Development Day
Pervasive 3D
CC-BY
9 August 2023
Pervasive 3D
The State of glTF

Alexey Medvedev, Meta
Chair 3D Formats
3D Formats

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

- ISO/IEC/JTC-1
Goals of adoption

**glTF** is the "JPEG of 3D", but vision is wider

**glTF** is a Transport Format for 3D Assets
Ratified and in-progress extensions

- **KHR_animation_pointer**
  - Allows targeting any value in a glTF asset. For example: Allows animation of color values or camera fov.

- **KHR_audio** extension
  - Adds ability to store audio and represent emitters in glTF.
  - Unifies existing vendor extensions:
    - OMI_audio_emitter
    - MSFT_audio_emitter

- **EXT_meshopt_compression** - Compresses mesh (geometry) data
- **EXT_mesh_gpu_instancing** - Reduces GPU rendering load
- **EXT_mesh_features** - Identifies features classification
- **EXT_structural_Metadata** - Supports metadata on scene features
KTX

Universal GPU Compressed Textures

Texture Assets (.png or .jpg) → Encode and Supercompress → Basis Universal supercompressed textures in KTX 2.0 container → Transcode ON THE FLY to GPU formats

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
Physics

- Collision geometry
- 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 (Hierarchical Level of Detail - HLOD)
glTF tomorrow

• Interactivity/behaviors
• Point clouds
• Annotations
• Composition
• Physics
• Audio
• New materials including MaterialX inputs
• Skeletal/body definitions
• Anchors, haptics
• USD⇔glTF interoperability
• Education
• Your idea?
Short Term glTF Roadmap

- **4Q23**
  - Behaviors (inc. animation pointer)
  - Audio
  - Physics
  - PBR Subsurface

- **1Q24**
  - MaterialX Node
  - Composition

- **2Q24**
  - Animation+ (Blender interface)

- **3Q24**
  - Multi-track animation

Finalized Specifications with Initial Implementations
Leveling Up 3D Commerce

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 for glTF & 3D Commerce
Carmine Luxe Arm Accent Chair with Brass Legs - Threshold™

$210.00 (reg. $330.00)
Sale ends 7/11/22 (92% off)
When purchased online

Color: Sage Green Velvet

Ship to 52404

Get it by Tue, Aug 1
Free shipping - Exclusions Apply
This item isn’t sold in stores

See this item in 3D

This item ships in its original packaging, revealing what’s inside.
LANDSKRONA
3-sits soffa, Grann/Bomstad svart/metall
9 995:-
7 995:- exkl. moms
(29)
Delbar natur Tr / Fr / Mäng / Mål: totalbelopp 11 224:- eff. ränte 7.87% med flera banker

10 års garanti
Medelfast
FURY
66,935.00

Regular length (36mm - 38mm wrist size)

This item will be individually hand-assembled upon order, thereby ensuring customer deliveries within 3-4 weeks.

Ceramic bezel and sapphire crystal are, flying and anti-reflected glass. The butterfly clasp is, precision, a stainless steel pilot's watch. Featuring the high-performance Bremont-branded 21-Jewel calibre movement, the FURY is a throwback to the polished stainless steel in-strike case which has been true of Bremont's Headquarter The Wing in Northampton, England.

SIZING GUIDE

3 YEAR WARRANTY

SWISS MADE IN THE UK
FALL ASLEEP FASTER
Gently warms your feet on either side to help you fall asleep faster.
EGO Power+ Z6 ZT4204L 42 in. 56 V Battery Zero Turn Riding Mower Kit (Battery & Charger) W/ FOUR 10.0 AH BATTERIES

SALE
$4,999.00

Make 6 payments of $833.17mo at 0% APR. Learn more

Promos
Ace Rewards members Save $500

ACE REWARDS
Estimated Points Earned: 4990

Add-on Service
Assembly available $20.00

Get it from:
Westlake Ace Hardware, Kansas C

Features of the EGO Power+ Z6
Importance of standardisation:

- Physical to Digital Consistency
  - 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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  - Processing & bandwidth can be varied therefore the lower the loading time the better. glTF stores 3D model information in JSON format. The use of JSON minimizes both the size of 3D assets and the runtime processing needed to unpack and use those assets.
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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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- Metaverse & Wearable AR (New Customers)
  - As new devices become more readily available and more affordable, so does the need to bring a consistent experience in other types of space and device. The demographic changes as does the requirement.
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- **Viewer Certification program**
Under development & exploration:

- **Skeletal & Facial Anchoring**
  - A small task sub group exploring standards needed for facial anchoring, wrist anchoring and other key virtual try on needs.
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  - The use of generative AI in 3D Asset & scene creation whilst following standards
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- **Industry Involvement**
  - Apparel, Automotive, Architecture, Gaming
Retailers looking to join the conversation about scaling 3D in their own eCommerce applications are invited to join the 3D Commerce Working Group at Khronos. Learn more at:

khronos.org/3dcommerce/ or email 3dcommerce-feedback@khronos.org.
Body Anchors

Patrick Hadley, Snap
Chair, Skeletal & Facial Anchoring / 3D Commerce
glTF and PBR Helped Standardize 3D Commerce

**glTF™ 2.0 Specification**

*Figure 7: Physically Based Rendering Example*
3D Commerce Initial Focus on Furniture / Home
Furniture (Surface) Placement

Asset Pivot Point (Placement, hanging points)

- Pivot, World (0,0,0)
  (pivot favoring back of the mesh)
- Pivot, World (0,0,0)
  (pivot aligns the floor)

Vertical-Surface Object  Floor-Surface Object  Ceiling-Surface Object
Need to Extend Focus to 3D / Body Interaction

- Lack of virtual try on (VTO) standards limit interoperability
Skeletal and Facial Body Anchor WG - Goals

1. Consistent
2. Best (Optimal) Fit
3. Easy to Use
4. Allows for Automation (No Touch)
Body Anchor Proposal - Footwear

<table>
<thead>
<tr>
<th>Medical / Precise Term</th>
<th>Khronos readable</th>
<th>Type</th>
<th>Required?</th>
<th>Description / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Footwear (Sneakers)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Leg</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Shoe Sole Rear Heel</td>
<td>shoe_insole_rear</td>
<td>Anchor</td>
<td>Required</td>
<td>used for placement, positioned on the back sole of the heel</td>
</tr>
<tr>
<td>Shoe Ankle Opening Rear</td>
<td>shoe_ankle_rear</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>middle back of the top of the shoe ankle opening</td>
</tr>
<tr>
<td>Shoe Ankle Opening Front</td>
<td>shoe_ankle_front</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>middle front of the top of the shoe tongue ankle opening</td>
</tr>
<tr>
<td>Shoe Ankle Opening Outer</td>
<td>shoe_ankle_outer</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>middle side (away from the body) of the top of the shoe ankle opening</td>
</tr>
<tr>
<td>Shoe Ankle Opening Inner</td>
<td>shoe_ankle_inner</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>middle side (towards the other leg) of the top of the shoe ankle opening</td>
</tr>
<tr>
<td>Shoe Sole Inner</td>
<td>shoe_insole_inner</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>furthest point on the inside of the foot (positioned on the sole), just before the toebox</td>
</tr>
<tr>
<td>Shoe Sole Outer</td>
<td>shoe_insole_outer</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>furthest point on the outside of the foot (positioned on the sole), just before the toebox</td>
</tr>
</tbody>
</table>

- Currently focused on Sneakers
- One placement anchor (required)
- Six ‘optional’ for clipping / fitting
Body Anchor Proposal - Eyewear

- Applies to glasses / sunglasses
- Three placement anchors (req)
- Two ‘optional’ for fit / clipping

<table>
<thead>
<tr>
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<th>Type</th>
<th>Required?</th>
<th>Description / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glasses</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Nose Bridge</td>
<td>eyewear_nosebridge</td>
<td>Anchor</td>
<td>Required</td>
<td>used for placement, positioned on the bottom of the nose bridge</td>
</tr>
<tr>
<td>Left Ear Contact with Glasses Temple</td>
<td>eyewear_l_ear_glassestemple</td>
<td>Anchor</td>
<td>Required</td>
<td>placed where the glasses’ left temple contacts the ear</td>
</tr>
<tr>
<td>Right Ear Contact with Glasses Temple</td>
<td>eyewear_r_ear_glassestemple</td>
<td>Anchor</td>
<td>Required</td>
<td>placed where the glasses’ right temple contacts the ear</td>
</tr>
<tr>
<td>Left Lens Bottom Center Point</td>
<td>eyewear_l_lens_bottom</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>point marking the bottom center of the left lens (at the bottom of the lens frame)</td>
</tr>
<tr>
<td>Right Lens Bottom Center Point</td>
<td>eyewear_r_lens_bottom</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>point marking the bottom center of the right lens (at the bottom of the lens frame)</td>
</tr>
</tbody>
</table>
### Body Anchor Proposal - Wrist (Watch / bracelet)

<table>
<thead>
<tr>
<th>Medical / Precise Term</th>
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<th>Type</th>
<th>Required?</th>
<th>Description / Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wrist (Watch / Bracelet)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arm</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Wristband Center</td>
<td>wristband_center</td>
<td>Anchor</td>
<td>Required</td>
<td>used for placement, positioned on the center of the circle of the band</td>
</tr>
<tr>
<td>Wristband Top</td>
<td>wristband_top</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>positioned on the inside of the band at the top (facing out from the wrist)</td>
</tr>
<tr>
<td>Wristband Bottom</td>
<td>wristband_bottom</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>positioned on the inside of the band at the bottom (towards the inside of the wrist)</td>
</tr>
<tr>
<td>Wristband Inner</td>
<td>wristband_inner</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>positioned on the inside of the band at the inner side of the wrist (towards thumb)</td>
</tr>
<tr>
<td>Wristband Outer</td>
<td>wristband_outer</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>positioned on the inside of the band at the outer side of the wrist (towards pinky)</td>
</tr>
<tr>
<td>Watch Face Attachment - Outer</td>
<td>watchface_outer</td>
<td>Attachment</td>
<td>Optional</td>
<td>positioned on the outer attachment of the fixed ‘face’ (doesn't change size)</td>
</tr>
<tr>
<td>Watch Face Attachment - Inner</td>
<td>watchface_inner</td>
<td>Attachment</td>
<td>Optional</td>
<td>positioned on the inner attachment of the fixed ‘face’ (doesn't change size)</td>
</tr>
</tbody>
</table>

- Band is flexible, face can be fixed
- One placement anchors (req)
- Four ‘optional’ for fit / clipping
- Two ‘optional’ for watch face
# Body Anchor Proposal - Ring

<table>
<thead>
<tr>
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</thead>
<tbody>
<tr>
<td>Ring</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fingers</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ring Center</td>
<td>ring_center</td>
<td>Anchor</td>
<td>Required</td>
<td>used for placement, positioned on the center of the circle of the ring</td>
</tr>
<tr>
<td>Ring Top</td>
<td>ring_top</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>positioned on the inside of the ring at the top (facing out from the back of the hand)</td>
</tr>
<tr>
<td>Ring Bottom</td>
<td>ring_bottom</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>positioned on the inside of the ring at the bottom (towards the palm of the hand)</td>
</tr>
<tr>
<td>Ring Inner</td>
<td>ring_inner</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>positioned on the inside of the ring at the inner side of the finger (towards thumb side)</td>
</tr>
<tr>
<td>Ring Outer</td>
<td>ring_outer</td>
<td>Fit / Clipping</td>
<td>Optional</td>
<td>positioned on the inside of the ring at the outer side of the wrist (towards pinky side)</td>
</tr>
<tr>
<td>Ring Setting</td>
<td>ring_setting</td>
<td>Attachment</td>
<td>Optional</td>
<td>positioned on the bottom center of the ring setting (doesn't change size - diamond, etc)</td>
</tr>
</tbody>
</table>

- Band is flexible, setting can be fixed
- One placement anchors (req)
- Four ‘optional’ for fit / clipping
- One ‘optional’ for ring setting
What’s Next?

- Formal glTF extension review process in GitHub
- Ratify the glTF extension
- Develop tools to help creators apply to previously built 3D models
What’s Next

Apparel

Earrings

Necklaces

Handbag body try on
Physically Based Rendering (PBR)

Ed Mackey, AGI
Chair, PBR / 3D Formats

Henrik Edstrom, Autodesk
PBR / 3D Formats
The Evolution of PBR in glTF

- Metal / Rough
- Clearcoat
- Sheen
- Transmission
- Volume
- Index of Refraction
- Specular

2017
2020
2021
The Evolution of PBR in glTF

- Emissive Strength
- Iridescence
- Anisotropy
Anisotropy

- The amount of roughness across a surface increases along the specified tangent direction.
- Reflections are noticeably distorted in that direction.
Anisotropy Parameterization

KHR_materials_anisotropy

- **anisotropyStrength**
  Indicates additional surface roughness is present

- **anisotropyRotation**
  Measured in radians, counterclockwise from tangent vector

- **anisotropyTexture**
  Red, Green - 2D direction vector
  Blue - Strength
IBL Approximations for Anisotropy

- Specification focuses on physical properties of material, not fast rendering approximations.

- Yet, specification is supportive of fast approximations, such as stretched IBL (shown on right).

- Path tracers can be accurate, rasterizers can go fast, innovators can innovate... all from the same glTF asset.
What’s Next on the PBR Roadmap

● Subsurface scattering & diffuse transmission are on the horizon.

● Additional skin rendering expertise is desired by the group.  
  (Please join Khronos!)
Relationship with other PBR material models

- Same principle as other Uber shaders
  - Adobe Standard Material
  - Autodesk Standard Surface
  - Blender Principled BSDF
  - Dassault Enterprise PBR
  - USD Preview Surface

- Advantages over shading languages or BSDF/lobe/closure graphs
  - Artist friendly and intuitive
  - Expressive enough in practice
  - Portable (easy to target low-end)

Ben Houston’s PBR comparison: https://docs.google.com/spreadsheets/d/1Af5Oevg-ES4aEH3BrH6tpzrUt9oPxN2O6wm5YRD9nZEl/edit#gid=0
Why not adopt one of the other Uber shaders?

- Not widely supported by engines or tools, especially real-time
- Needed an incremental approach: separate PBR extensions
  - Implementable in (real-time) engines today
  - Prioritize value and maturity
- Existing PBR models were used as a basis for the PBR extensions
  - Adobe Standard Material
  - Autodesk Standard Surface
  - Blender Principled BSDF
  - Dassault Enterprise PBR

Easy to convert to and from glTF PBR
Relationship with MaterialX

- MaterialX is not a PBR model itself, but a graph based standard to exchange both pattern graphs (texturing) and PBR models across applications and renderers:

Pattern graphs + PBR graphs + ShaderGen (optional)

Driving input channels:
- color
- roughness
- ior
- ...

Expresses a PBR model:
- glTF PBR
- Standard Surface
- USD Preview Surface
- ...

- GLSL
- OSL
- MDL
- MSL
- ...

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Khronos glTF PBR available in MaterialX

- glTF’s PBR material is available as a node graph in MaterialX since last year.

- This year we are exploring the possibility to use MaterialX as a set of procedural texture inputs into glTF’s existing PBR model.
  - Would enable much higher detail in smaller assets.
  - Would remain compatible with existing PBR shaders.
  - Assets could optionally offer texture atlas fallbacks for compatibility.
Interactivity

Gerald Guyomard, Adobe
Adding Interactivity to glTF

★ Interactivity brings your 3D Content to life:
  ○ content dynamically reacts to user inputs
  ○ A typical use case: Product Configurators
Adding Interactivity to glTF

glTF can embed static scenes made of multiple sorts of assets (meshes, textures, animations, sounds...) but there is no internal rules to define how the runtime should handle them

*Until now interactivity has been external to glTF, hence hardcoded into the application*

Interactive content is not portable to other applications
Adding Interactivity to 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...)

KHronos Group

KHR_interactivity

Interactive glTF

glTF TODAY
General Strategies for building Interactivity Logic

- Write code
  - Compiled Language: C, C++, Swift...
  - Interpreted Language: Javascript, Lua, Python...
  - It requires some programming skills
  - Portability Issues

- Visual Scripting
  - Creator assembles and connects building blocks
  - Much easier to learn for non-engineers (no syntax to learn, no compilation necessary)
  - More portable (lightweight runtime, no sandboxed VM to rely on)
  - Limited set of blocks makes it more secure

```c++
#include "GameEngine.h"

class MyGame {
private:
    Object* _object;

public:
    void onKeyPressed(char key) override {
        if (key == ' ') {
            while (true) /* pseudo code */{
                ::sleep(1);
                _object->rotateBy(30.f);
            }
        }
    }
};
```
Visual Scripting: Node Based Graph

- Comprehensive feature set (get/set variables or world state, branching flow, logic)
- Implemented by Unity (Visual Scripting), Unreal (Blueprints), Nvidia Omniverse (Action Graph), ...

★ KHR_interactivity provides specifications for Node Based Graphs:
  - Accessible and powerful
  - Extensible with future extensions
  - Compatible with visual editing, but visual editors are not required
Example of a glTF Interactivity Graph

- Enumerates a sequence of integers 1, 2, 3, 4, 5
- Sends custom events "odd" or "even" for every number (eg \((\text{value} \% 2) == 0\)?)
- Once done, after 2 seconds, sends custom event "Done"

Various categories of Node:
- `lifeCycle/`.onStart, `onTick`
- `forLoop`, `delay`, `branch`, `while`
- `modulo`, `equal`, `add`, `subtract`
- `send`, `receive`
What can't you do, and why?

Considerations: Security, Portability, Ease of Implementation

Limitations:
- No dynamic allocation (no object instantiation, no array variables, no dynamic strings)
- No network access
- No file system access
- No multi user
Composite Scenes

Leonard Daly, Khronos / Daly Realism
Chair, Tooling / Pervasive 3D
Outline

- Use cases for complex scenes
  - graphics of several different situations
- Khronos developing glTF Composition
  - New file format
  - Supports glTF files as “leaf” nodes
  - Planned support for Interactivity
- Video of Demo
  - 90 seconds (at most)
Origination of Idea

- Adobe came to 3D Formats with a description of Composition & Interactivity at the same time as 3D Commerce was beginning to formulate use cases for the same
- Separate development with knowledge of the others work
- Combined efforts this spring with 3D Commerce taking the lead on Composition and 3D Formats for Interactivity
Types of Composition

- Level of detail
  - Distance based [traditional]
  - Time based [items that do not need to be visible throughout experience]
  - Environment based
- Streaming [large model progressive loading]
- Smart Loading [based on user device & network]
- Change (add/delete) objects in scene
LOD - Geospatial

Tree arrangement of data to support scene detail at varying distance and allow ease of navigation while streaming important data.

![Image of a water treatment plant](image.png)
LOD: Building Information Modeling
LANDSKRONA
3-sits soffa, Grann/Bomstad svart/metall

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10 års garanti

Medelfast
Work to Date

- Work done in May 2023 as Prototype
- Basic test of current specification
- glTF files are “leaf” nodes [high-level scene graph]
- Includes interactivity
- Note name change to “gltf Composition”
- Demo
Plans and Next Steps

• Specification development
  - Interactivity - already described & in progress
  - Composition - work just starting
  - All in public GitHub

• Prototype development
  - Use case & Specification development by 3D Commerce
  - Technical development by 3D Formats
  - Prototype development by UX3D by extending Sample Viewer
Learn More

- **Khronos Members**
  - 3D Commerce - use cases and concept development
  - 3D Formats - technical & specification development

- **Partially Public**
  - 3D Formats Advisory Panel
  - 3D Commerce Forum

- **Fully Public**
  - GitHub repo for Interactivity
  - SampleViewer Demo
  - ???

- **Contact**
  - Leonard Daly, Khronos Project Manager <Leonard@KhronosGroup.org>
  - Dan Firth, 3D Commerce WG Chair
  - Alexey Medvedev, 3D Formats WG Chair
Tooling

Leonard Daly, Khronos / Daly Realism
Chair, Tooling / Pervasive 3D
Mission & Projects

Provide the focus on developing tooling for glTF and other asset formats

Undertaken projects to

- Increase visibility of glTF
- Increase support to the community
- Easier to use glTF
- New & existing member outreach
- Community outreach
Members

- AGI - Ed Mackey
- Amazon - Jack Mousseau
- Cesium - Adam Morris
- RasterGrid - Mátyás Császár
- Snap - Lydia Lam
- Wayfair - Eric Chadwick
- Independent - Marco Hutter
- Independent - Alexey Knyazev

Contractors (alphabetical)

- Julien Duroure, Blender
- Khronos, Project Explorer
- Phasmatic, glTF-Compressor
- RasterGrid, KTX Tool
- SuperDNA Labs, Asset Auditor
- UX3D, SampleViewer
- visualSilicon, Videos

Plus Support from 3D Formats Working Group and Khronos Officers and Board of Promoters
Completed

- Ecosystem explorer
- glTF-Compressor with KTX (interactive)
- KTX Tool (batch compression)
- Metadata support
- Blender Importer/Exporter
- Sample Asset Repo
- glTF PBR extension video tutorials
- glTF Outreach videos
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Content Creation

[Image of a robot]

[Image of a chess set]

[Image of Blender software]

Lightbulb: created by Freepik at Flaticon (https://www.flaticon.com/free-icons/lightbulb)
Education: © Steve Schoger at IconBolt. License: CC-BY.
Futures

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

**Future Videos**

- glTF Sample Viewer
- Project Explorer
- glTF on iOS

**Futures**

- RFP
- Metadata
- glTF-Transform

Future: © Icons8. License - Future Clock
Current & Future Work

- Composition prototypes
- Blender Features
  - Animation
  - New extensions
  - New BRDF (rendering process)
- SampleViewer support
- Interactive geometry compression
- 3D Commerce Videos
- glTF on iOS [Open, public RFP]
Contact

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Linked In
Q & A

Dan Frith & Alexey Medvedev
Break
Guidelines, Tips and Tricks

• Layouts
  - Every slide should use one of the eight available layouts (see layout button)
  - Click Reset early and often to make sure you are using the layout!
  - Don’t delete slides in this template until you have used all the layouts you need
    - PowerPoint RANDOMLY deletes unused layouts (use two indents sparingly)

• Text
  - Use Trebuchet font for ALL text
  - Don’t insert empty lines within layout text boxes

• Graphics
  - Do not use shading or shadows on graphics
  - Try to connect your lines to boxes to make editing easier

• Animations and Transitions
  - Don’t forget to check them before presenting! Don’t use transitions on Zoom

• Don’t create boring slides with just text (like this one!)
  - Use more pictures and less text to get your message across
Use this blank layout when your slide content is self explanatory and you don’t need a title

This is the default standalone text box style

Add a background and/or outline using ‘Format Shape’
Automatically fit the text to the outline box using Autofit
If a box with no text mysteriously won’t change size - turn off Autofit!
Alternative to Right-aligned Bullets

Brief overview of Khronos compute acceleration standards
   And why they might be of interest to the RISC-V Community

   Deeper dive into OpenCL
      Including roadmap developments

   Discussion on how Khronos and RISC-V could collaborate
      Khronos is open to any organization - please get directly involved if you wish!
      We welcome feedback and cooperation between organizations

   These slides will be available online
      www.khronos.org
Smaller Font Bullets Make Space for Graphics

- Explicit control for acquisition and presentation of images
  - Designed to fit the Vulkan API and today’s compositing window systems
  - Cleanly separates device creation from window system

- Platform provides an array of persistent presentable images = Vulkan Swapchain
  - Device exposes which queues support presentation
  - Application explicitly controls which image to render and present

- Standardized extensions - unified API for multiple window systems
  - Works across Android, Mir, Windows (Vista and up), Wayland and X (with DRI3)
  - Platforms can extend functionality, define custom WSI stack, or have no display at all
Medium Bullets

- Broad commercial uptake of OpenCL
  - Imaging, video, vision, simulation
  - Adobe, Apple, SONY, Corel, ArcSoft
  - Dassault, Houdini, Mathematica, MAYA...

- “OpenCL” on Sourceforge, Github, Google Code, Bitbucket finds over 2,000 projects
  - OpenCL implementations - Beignet, pocl
  - VLC, X264, FFMPEG, Handbrake
  - GIMP, ImageMagick, IrfanView
  - Hadoop, Memcached
  - WinZip, Crypto++ Etc. Etc.

- Desktop benchmarks use OpenCL
  - PCMark 8 - video chat and edit
  - Basemark CL, CompuBench Desktop

https://www.khronos.org/opencl/resources/opencl-applications-using-opencl
Short Bullets

• To accompany larger graphics
Dual Column Bullets

- Extensible modular architecture encourages many fine-grained layers - new layers can be added easily.
- Khronos encouraging open community of tools e.g. shader debugging.
- Valve, LunarG, Codeplay and others are already driving the development of open source Vulkan tools.
- Customized interactive debugging and validation layers will be available together with first drivers.

- Prototype Vulkan Debugger from Valve and LunarG
- LunarG.com/Vulkan
Typical Diagram Using Title Only Layout

API Working Groups
(Industry and Academic members)

Conformance Tests and Adopters Program
Royalty-Free Specifications
Documentation, Tools SDKs, Code Samples,
Educator Guidelines Courseware Materials

Members
Wider Community

Adopters
Build conformant implementation and products

Developers
Develop applications using the APIs

Educators / Certifiers
Create Courses Training and Certification