The Latest on Khronos Standards
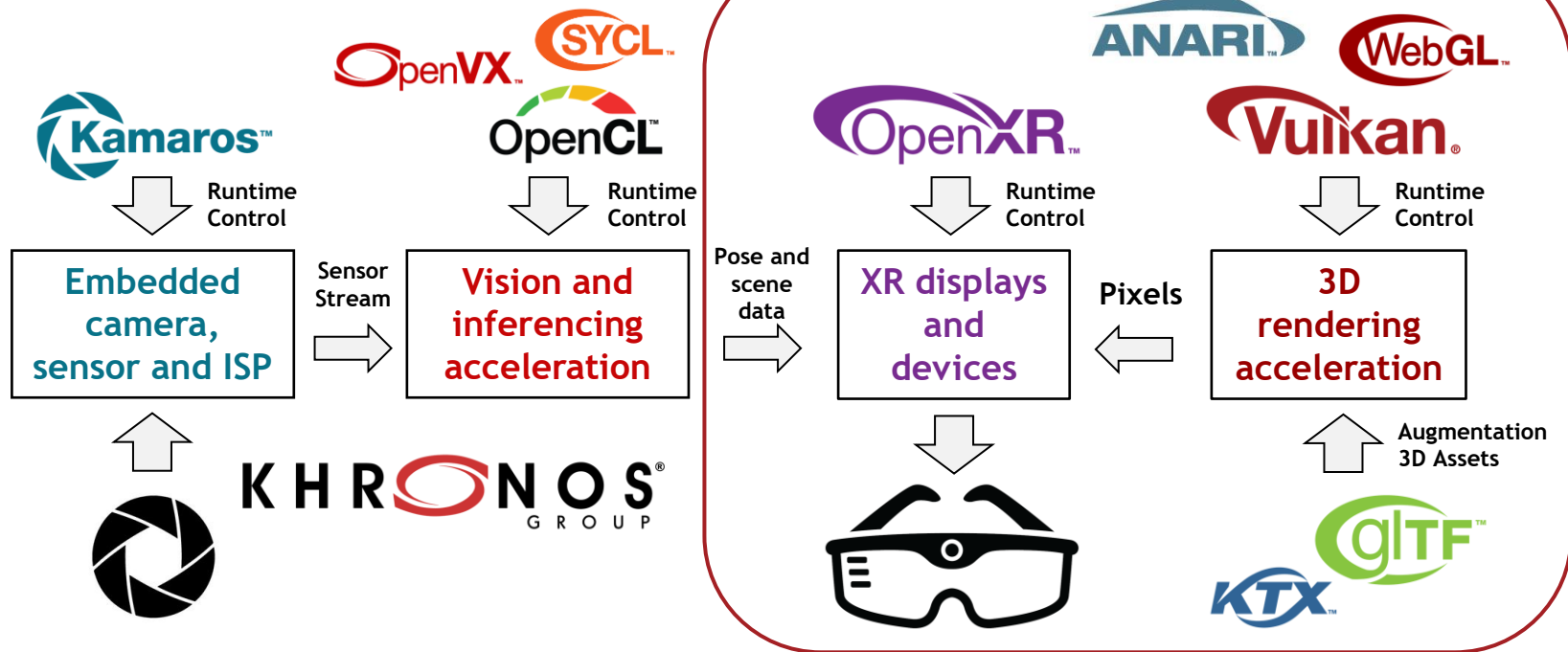
Neil Trevett
VP Developer Systems, NVIDIA
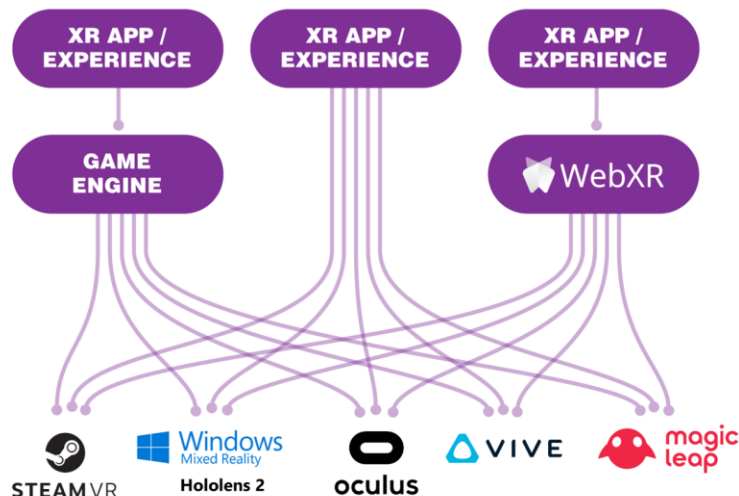**President, Khronos and Metaverse Standards Forum**

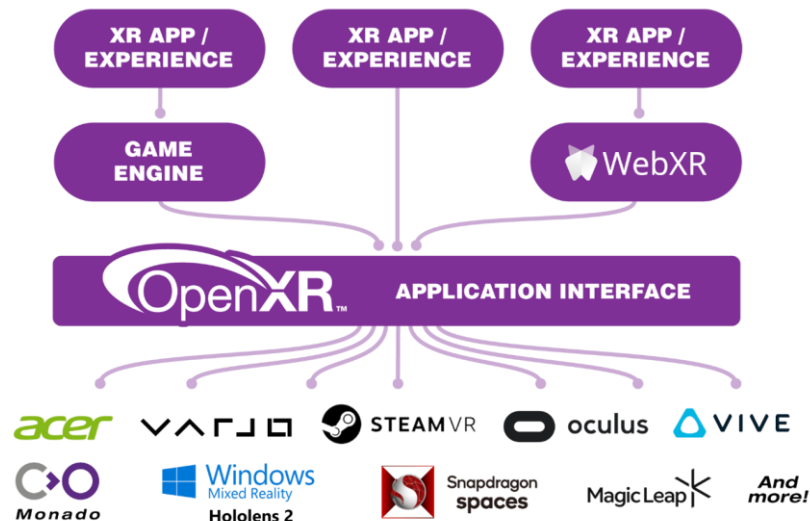**October 2023**

Khronos Standards for Spatial Computing

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 C·O
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	ul ByteDance	SONY
Spatial Labs Display Series	Neo 3 and Pico 4	Spatial Reality Display (Conformance expected summer 2023)

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

Engines

WebGL™
WebGPU

WebXR

W3C®

OpenGL|ES™ Vulkan®

OpenXR™

KHRONOS® GROUP
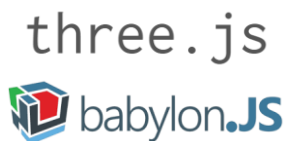
3D Stack
Driving GPUs to render scenes and augmentations

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 is evolving the WebGL specification and supports multiple implementations
    - ANGLE's Metal backend supports WebGL 2.0 in Safari on macOS/iOS
    - Coming soon to Chromium on macOS
    - display-p3 wide-gamut color profile support is in progress in Firefox

WebGL 2.0 📄 - OTHER

Next version of WebGL. Based on OpenGL ES 3.0.

	Chrome	Edge	Safari	Firefox	Opera	IE	Chrome for Android	Safari on iOS	Samsung Internet	Opera Mini	Opera Mobile	UC Browser for Android	Android Browser	Firefox for Android	QQ Browser	Baidu Browser	KaiOS Browser
				2 - 24													
				25 - 41													
	4 - 42		3.1 - 10	42 - 44				3.2 - 11.4									
	43 - 55	12 - 18	10.1 - 14.1	45 - 50	10 - 42			12 - 14.8	4 - 6.4								
	56 - 116	79 - 116	15 - 16.6	51 - 117	43 - 102	6 - 10		15 - 16.6	7.2 - 21		12 - 12.1		2.1 - 4.4.4				2.5
	117	117	17.0	118	103	11	117	17.0	22	all	73	15.5	117	118	13.1	13.18	3.1
	118 - 120		17.1 - TP	119 - 121				17.1									

Usage: % of all users — Global 94.48%

WebGL 2.0 is available on 95% of global 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
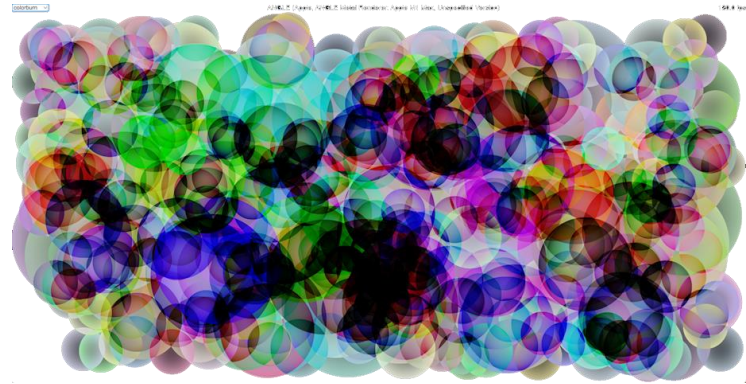
glTF Pervasive Adoption
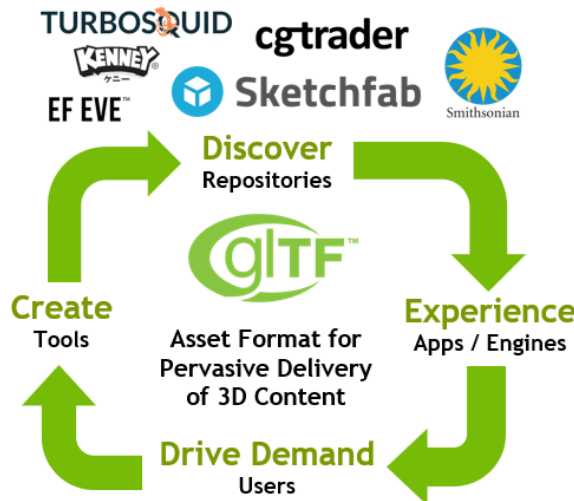
glTF and USD

glTF design goals are complementary to authoring formats such as USD
Innovate on pervasive deployment of proven technology
Optimize for run-time use cases on cloud, desktop and mobile (native and web)
Precise specification and open-source tooling for multi-vendor consistency
Pure file format – no mandated run-time behavior
Be a cooperative distillation target for authoring formats

Designed for compact, fast run-time delivery

Aligning glTF and USD ecosystems is significant industry benefit

Khronos working for glTF to be a seamless distillation target for USD with lossless roundtripping

Designed for powerful authoring collaboration

glTF – 3D Asset Transmission Format
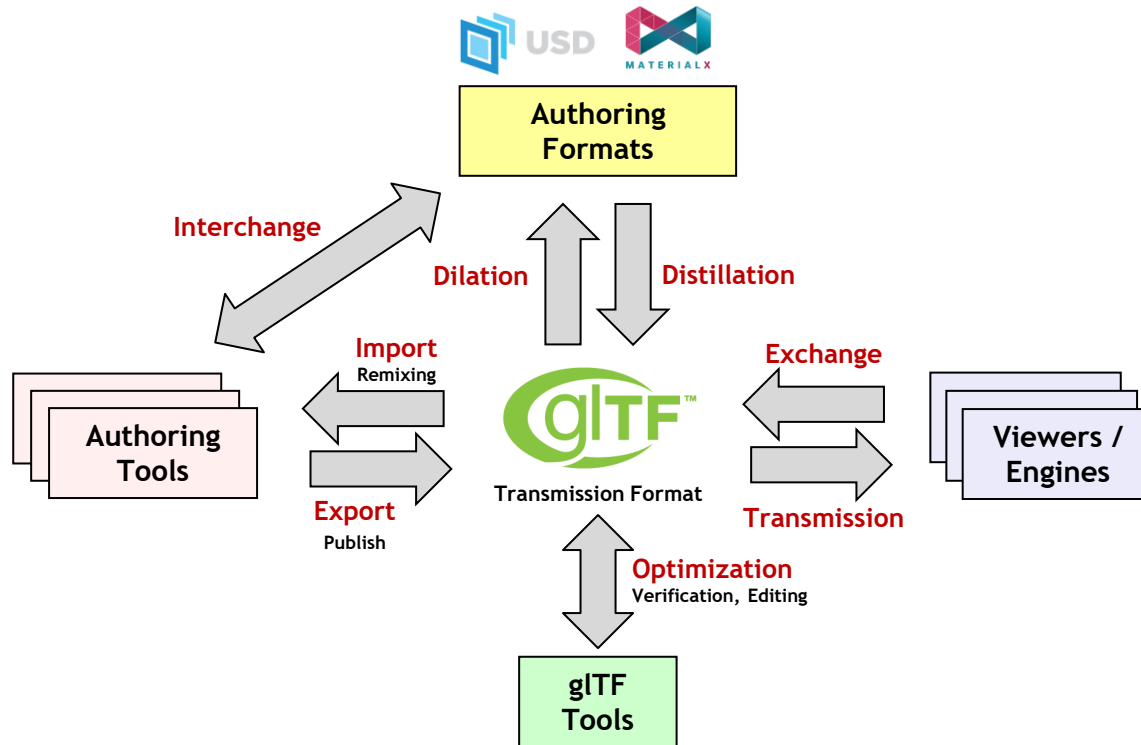
glTF 2.0 is now an
ISO/IEC International Standard

Encouraging broad adoption,
including bringing 3D
functionality to PDF and MPEG

glTF PBR Evolution

Incremental consolidation and meticulous specification of accepted industry practices

Clearcoat · Volume · Sheen · Index of Refraction · Emissive Strength · Metal / Roughness · Transmission · Specular · Iridescence · Anisotropy
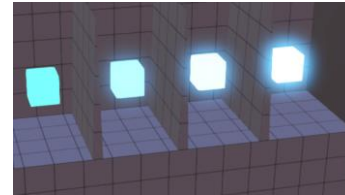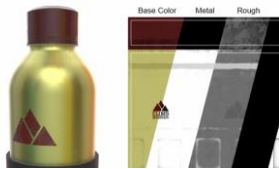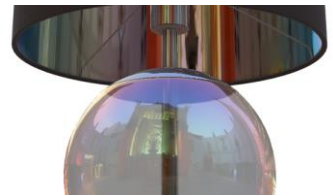
2017 · 2020 · 2021 · 2022 · 2023

Short Term glTF Roadmap

Animation+ (Blender interface)

Multi-track animation

PBR Subsurface

glTF PBR MaterialX Node

Audio

Composition

Interactivity

Physics

4Q23   1Q24   2Q24   3Q24

Finalized Specifications with Initial Implementations
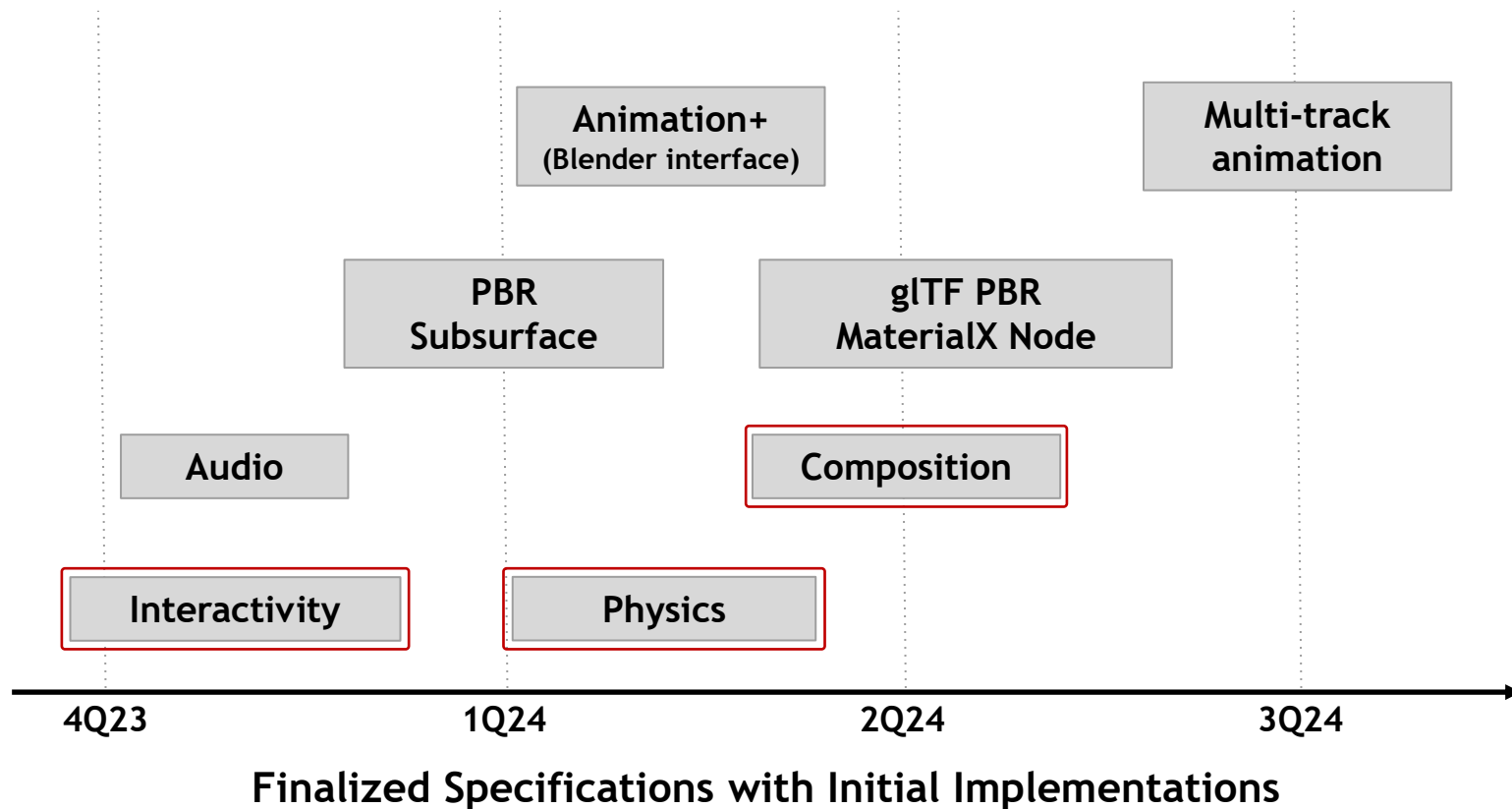
glTF Interactivity

- **Portable description of how content should respond to user actions or events**
    - Interactivity defined by a Node-based graph
- **Distillation of engine accepted practice**
    - Unity (Visual Scripting), Unreal (Blueprints), Nvidia Omniverse (Action Graph)
    - Similar design process to PBR extensions
- **Enables simple interactive applications**
    - Games, Education, Design Review, e-commerce

glTF 2.0

Interactive glTF
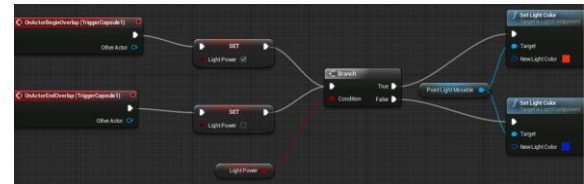
Unreal Editor

glTF Physics

- **Express the physics properties of assets in a platform independent way**
  - Enables procedural animation
  - Makes scenes more interesting, believable, and dynamic
- **Enables scene understanding**
  - Possible with render geometry, but much more efficient with physics
- **Rigid Bodies**
  - Collision geometry
  - Rigid bodies
  - Motions
  - Materials
  - Joints
  - Filters

  **Distillation of widely adopted
  physics engines practices**
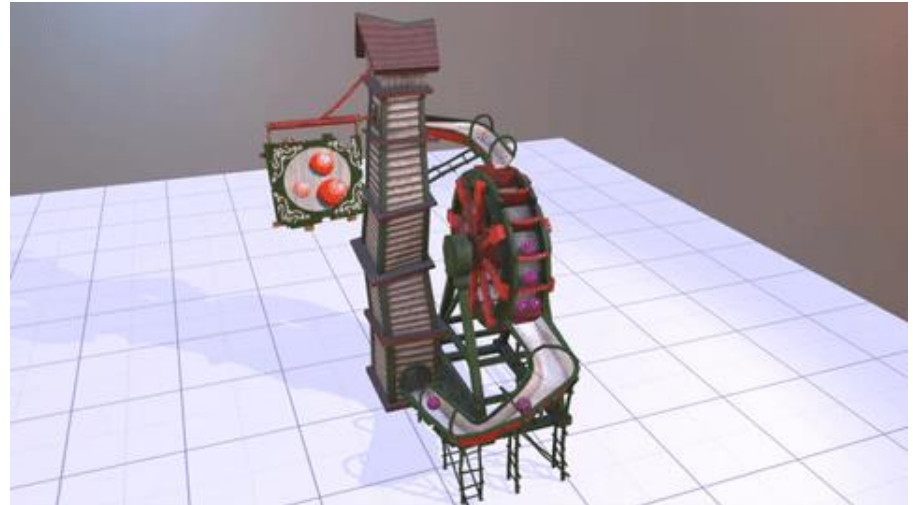
glTF Composition

- **Compose scenes and behaviors 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 by glTF Composition
  - Including behaviors

Final naming of 'composition' and .gltfc file extension may change – seeking to avoid confusion with (much more complex) USD composition

.gltfc Scene → .gltfc Node Bike 1 → .glTF Frame 1, .glTF Tire

.gltfc Node Bike 2 → .glTF Frame 1, .glTF Tire

.gltfc Node Shop → .glTF Rack, …

Image used under license, stock.adobe.com
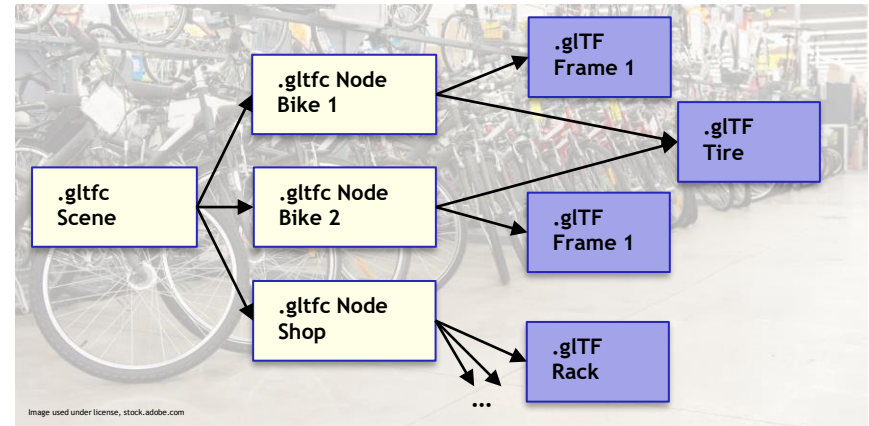
KTX GPU Texture Container Format

KTX 2.0 enables universal distribution of supercompressed GPU Textures with on-the-fly decompression to native GPU formats for significant transmission AND memory savings!

(300% zoom)
JPG + PNG
File size: 12.8 MB
Memory: 96.2 MB

(300% zoom)
KTX: UASTC + ETC1S
File size: 10.4 MB
Memory: 21.4 MB

(300% zoom)
KTX: ETC1S
File size: 4.6 MB
Memory: 15.7 MB

Models downloadable here

Khronos and the Metaverse Standards Forum

- **The metaverse is driving significantly increased interest in interoperability standards!**

- **Khronos recognized the need for broad standards cooperation to avoid duplication, eliminate gaps, and gather use cases and requirements**

- **Khronos bootstrapped the Forum in 2022 and successfully executed the Forum's transition an independent consortium in April 2023**

FAST COMPANY

[Fast Company Gives Metaverse Standards Forum Honorable Mention in 'World Changing Idea' Awards!](#)

Metaverse STANDARDS FORUM™

KHRONOS GROUP

Khronos launches the Forum in bootstrap mode to quickly start cooperative work while determining industry interest

37 Founding Companies including Meta, Microsoft, NVIDIA, Epic, Unity, Adobe, Autodesk

June 2022

Metaverse STANDARDS FORUM™

The Forum grows to over 2500 Member organizations

Multiple Domain Working Groups working to improve interoperability one project at a time

End 2022

The Forum incorporates with unanimous agreement from its membership

Independent, self-funded, non-profit industry consortium

The Forum's mission is to create a wavefront of business opportunities through fostering interoperability 'brick-by-brick' on the road to the metaverse

April 2023

Thank You! Have a Great Show!

More Information:
www.khronos.org

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@neilt3d