glTF and 3D Commerce Introduction

December 2020
Khronos Connects Software to Silicon

Open interoperability standards to enable software to effectively harness the power of 3D and multiprocessor acceleration

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

Founded in 2000

>150 Members ~ 40% US, 30% Europe, 30% Asia
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
glTF - The JPEG of 3D!

<table>
<thead>
<tr>
<th>Audio</th>
<th>Video</th>
<th>Images</th>
<th>3D</th>
</tr>
</thead>
<tbody>
<tr>
<td>MP3</td>
<td>H.264</td>
<td>JPEG</td>
<td>glTF</td>
</tr>
</tbody>
</table>

- Efficient, reliable transmission
- Bring 3D assets into 1000s of apps and engines
- Compact to Transmit
- Simple and Fast to Load
- Describes Full Scenes
- Runtime Neutral
- Open and Extensible

glTF 1.0 - December 2015
Primarily for WebGL
Uses GLSL for materials

glTF 2.0 - June 2017
Native AND Web APIs
Physically Based Rendering
Metallic-Roughness and Specular-Glossiness

glTF spec development
on open GitHub - get involved!
https://github.com/KhronosGroup/glTF

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Core glTF 2.0 Asset 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

PBR stands for “Physically-Based Rendering”

**Mandatory Metallic-Roughness Materials**
- Base Color (Albedo) | Metalness | Roughness
- Emission | Normal Map | Baked Ambient Occlusion

**Optional Specular-Glossiness Materials**
- Diffuse | Specular | Glossiness

Texture based PBR materials
glTF Draco Mesh Compression Extension

- glTF extension for compressed geometry
  - Typically 10-25x geometry size reduction

- Google Draco technology - designed for decompression efficiency and speed
  - https://github.com/google/draco

- Draco geometry encoders and decoders in open source
  - C++ source code encoder
  - C++ and JavaScript decoders
  - https://github.com/google/draco/tree/gltf_2.0_draco_extension

- glTF Draco compression adoption is growing in tools, applications and engines
  - glTF pipeline, FBX2glTF, AMD Compressonator and glTF sample models

Mesh Compression Ratios

- BoomBox
- Duck
- SciFiHelmet
- Suzanne

0x 5x 10x 15x 20x 25x
glTF Universal Texture Extension

- Supercompressed textures that can be transcoded for native acceleration on any GPU
  - Eliminates need for multiple texture assets for different target platforms

- Uses ‘Basis Universal’ compression technology from Binomial
  - Compressed textures transcodable on-the-fly to native GPU-accelerated texture formats
  - RDO-encoded, block-compressed UASTC with optional zstd compression - for highest quality
  - Block-compressed ETC1S with custom LZ supercompression - for JPEG-sized textures
    - https://github.com/BinomialLLC/basis_universal

- KTX 2.0 container for consistent, cross-vendor asset generation and validation
  - Open source tools to create, transcode and upload to WebGL, OpenGL and Vulkan
    - https://github.com/KhronosGroup/KTX-Software/tree/ktx2

[Diagram showing the process of encoding and transcoding textures]
glTF Universal Textures: Compression Ratios

FlightHelmet_baseColor
2048 x 2048, RGB

PNG and JPEG must be fully decompressed into GPU memory

Universal textures can be directly transcoded to compressed GPU textures

File Size
Bytes

GPU Size

Uncompressed
PNG
JPEG
ETC1S
Basis Universal

12,582,912
2,776,518
315,619
2,097,152
232,104

14,000,000
10,500,000
7,000,000
3,500,000
0
KTX and .basis Container Formats

Two complementary container formats for Basis Universal assets

'Basis Universal' texture compression technology
Supercompressed JPG-sized textures that can be transcoded on-the-fly to natively supported compressed GPU formats
https://github.com/BinomialLLC/basis_universal

.basis
Binomial and Google open sourced 'Basis Universal' compressor and transcoder
C++ or WebAssembly code for handling
'.basis' format textures in native apps and websites
https://github.com/binomialLLC/basis_universal
Works if developer is in full control of their own texture assets and rendering

Khronos KTX
Precisely-defined container supporting wide range of texture formats used in Vulkan/DirectX/Metal with streaming and full random access to MIP levels.
glTF Universal Texture extension uses KTX 2.0.
Open-source tools to create, transcode and upload Universal Textures to WebGL, OpenGL and Vulkan
https://github.com/KhronosGroup/KTX-Software/
Great for cross-vendor distribution of textures to multiple applications and engines
glTF PBR Materials Roadmap

Creating a rich physically-based material framework for the glTF ecosystem

- glTF extensions add PBR material parameters that integrate with and build on existing materials
- Building industry consensus on interoperable PBR that is also deployable on diverse platforms and devices

June 2017
Core glTF 2.0
Mandatory Metallic-Roughness
Optional Specular-Glossiness

Water Bottle sample is CC0, by Microsoft

December 2020
First Wave glTF PBR Extensions
Clear Coat
Transmission
Sheen

Future Waves of glTF PBR Extensions
Subsurface Scattering, Attenuation,
Index of Refraction (IOR), Thickness, Specular Color,
Anisotropy, Translucency, Thin Film (iridescence)
and more…

Roadmap includes requirements from Khronos 3D Commerce Working Group

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glTF Clearcoat, Transmission and Sheen PBR

Clearcoat
KHR_materials_clearcoat
Clearcoat Factor
Clearcoat Texture
Clearcoat Roughness Factor
Clearcoat Roughness Texture
Clearcoat Normal Texture

Layers over a Metallic-Roughness Material and optionally over Sheen

Transmission
KHR_materials_transmission
Transmission Factor
Transmission Texture

Layers over a Metallic-Roughness Material

Sheen
KHR_materials_sheen
Sheen Color Factor
Sheen Color Texture
Sheen Roughness Factor
Sheen Roughness Texture

Layers over a Metallic-Roughness Material and optionally under Clearcoat
New Wave PBR Ecosystem Forming Quickly

Tools to Create and View PBR Assets

- Autodesk 3DS MAX
- Adobe
- Blender

Online Model using Babylon.js

- glTF Validator
- PBR Capable Viewers and Applications
  - three.js
  - Babylon.js

PBR Samples
- glTF Sample Viewer

Input welcome on GitHub from developers and artists. Let us know what PBR materials are important to you!
3D Commerce - The Promise

IKEA Communications AB

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

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

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

= $$!
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 thousands of products
Many friction points - tooling, technical and commercial

3D Commerce can’t reach industrial scale so...
Interoperability standards to the rescue!
3D Commerce Initiative - the Opportunity

Enable 3D Commerce to achieve deployment at industrial scale
Industry cooperation between technology and retail leaders
Interoperability standards, guidelines and Certification Programs

Alignment Needed
PRODUCT DESIGN TOOL
MANUFACTURER
RETAILER

Alignment Needed
PRODUCT DESIGN TOOL
MANUFACTURER
RETAILER

Alignment Needed
MANUFACTURER
RETAILER

MOBILE & WEB PLATFORMS
XR PLATFORMS
SOCIAL PLATFORMS
AG PLATFORMS

View in 3D
Leading Technology & Commerce Companies...

World-Leading 3D Technology Companies

World-Leading E-Commerce Companies
... Working Together at Khronos on 3DCommerce™
Khronos 3D Commerce 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

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

**Viewer Certification**
Test models, reference viewer, display analysis tools and capability specifications to guarantee a consistent and accurate end user experience

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**glTF’s first new generation PBR materials enable realistic and reliable display of many household goods. Next wave glTF requirements may include realistic rendering and animation of apparel**

https://belcour.github.io/blog/research/2017/05/01/brdf-thin-film.html

https://google.github.io/filament/Filament.md.html

https://modelviewer.dev/fidelity/
3D Commerce Khronos Synergy

3D Asset Format

glTF Extensions  Viewer Certification  Asset Creation Guidelines

OpenXR™  Portable AR and VR Apps

 WebGL™  Interactive 3D on the Web

Vulkan. High-performance cross-platform 3D graphics

3D Commerce™