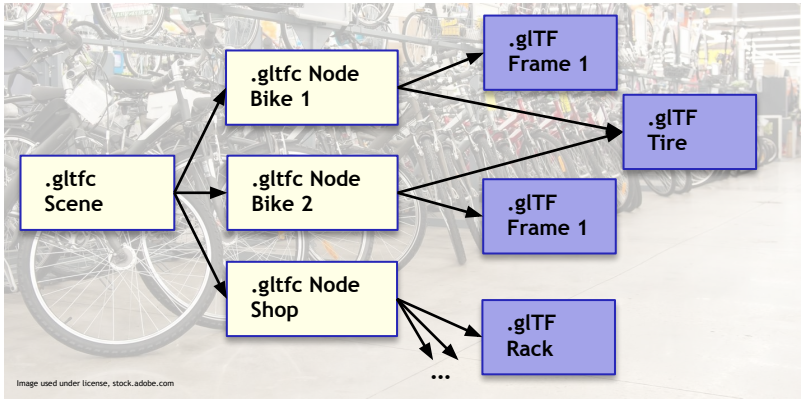
Interactive glTF

This new glTF extension:

- Provides blueprint for implementation of Interactive Assets (static geometry + behaviors)
- Empowers development of simple interactive applications (Games, Education, Design Review, e-commerce…)

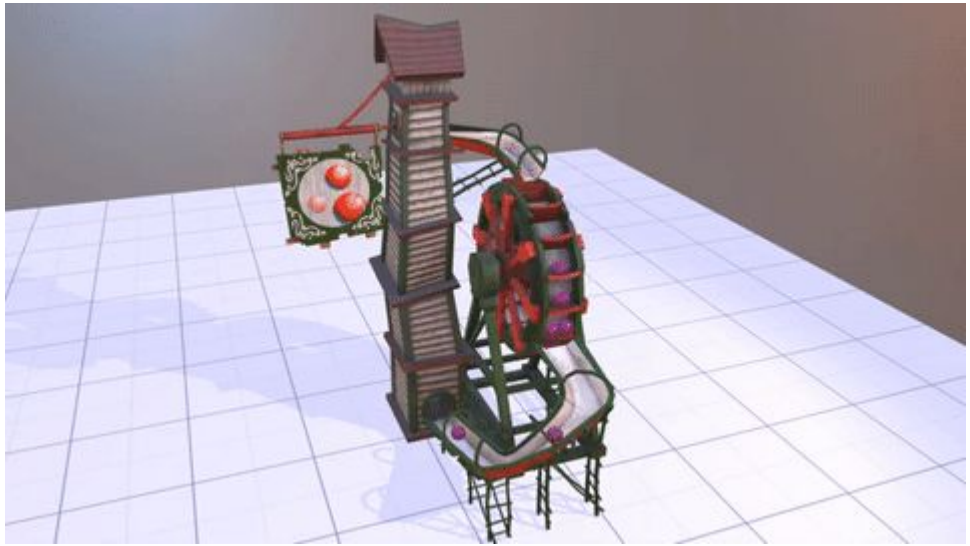
Composition

- Compose scenes and behaviors (in future) from multiple glTF assets
- Designed for efficiency in transmission/delivery use cases: Placement, Configuration, Cache Reuse, Personalization, Deferred Loading, LODs, Mesh Variants
- Composition is extensible, selected future glTF extensions may also be used directly by glTF Composition
- This is a final name for Complex Scenes
- New file extension: .gltfc



Physics

- **Express the physics properties of assets in the platform independent way:**
  - Collision geometry
  - Rigid bodies
  - Motions
  - Materials
  - Joints
  - Filters



Geospatial

Expand the capabilities of glTF and related technologies to better address the needs and requirements for transmission and display of 3D models, scenes, and interfaces for geospatial applications

- Liaison with Open Geospatial Consortium (OGC)
- Very large data sets
- Specialized data handling (Heirarchical Level of Detail - HLOD)

Tooling and Tutorials

Content Creation

Tutorial Videos
glTF-Compressor
Asset Auditor
Asset Repository
glTF support in Blender

Pipeline & Distribution

KTX Tooling
glTF-Compressor
glTF SampleViewer
glTF on iOS
Composite Scenes
Asset Auditor
Metadata
Asset Repository
Blender

Education

Tutorial Videos
glTF Sample Viewer
Project Explorer
glTF on iOS
Composite Scenes
Asset Repository
Blender

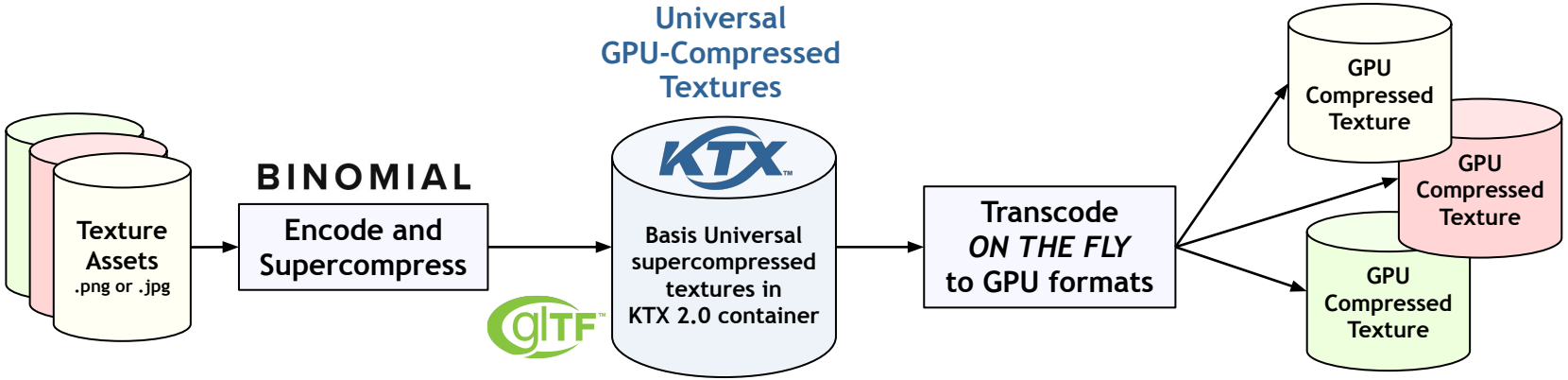
Futures

glTF SampleViewer
glTF on iOS
Composite Scenes
Metadata
Asset Repository
Blender

KTX 2.0 Supports Basis Universal Compression

KTX + glTF

Compact, visually rich, assets that can be efficiently rendered on diverse platforms



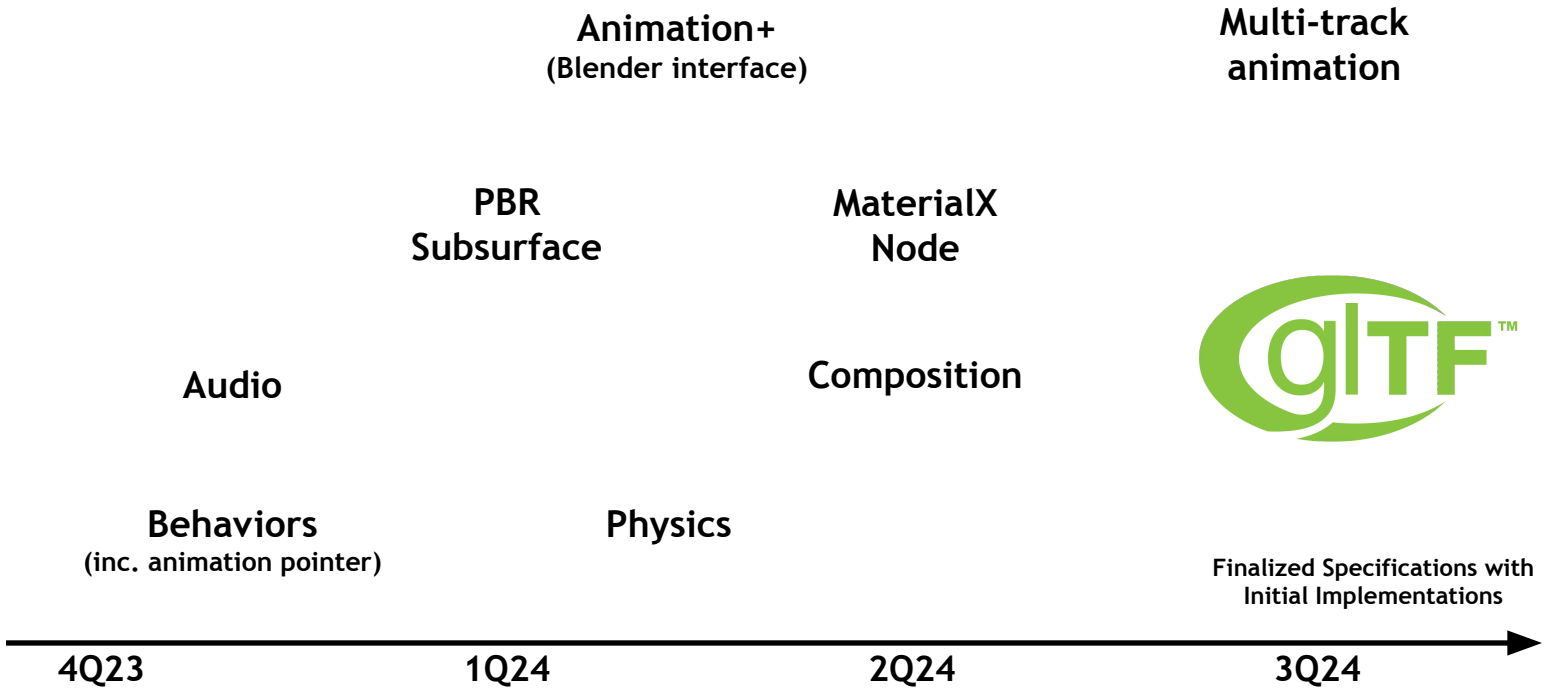
Open-source Basis Universal encoder with supercompression produces compact textures for transmission

Open-source tools pack supercompressed textures into KTX 2.0 container and then pack KTX textures into glTF assets

Open-source C++ and WebAssembly transcoding to GPU compressed formats

Use GPU compressed textures native to platform
Desktop: BC*
Mobile: ETC1/2, PVRTC1, ASTC

Short Term glTF Roadmap



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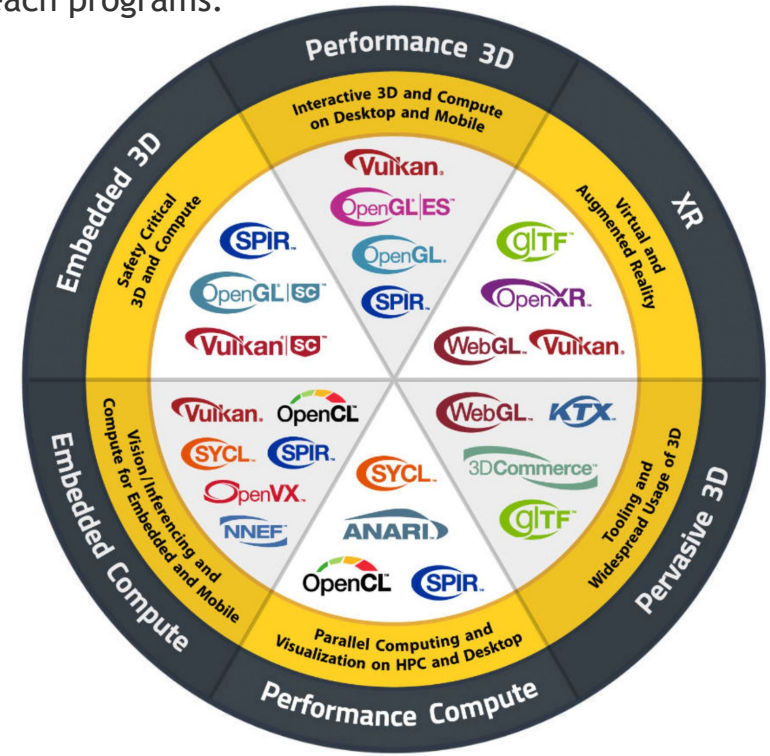
glTF™ 3DCommerce™

Dan Frith, Avataar
Chair, 3D Commerce | Vice Chair, 3D Formats

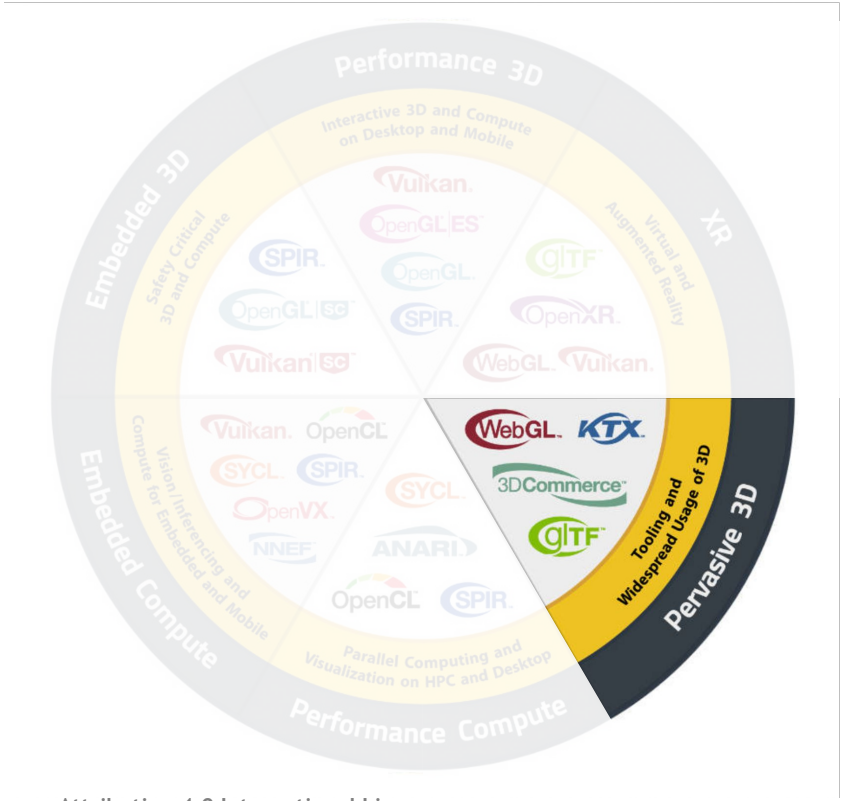
Khronos Ecosystem Segmentation

Multiple Khronos standards are often relevant to developers with similar requirements. Khronos currently identifies **six** such **market segments**. Working Groups within a segment coordinate and cooperate to develop coherent solutions and outreach programs.

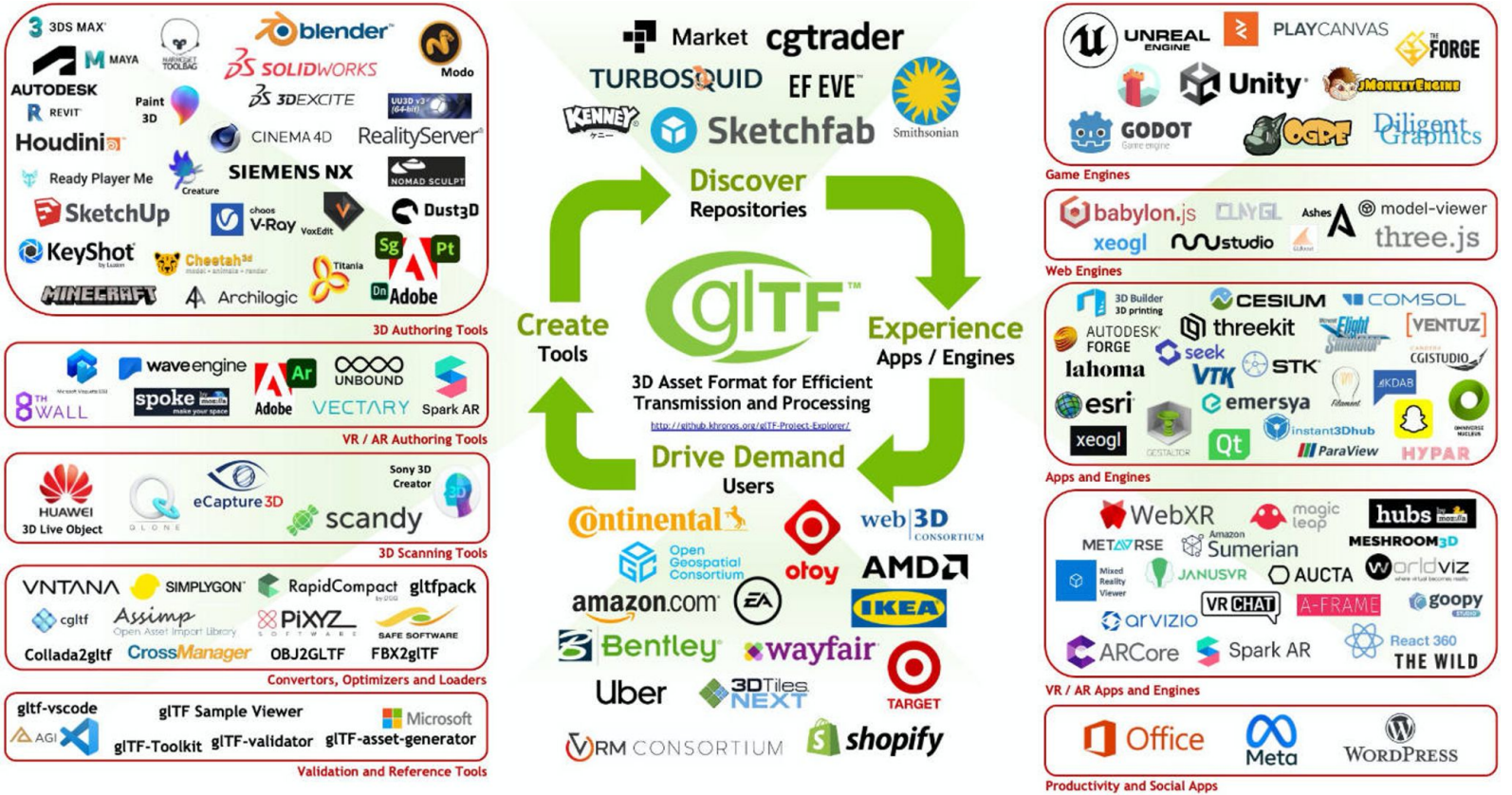


Khronos Ecosystem Segmentation

3D content is poised to become **pervasive** in retail. Virtual representations of products will be everywhere from ads, web on mobile & computer, Augmented Reality, Virtual Reality to Mixed Reality devices.



glTF Ecosystem



glTF Ecosystem & 3D Commerce

Industry Support glTF & 3D Commerce

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  - Getting as close to the real thing as possible **increases e-commerce conversion**, **online duration** for consumers & **reduces returns** of physical products, **increasing brand trust**.

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- **Physics, Scene Composition & Interactivity**
  - When compared to traditional 2D methods, 3D converts consumers but adding in Physics, Interaction & Multi-Sku and Scene Composition, consumers can play with e-commerce.

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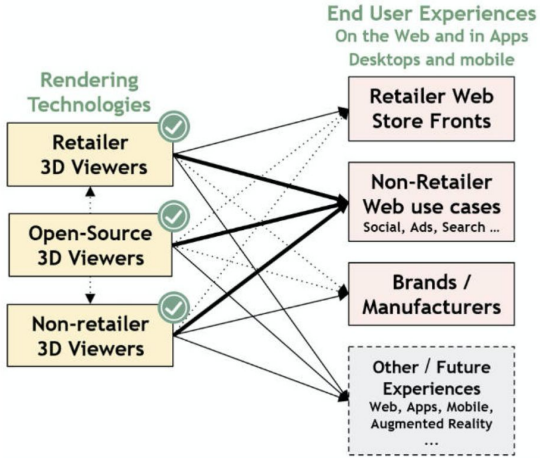

3D Viewer Certification

Ensuring accurate display of 3D products in a wide variety of end-user experiences on the Web, social media, ad platforms and applications

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- **NeRF (Neural Radiance Fields), Machine Learning & AI in 3D**
  - The use of generative AI in 3D Asset & scene creation whilst following standards

We Look Forward to Discussing More Details!

Come to the Khronos Networking Reception on Wednesday evening!
After the Khronos BOF Day in JW Marriott Platinum Salon C/D

The State of 3D Asset Interoperability using USD and glTF Mon Aug 7, LACC RM 514, 10:30	Capture & Replay with Vulkan & DX12: GFXReconstruct Mon Aug 7, Marriott, 15:00	Geometry, Textures, and Workflow - Optimizing glTF Tue Aug 8, LACC RM 513, 8:30	The Vulkan Computer Graphics API Tue Aug 8, LACC RM 515B, 9:00	glTF Complex Scenes & Interactivity Tue Aug 8, LACC RM 513, 10:00
Unleashing Creativity in 3D Models with glTF and PBR Tue Aug 8, LACC RM 513, 11:00	Let's Get Moving: Adding Physics to glTF Tue Aug 8, LACC RM 513, 15:00	Vulkan Development in Apple Environments Wed Aug 9, LACC RM 518, 09:00	ANARI: The Industry's First Portable Rendering Engine API Wed Aug 9, Marriott, 10:00	OpenXR: Enabling Cross-Platform VR/AR Experiences Wed Aug 9, Marriott, 11:00
glTF: Transforming 3D Asset Delivery for Real-Time Graphics Wed Aug 9, Marriott, 13:00	Vulkan:Forging Ahead Wed Aug 9, Marriott, 15:00	Khronos Group Networking Reception Wed Aug 9, Marriott, 18:00	Standardizing Body Attachment Points for 3D Commerce Virtual Try On Thu Aug 10, LACC RM 518, 10:00	

https://www.khronos.org/events/2023-siggraph