XR Adoption: Standards for Content Development

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Khronos Connects Software to Silicon

Open interoperability standards to enable software to effectively harness the power of multiprocessors and accelerator silicon

3D graphics, XR, parallel programming, vision acceleration and machine learning

Non-profit, member-driven standards-defining industry consortium

Open to any interested company

All Khronos standards are royalty-free

Well-defined IP Framework protects participant’s intellectual property

>150 Members - 40% US, 30% Europe, 30% Asia

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Khronos Active Initiatives

3D Graphics
Desktop, Mobile, Web
Embedded and Safety Critical

3D Assets
Authoring and Delivery

Portable XR
Augmented and Virtual Reality

Parallel Computation
Vision, Inferencing, Machine Learning

Guidelines for creating APIs to streamline system safety certification
Pervasive Vulkan

Desktop and Mobile GPUs

Platforms

- Desktop
- Android (Android 7.0+)
  (Vulkan 1.1 required on Android Q)
- Apple (via porting layers)
- Media Players
- Cloud Services
- Game Streaming
- Consoles
- Virtual Reality
- Embedded

Engines

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

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OpenXR is a collaborative design
Integrating many lessons from proprietary ‘first-generation’ XR API designs

* OpenXR 1.0 is focused on enabling cross-platform applications. Optional device plugin interface will be supported post V1.0

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OpenXR is used with a 3D API

**Application or Engine**

**High-performance, low-latency 3D rendering and composition**
- Multiview
- Context priority
- Front buffer rendering
- Tiled rendering (beam racing)
- Variable rate rendering

**Cross-platform access to XR**
- HMDs and sensors
- XR application lifecycle
- Input device discovery and events
- Sensor tracking and pose calculation
- Frame timing and display composition
- Haptics Control

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* OpenXR can be used with other 3D APIs such as Direct3D, OpenGL and OpenGL ES

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OpenXR 1.0 Availability

Significant Community Feedback
Improved
Input subsystem, game engine editor support, loader ...

Provisional Specification
*GDC, March 2019*

Ratify and Release OpenXR 1.0
*SIGGRAPH, July 2019*

Finalize Conformance Test Suite
Enable Officially Conformant Implementations

OpenXR for Windows Mixed Reality headsets and HoloLens 2
PLUS extensions to support HoloLens 2 hand tracking, eye tracking, spatial mapping and spatial anchors

OpenXR support for Oculus Rift and Oculus Quest
Oculus PC (for Rift) and Android SDK (for Quest) include OpenXR for native C/C++ development

‘Monado’ OpenXR open source implementation
Support OpenHMD hardware and Project Northstar HMD

OpenXR 1.0 plugin for Unreal Engine v4.2.4

Many more coming!
OpenXR Win-Win-Win

XR Vendors
Can bring more applications onto their platform by leveraging the OpenXR content ecosystem

XR ISVs
Can easily ship on more platforms for increased market reach

XR End-Users
Can run the apps they want on their system - reducing market confusion and increasing consumer confidence
Bringing XR to the Web

Native XR Apps

Web XR Apps

Native 3D Engines

Web 3D Engines

Lifting OpenXR functionality into the Web stack

Close cooperation between WebXR and OpenXR

The Web will Evolve into the Metaverse

Khronos provides the foundation for native and Web-based 3D/XR
OpenXR and Edge Server Applications with 5G

Wireless mobile device with display and sensors

OpenXR APIs hide the 5G round trip from applications

Sensor handling

Display composition

Low latency Sensor Data

Location-aware Content Requests

MEC (Multi-access Edge Computing) Server

1. Processes sensor data, including machine learning for environmental lighting, occlusion, scene semantics, object reconstruction and UI
2. Generates imagery from 3D models, including stereo, foveal rendering, ray-tracing, optics pre-distortion, varifocal processing

Generated Augmentations & Scenes

NVIDIA EGX

Needed assets loaded to edge server

Apps and 3D Assets
glTF 2.0 Scene Description Structure

- **.gltf (JSON)**: Node hierarchy, PBR material textures, cameras
- **.bin**: Geometry: vertices and indices, Animation: key-frames, Skins: inverse-bind matrices
- **.png**, **.jpg**, **.ktx2**: Textures

Mandatory Metallic-Roughness Materials

Optional Specular-Glossiness Materials
gltF Roadmap

**gltF Universal Textures**

*imminent*

- Complements Draco Mesh Compression
- Basis Universal encoding/transcoding
- KTX2 Container

**Second Generation Physically-Based Rendering (PBR)**
- Set of coherent extensions
  - Clear coat (imminent)
  - Absorption/attenuation
  - Subsurface scattering
  - Anisotropy
- Wide Industry Cooperation
  - Dassault Systèmes
  - Autodesk Standard Surface
  - Google Filament
  - NVIDIA MDL, OTOY Octane
  - UX3D, Chaos Group V-Ray

**Seeking Requirements**
- Subdivision surfaces
- Advanced Animation
- LOD and Streaming
- Compressed Point Clouds
- Cross-asset linking
- Enhanced Metadata
- Composability
- Instancing
- CAD/BIM model support
- Encryption and security
- 3D Printing

Working Group is constantly balancing feature requests against the ‘gltF Prime Directive’ - remain a universal and easy to process delivery format

File Size | GPU Size
---|---
Uncompressed | JPEG
2,798,518 | 315,619
JPEG must be fully decompressed into GPU memory

Universal textures can be directly transcoded to compressed GPU textures

File Size | GPU Size
---|---
Memory | KTX2 Container
Etcs | 2,097,152 | 232,104
JPEG | 3,500,000 | 0
JPEG | 7,000,000 | 0
JPEG | 10,500,000 | 0
JPEG | 14,000,000 | 0

FlightHelmet_baseColor
2048 x 2048, RGB

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3D Commerce - The Opportunity

3D Commerce = E Commerce enhanced with the use of 3D Models on any platform - including VR and AR

Early Experience Shows
Increased customer engagement!
Strengthened brand loyalty!
Deeper product understanding!
More online sales!
Fewer returns!

IKEA catalog uses augmented reality to give a virtual preview of furniture in a room - August 2013

IKEA Communications AB

So why is 3D Commerce taking so long to become widespread?

= $$!
3D Commerce - Today’s Reality

I wish I had high quality, realistic 3D models for virtual promotional photoshoots!

Everyone defines their product data for sizes and colors differently - nothing is consistent!

I need the materials in my 3D models to look completely realistic!

Products don’t come with 3D data - and I can’t physically scan them all fast enough!

The green couch looks blue on some devices - lots of product returns are expensive!

CAD tools don’t let me easily generate the data I need for E Commerce!

Many 3D products on my ecommerce website first appear upside down! I have to hand-tune 1000s of models!

Complex retail pipeline with hundreds of companies and millions of products

Many friction points: tooling, technical and commercial

3D Commerce can’t reach industrial scale so...

Interoperability Standards to the rescue!
Khronos 3D Working Group

Announced SIGGRAPH 2019

Creating specifications and guidelines to align the 3D asset workflow from product design through manufacturing and each stage of retail to end-user delivery platforms.

Any company is welcome to join!  
https://www.khronos.org/3dcommerce
3dcommerce-feedback@khronos.org

Broad Industry Participation from tooling, retail, technology and platform companies.
3D Commerce - Four Initial Areas of Focus

**Asset Creation Guidelines**
For tools and product designers to create assets with consistent data to be used through the 3D Commerce pipeline

**Product Configuration**
Universal product configurability data and guidelines on how to drive consistent product display

**First Goals**
Helping evolve glTF to meet the needs of 3D Commerce
- Next generation PBR
- Advanced metadata

Industry cooperation to urgently develop guidelines and tools to address priority problem areas

**Metadata**
Structured metadata definitions and examples to consistently carry product information through the retail pipeline

**Viewer Validation and Certification**
Test models, reference viewer, display analysis tools and capability specifications to guarantee a consistent and accurate end user experience
How To Get Involved!

• Any company or organization is welcome to join Khronos!
  - For a voice and a vote in any of these standards - membership starts at $3,500

• OR request an invite to Vulkan, OpenXR and 3D Commerce Advisory Panels/Forums
  - No fee, under Khronos NDA - and IP Framework for draft specification feedback

• We welcome your feedback
  - Khronos Forums: https://forums.khronos.org/
  - Khronos Slack Channels: https://khronosdevs.slack.com/messages
  - Khronos open source GitHub repositories: https://github.khronos.org/

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