Development Day
Pervasive 3D

CC-BY
9 August 2023

SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

ANARI OpenXR WebGL 3DCommerce glTF Vulkan

Pervasive 3D

SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

glTF™ 3DCommerce™

The State of glTF

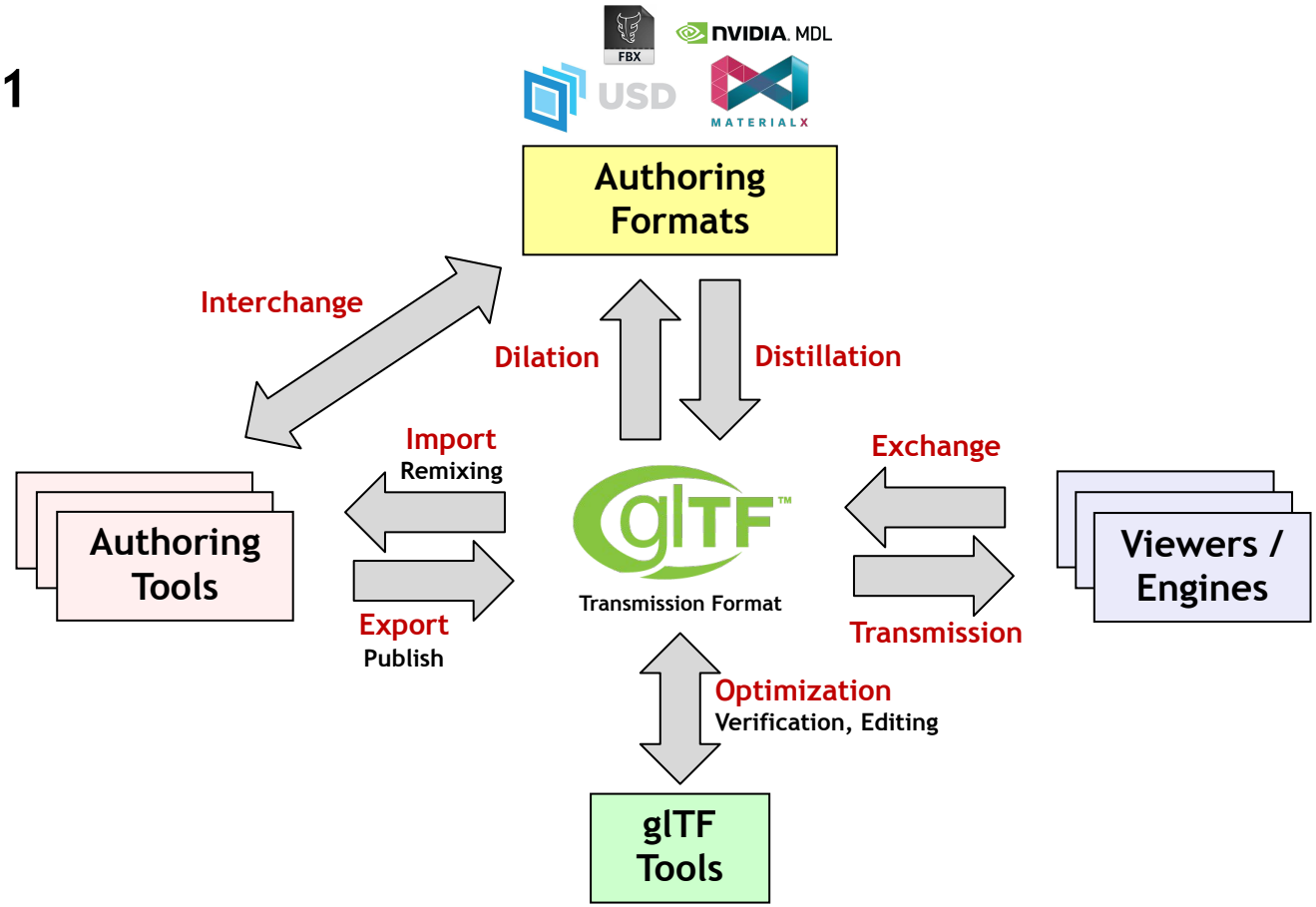
Alexey Medvedev, Meta
Chair 3D Formats

3D Formats

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

glTF

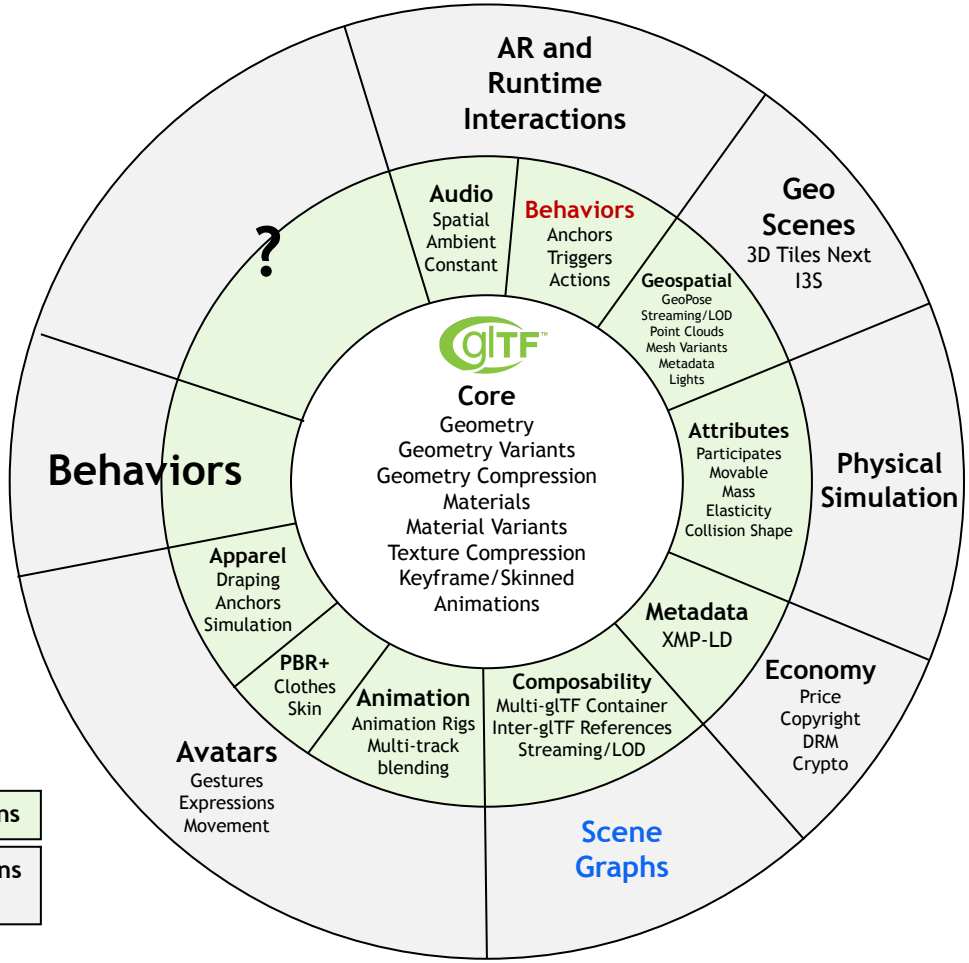
- ISO/IEC/JTC-1

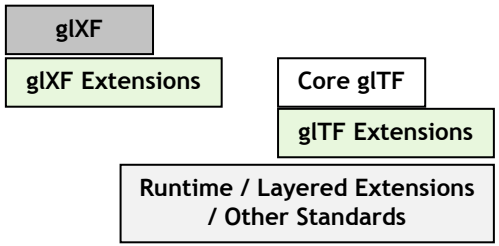


Goals of adoption

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

glTF is a Transport Format for 3D Assets

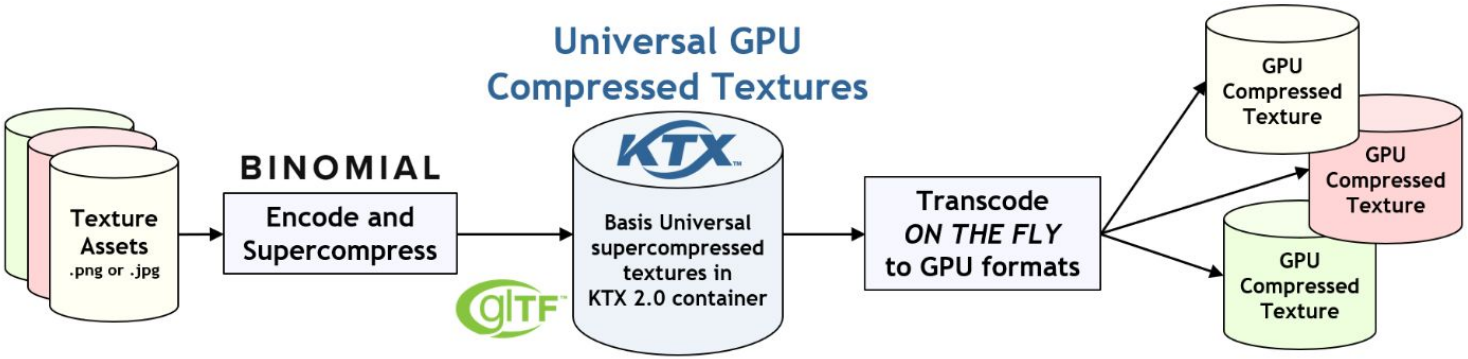




Ratified and in-progress extensions

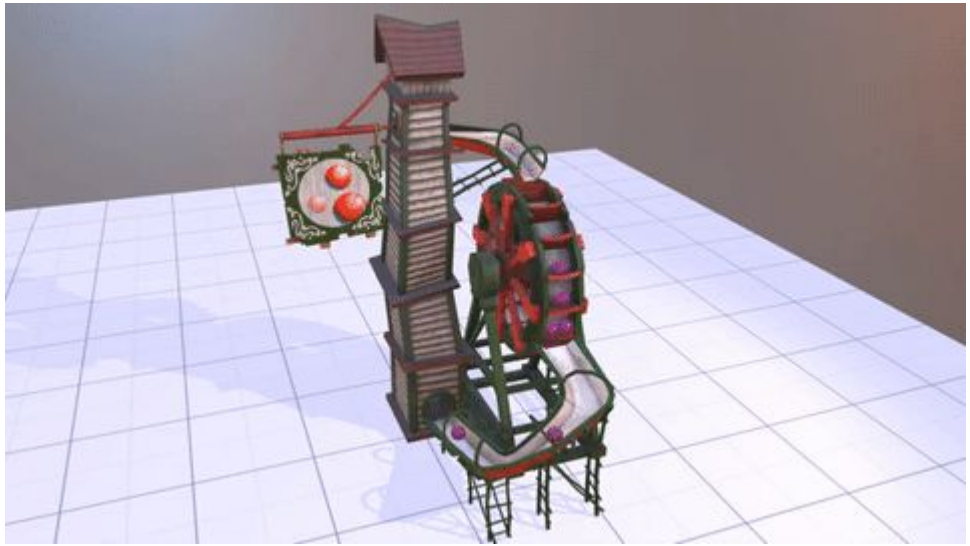
- KHR_animation_pointer
  - Allows targeting any value in a glTF asset.For example: Allows animation of color values or camera fov.
- KHR_audio extension
  - Adds ability to store audio and represent emitters in glTF.
  - Unifies existing vendor extensions:
    - OMI_audio_emitter
    - MSFT_audio_emitter
- 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



Physics

- Collision geometry
- Motions
- Materials
- Joints
- Filters



Geospatial

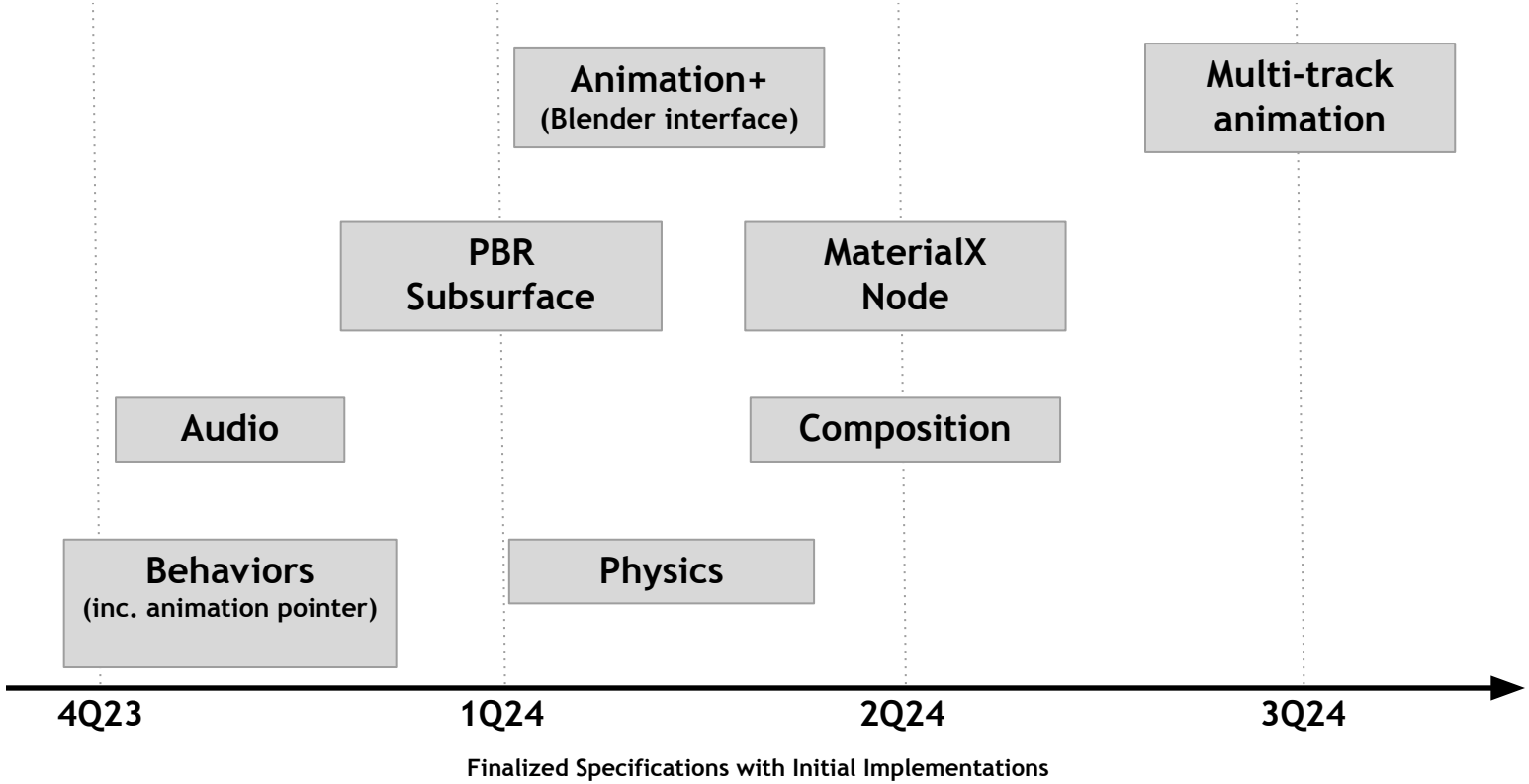
Expand the capabilities of glTF and related technologies to better address the needs and requirements for transmission and display of 3D models, scenes, and interfaces for geospatial applications.

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



SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

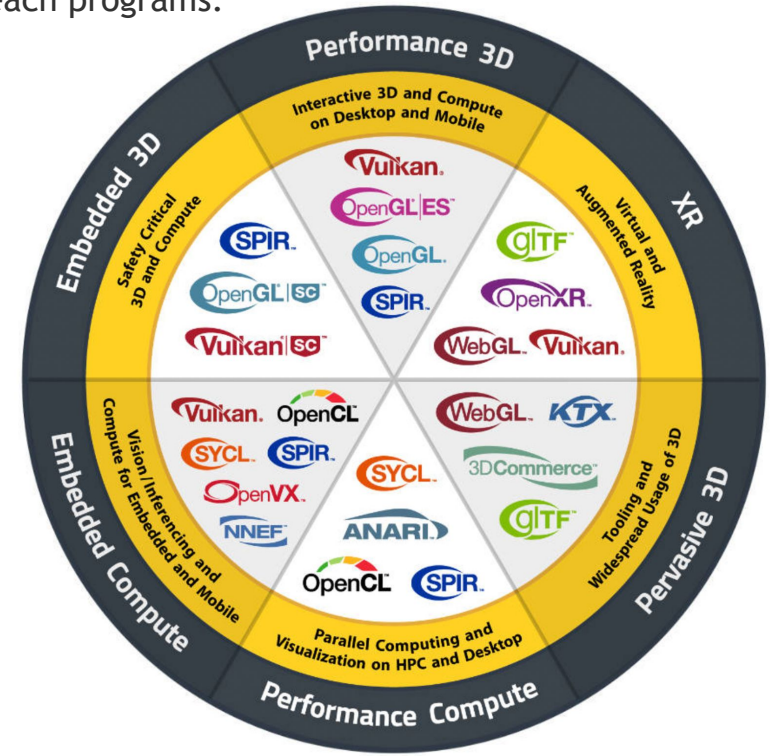
glTF™ 3DCommerce™

Leveling Up 3D Commerce

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

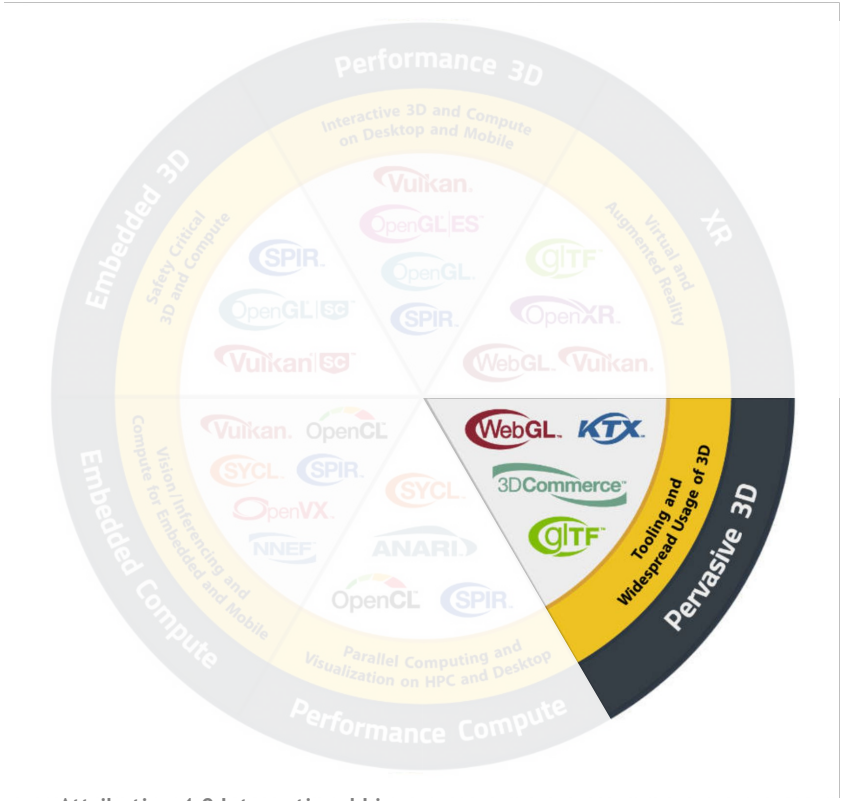
Khronos Ecosystem Segmentation

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.

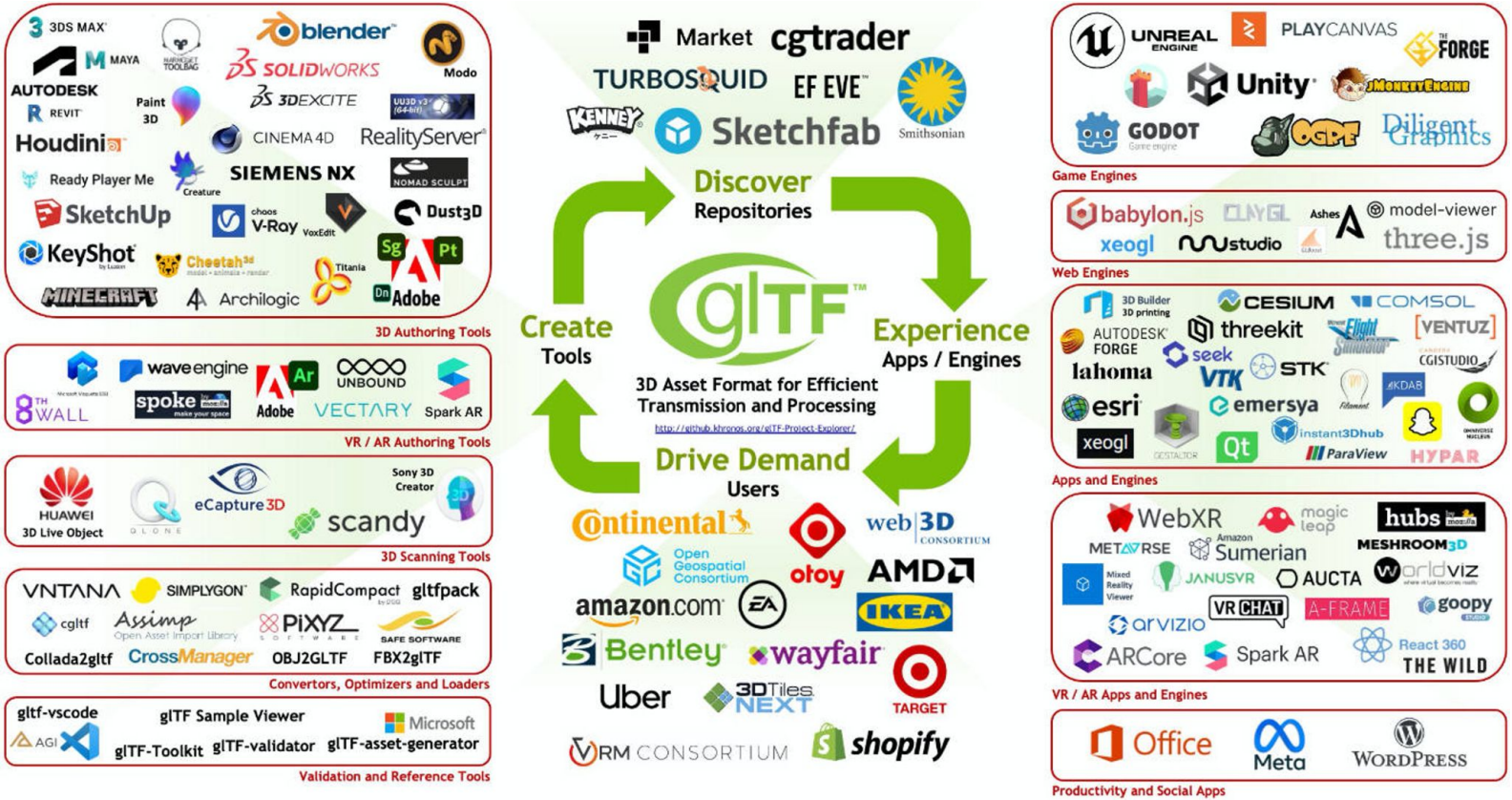


Khronos Ecosystem Segmentation

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

52404 Cedar Rapids South

Registry Weekly Ad RedCard Target Circle Find Stores

Categories Deals What's New Pickup & Delivery

What can we help you find?

Sign in

Target / Furniture / Living Room Furniture / Chairs

Shop all Threshold

Carmine Luxe Arm Accent Chair with Brass Legs - Threshold™

$210.00 reg $350.00

Sale save $140.00 (40% off)

When purchased online

6

Color **Sage Green Velvet**

Ship to 52404 Edit location

Get it by Tue, Aug 1

Free shipping - Exclusions Apply.

This item isn't sold in stores

This item ships in its original packaging, revealing what's

See this item in 3D

TARGET.COM

IKEA 80 år - vi firar med erbjudanden!

Meny

IKEA

Vad letar du efter?

Logga in/Registrera dig

Produkter Erbjudanden Toppsäljare Alla rum

Ange postnummer Välj varuhus

Produkter › Möbler › Soffor & soffgrupper › Skinnsoffor › 3-sits skinnsoffor › LANDSKRONA 3-sits soffa

LANDSKRONA

3-sits soffa, Grann/Bomstad svart/metall

9 995:-

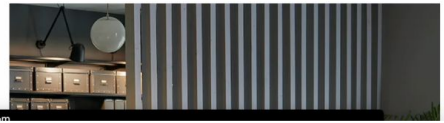
7 996:- exkl. moms

★★★★★ (29)

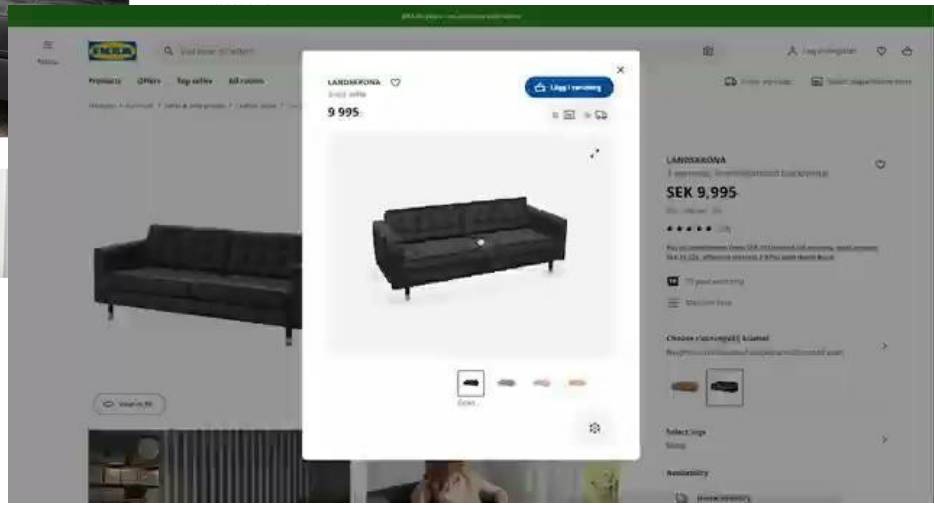
Delbetala fr. 312:-/mån (36 mån; totalbelopp 11 224:-; eff. ränta 7,97%) med ikano Bank

10 10 års garanti

Medelfast



Waiting for www.ikea.com



BREMONT'S ICONS OF MOTORSPORT | DISCOVER THE NEW WATCHES ›

WATCHES COLLECTIONS ACCESSORIES INSIDE BREMONT MILITARY

BREMONT
CHRONOMETERS

Search

SOLO AIRCO PILOT CHRONOGRAPHS MARTIN-BAKER U-2

Case Size Barrel Colour Gender Collection Dial Colour Material Case Finish Strap Material Manual

ALT1-C

The original Bremont design - Case Size 43mm

H1 GENERATION

FURY

A contemporary take on the classic pilot's watch - Case Size 40mm

FURY

€6.935,00

Regular length (15cm - 19cm wrist size)

ADD TO BAG

BOOK AN APPOINTMENT FIND A RETAILER SPEAK TO AN EXPERT

This timepiece will be individually hand assembled upon order, currently arranging client deliveries within 8-10 weeks.

Celebrating Co-Founders Nick and Giles' passion for planes, flying and aeronautical engineering, the Fury is a contemporary take on a classic pilot's watch. Housing the high performance Bremont manufactured ENG365 calibre movement, the Fury is a 40mm timepiece with a polished stainless steel Trip-Tick® case construction which has been made at Bremont's Headquarters The Wing in Henley-on-Thames, England

SIZE GUIDE

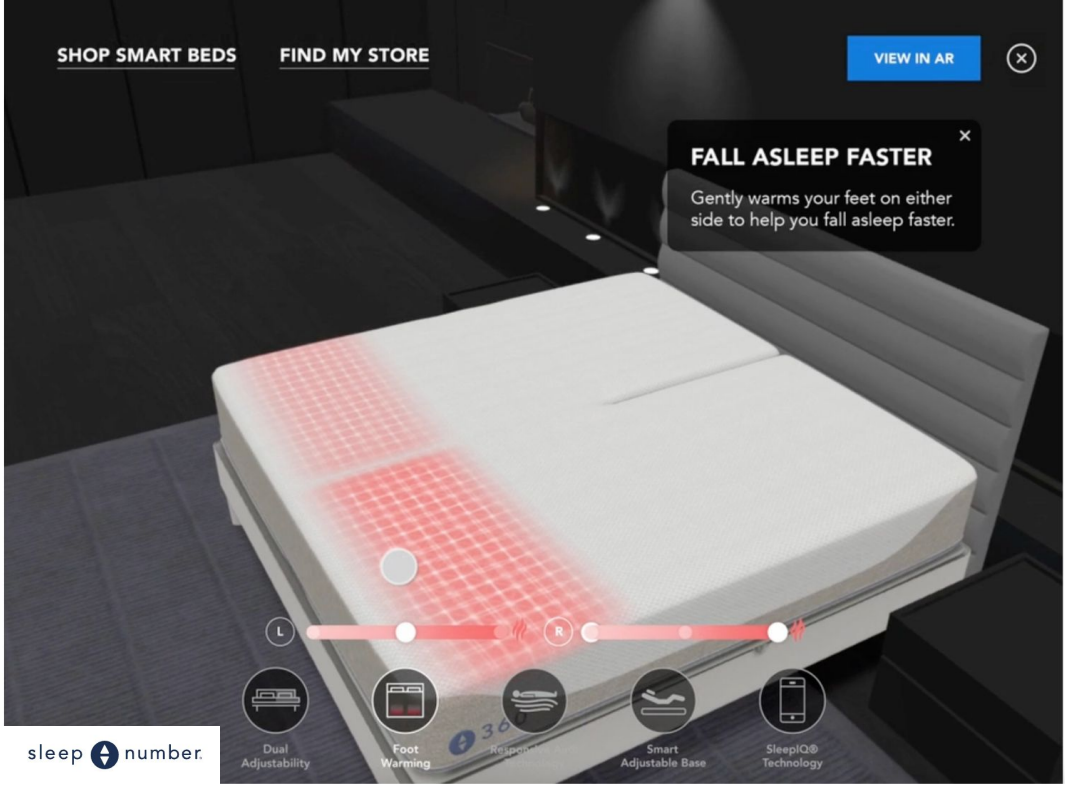
5 YEAR WARRANTY

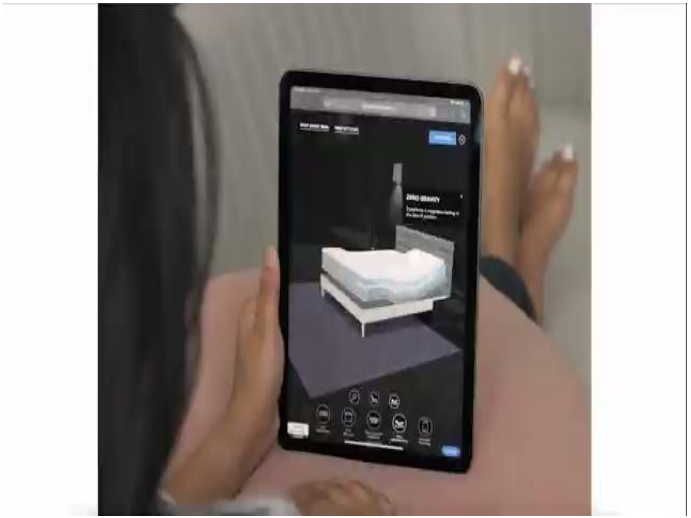
PROUDLY MADE IN THE UK

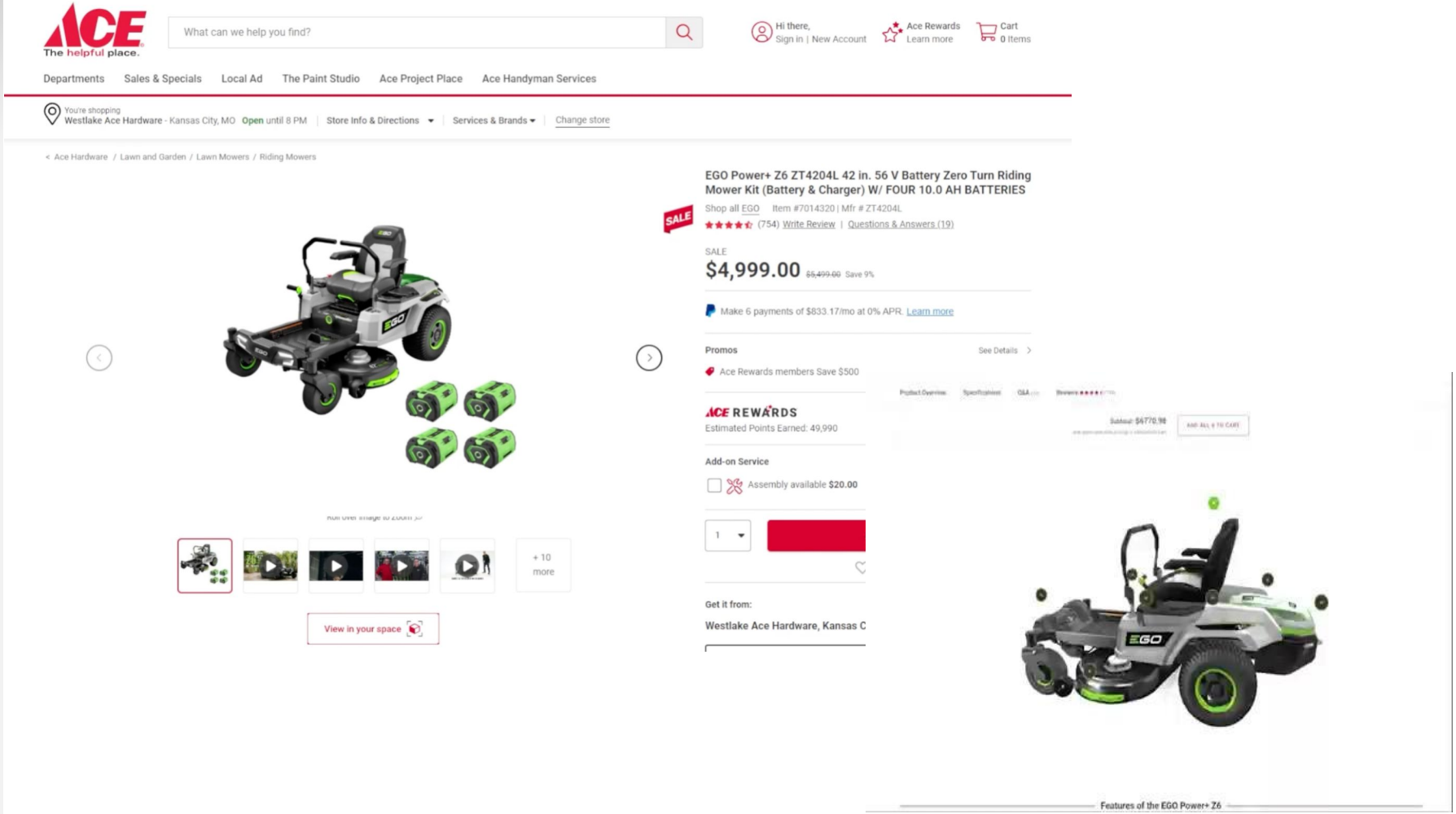
OTHER VARIATIONS

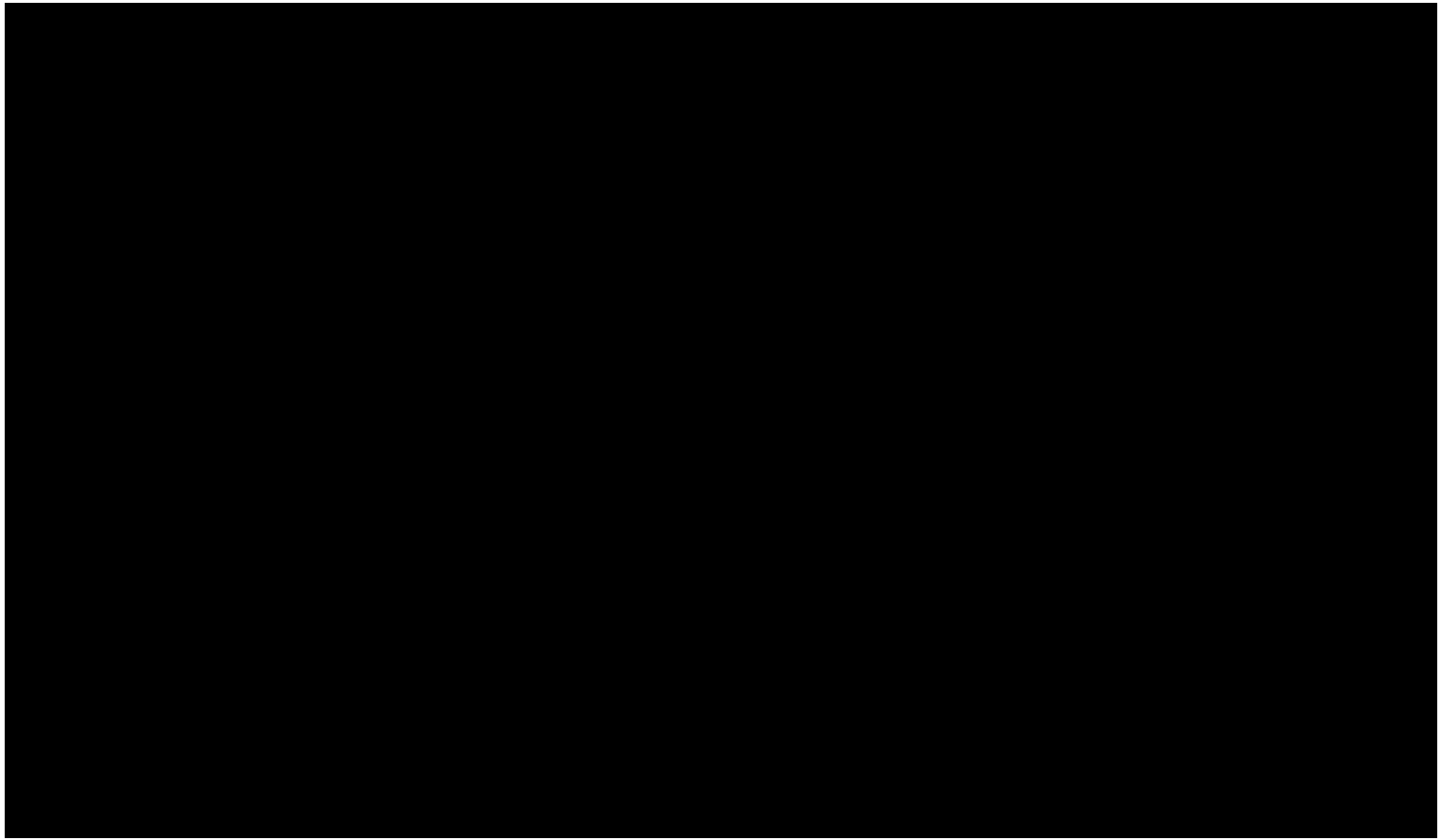
FURY
Black Dial
€6.935,00

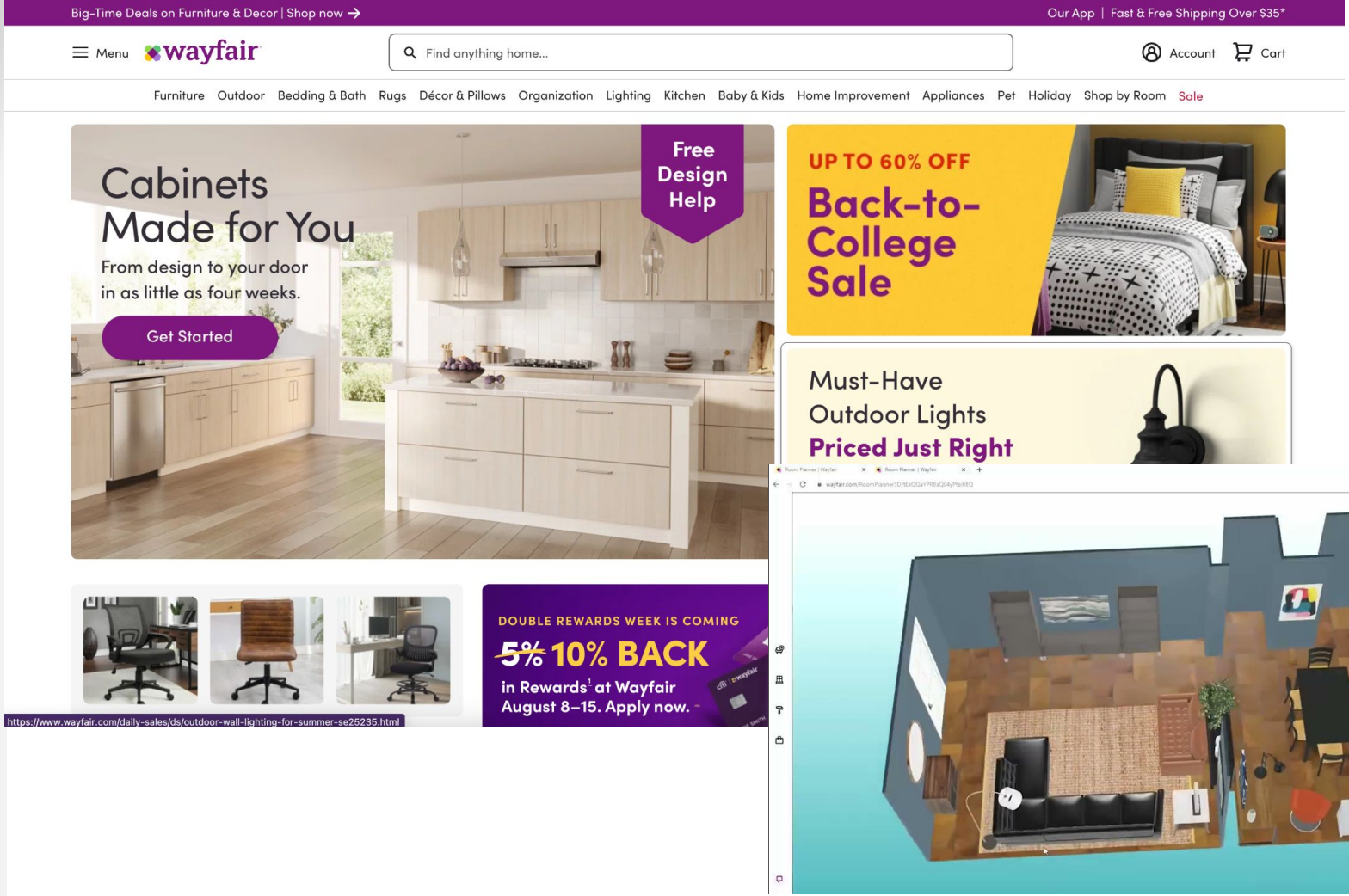
SHOP NOW











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**.

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**.
- **Load time**
  - **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

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**.
- **Load time**
  - **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
- **Experience**
  - The use of **standardised file formats** provides a **consistent experiences** across a variety of devices and platforms. What is viewed on the web should be the same on another device whether that browsing, AR, VR or MR.

Importance of standardisation:

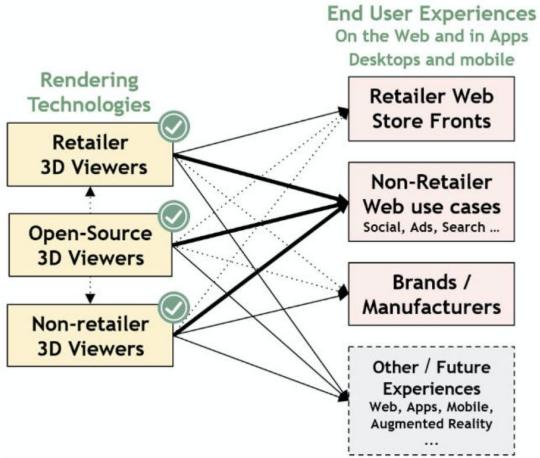
- **Physical to Digital Consistency**
  - Getting as close to the real thing as possible **increases e-commerce conversion**, **online duration** for consumers & **reduces returns** of physical products, **increasing brand trust**.
- **Load time**
  - **Processing & bandwidth** can be varied therefore 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
- **Experience**
  - The use of **standardised file formats** provides a **consistent experiences** across a variety of devices and platforms. What is viewed on the web should be the same on another device whether that browsing, AR, VR or MR.
- **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.

Importance of standardisation:

- **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.

Importance of standardisation:

- **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.
- **Viewer Certification program**



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

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.

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.
- **Asset Creation Guidelines**
  - Evolution, updates, industry support & community

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.
- **Asset Creation Guidelines**
  - Evolution, updates, industry support & community
- **Scene Composition**
  - Exploring needs and use cases for multi-sku, interactive and physics based experiences for use in e-commerce to support greater, more inspiring customer experiences.

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.
- **Asset Creation Guidelines**
  - Evolution, updates, industry support & community
- **Scene Composition**
  - Exploring needs and use cases for multi-sku, interactive and physics based experiences for use in e-commerce to support greater, more inspiring customer experiences.
- **Viewer Certification program**
  - Enhancements, improvements and advancements in the Viewer Certification Program to support tone mapping, colour consistency and other e-commerce requirements as browsers and platforms evolve.

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.
- **Asset Creation Guidelines**
  - Evolution, updates, industry support & community
- **Scene Composition**
  - Exploring needs and use cases for multi-sku, interactive and physics based experiences for use in e-commerce to support greater, more inspiring customer experiences.
- **Viewer Certification program**
  - Enhancements, improvements and advancements in the Viewer Certification Program to support tone mapping, colour consistency and other e-commerce requirements as browsers and platforms evolve.
- **Interoperable tools & standards**
  - Exploring the need for tools and standards that can fully operate in conjunction with one another. Build once, use anywhere to assist the ingestion of assets and scenes.

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.
- **Asset Creation Guidelines**
  - Evolution, updates, industry support & community
- **Scene Composition**
  - Exploring needs and use cases for multi-sku, interactive and physics based experiences for use in e-commerce to support greater, more inspiring customer experiences.
- **Viewer Certification program**
  - Enhancements, improvements and advancements in the Viewer Certification Program to support tone mapping, colour consistency and other e-commerce requirements as browsers and platforms evolve.
- **Interoperable tools & standards**
  - Exploring the need for tools and standards that can fully operate in conjunction with one another. Build once, use anywhere to assist the ingestion of assets and scenes.
- **Tutorials, guides & videos**
  - More tutorials, guides and videos. From end to end suggestions on pipelines to be shared from e-commerce experts to 1 to 1 interviews from industry experts to support the community.

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.
- **Asset Creation Guidelines**
  - Evolution, updates, industry support & community
- **Scene Composition**
  - Exploring needs and use cases for multi-sku, interactive and physics based experiences for use in e-commerce to support greater, more inspiring customer experiences.
- **Viewer Certification program**
  - Enhancements, improvements and advancements in the Viewer Certification Program to support tone mapping, colour consistency and other e-commerce requirements as browsers and platforms evolve.
- **Interoperable tools & standards**
  - Exploring the need for tools and standards that can fully operate in conjunction with one another. Build once, use anywhere to assist the ingestion of assets and scenes.
- **Tutorials, guides & videos**
  - More tutorials, guides and videos. From end to end suggestions on pipelines to be shared from e-commerce experts to 1 to 1 interviews from industry experts to support the community.
- **NeRF (Neural Radiance Fields), Machine Learning & AI in 3D**
  - The use of generative AI in 3D Asset & scene creation whilst following standards

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.
- **Asset Creation Guidelines**
  - Evolution, updates, industry support & community
- **Scene Composition**
  - Exploring needs and use cases for multi-sku, interactive and physics based experiences for use in e-commerce to support greater, more inspiring customer experiences.
- **Viewer Certification program**
  - Enhancements, improvements and advancements in the Viewer Certification Program to support tone mapping, colour consistency and other e-commerce requirements as browsers and platforms evolve.
- **Interoperable tools & standards**
  - Exploring the need for tools and standards that can fully operate in conjunction with one another. Build once, use anywhere to assist the ingestion of assets and scenes.
- **Tutorials, guides & videos**
  - More tutorials, guides and videos. From end to end suggestions on pipelines to be shared from e-commerce experts to 1 to 1 interviews from industry experts to support the community.
- **NeRF (Neural Radiance Fields), Machine Learning & AI in 3D**
  - The use of generative AI in 3D Asset & scene creation whilst following standards
- **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.

SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

glTF™ 3DCommerce™

Body Anchors

Patrick Hadley, Snap
Chair, Skeletal & Facial Anchoring / 3D Commerce

glTF and PBR Helped Standardize 3D Commerce

glTF™ 2.0 Specification

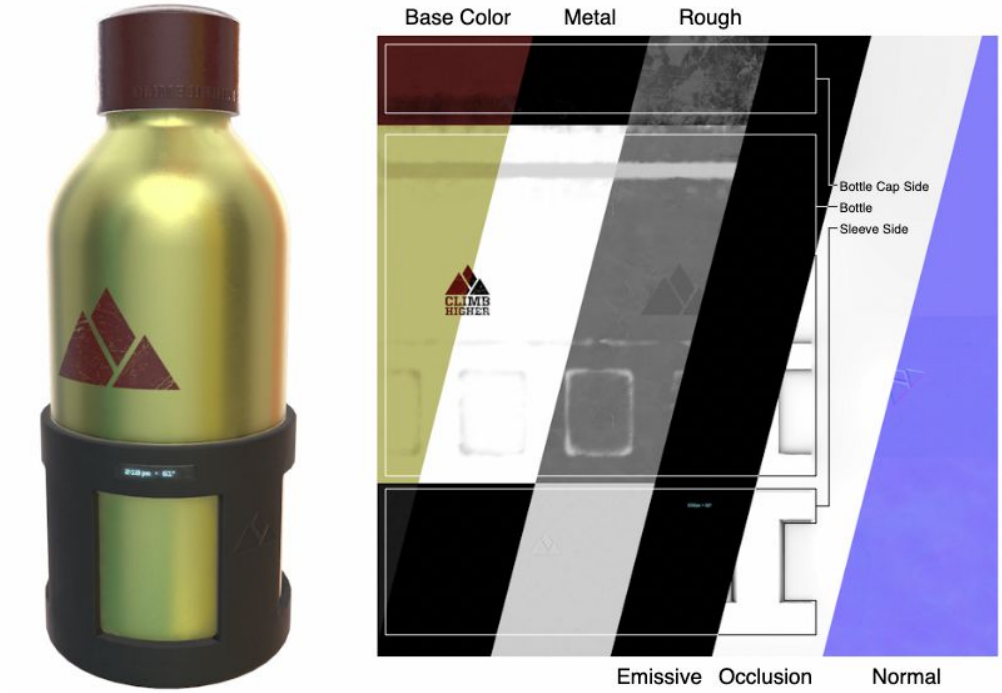
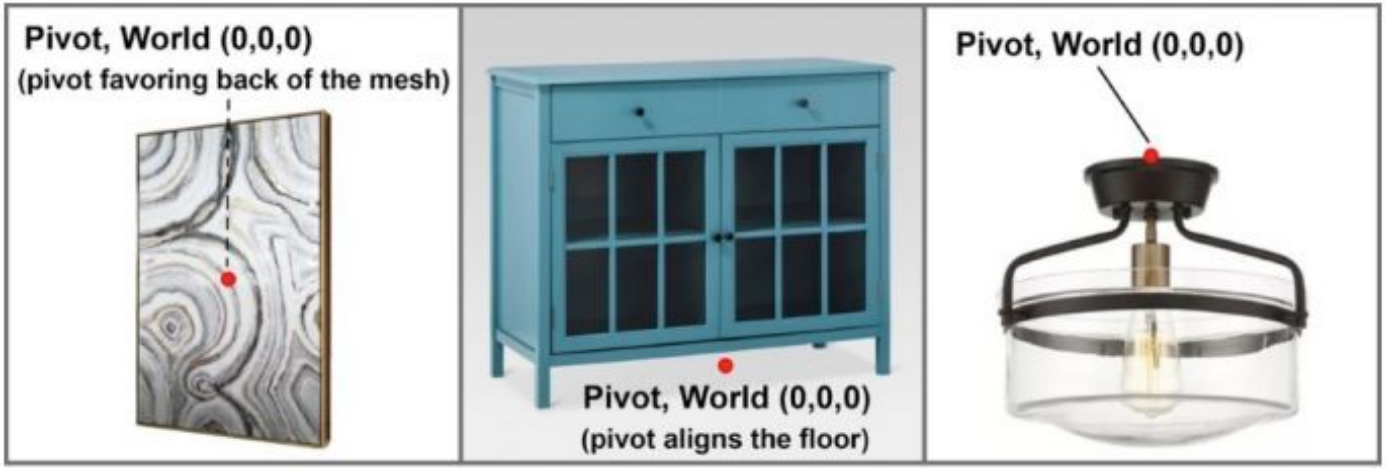


Figure 7. Physically Based Rendering Example

3D Commerce Initial Focus on Furniture / Home

Furniture (Surface) Placement

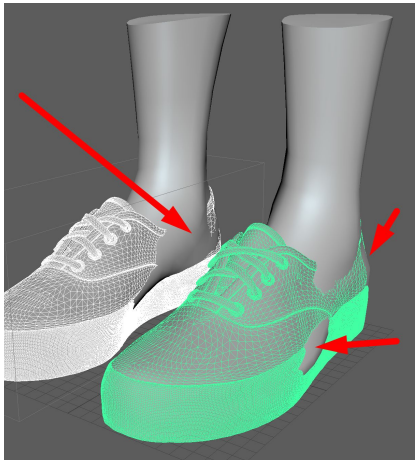
Asset Pivot Point (Placement, hanging points)



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

Placement	Clipping / Collisions
 	 

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

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

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

Body Anchor Proposal - Eyewear

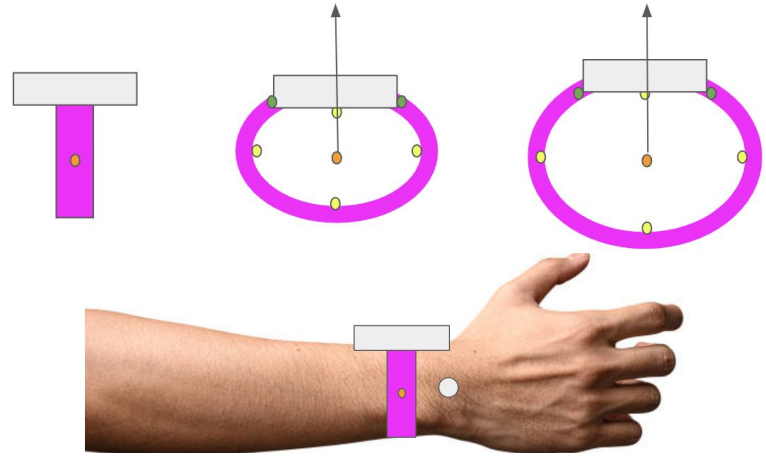
Medical / Precise Term	Khronos readable	Type	Required?	Description / Comments
Glasses				
Head				
Nose Bridge	**eyewear_nosebridge**	Anchor	Required	used for placement, positioned on the bottom of the nose bridge
Left Ear Contact with Glasses Temple	**eyewear_l_ear_glassestemple**	Anchor	Required	placed where the glasses' left temple contacts the ear
Right Ear Contact with Glasses Temple	**eyewear_r_ear_glassestemple**	Anchor	Required	placed where the glasses' right temple contacts the ear
Left Lens Bottom Center Point	**eyewear_l_lens_bottom**	Fit / Clipping	Optional	point marking the bottom center of the left lens (at the bottom of the lens frame)
Right Lens Bottom Center Point	**eyewear_r_lens_bottom**	Fit / Clipping	Optional	point marking the bottom center of the right lens (at the bottom of the lens frame)

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

Body Anchor Proposal - Wrist (Watch / bracelet)

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

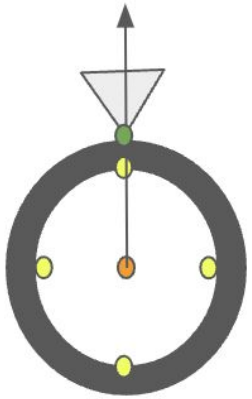
- Band is flexible, face can be fixed
- One placement anchors (req)
- Four ‘optional’ for fit / clipping
- Two ‘optional’ for watch face



Body Anchor Proposal - Ring

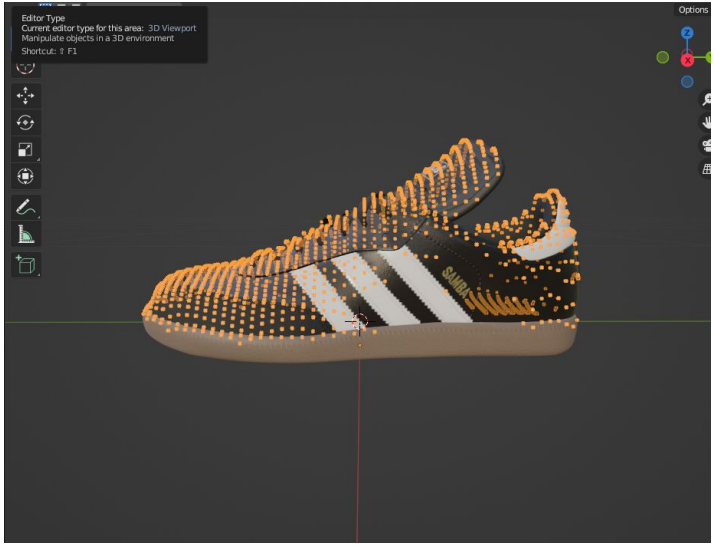
Medical / Precise Term	Khronos readable	Type	Required?	Description / Comments
Ring				
Fingers				
Ring Center	**ring_center**	Anchor	Required	used for placement, positioned on the center of the circle of the ring
Ring Top	**ring_top**	Fit / Clipping	Optional	positioned on the inside of the ring at the top (facing out from the back of the hand)
Ring Bottom	**ring_bottom**	Fit / Clipping	Optional	positioned on the inside of the ring at the bottom (towards the palm of the hand)
Ring Inner	**ring_inner**	Fit / Clipping	Optional	positioned on the inside of the ring at the inner side of the finger (towards thumb side)
Ring Outer	**ring_outer**	Fit / Clipping	Optional	positioned on the inside of the ring at the outer side of the wrist (towards pinky side)
Ring Setting	**ring_setting**	Attachment	Optional	positioned on the bottom center of the ring setting (doesn't change size - diamond, etc)

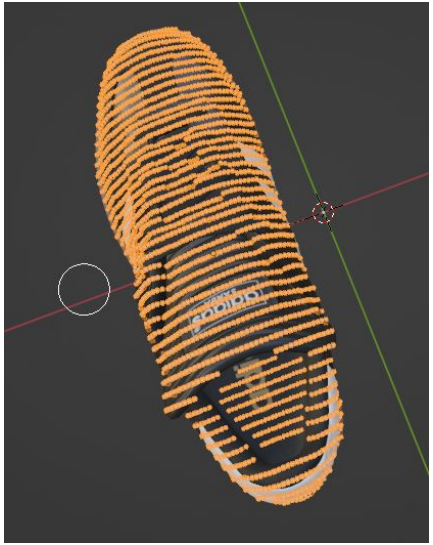
- Band is flexible, setting can be fixed
- One placement anchors (req)
- Four ‘optional’ for fit / clipping
- One ‘optional’ for ring setting



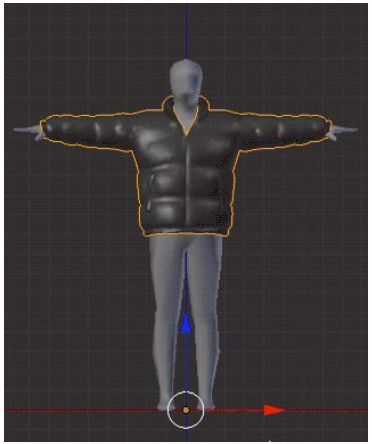
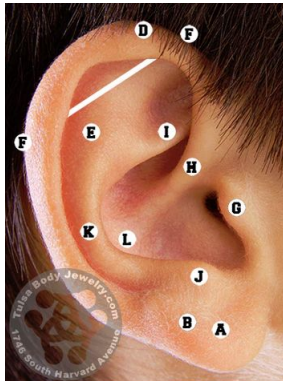
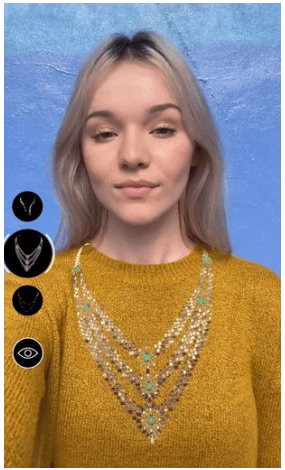
What's Next?

- 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
			

SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

glTF™ 3DCommerce™

Physically Based Rendering (PBR)

Ed Mackey, AGI
Chair, PBR / 3D Formats

Henrik Edstrom, Autodesk
PBR / 3D Formats

The Evolution of PBR in glTF

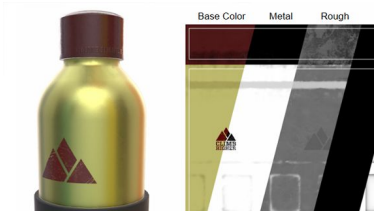
Clearcoat

Volume

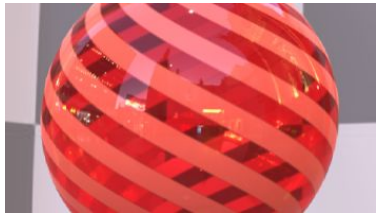
Sheen

Index of Refraction

Metal / Rough



Transmission

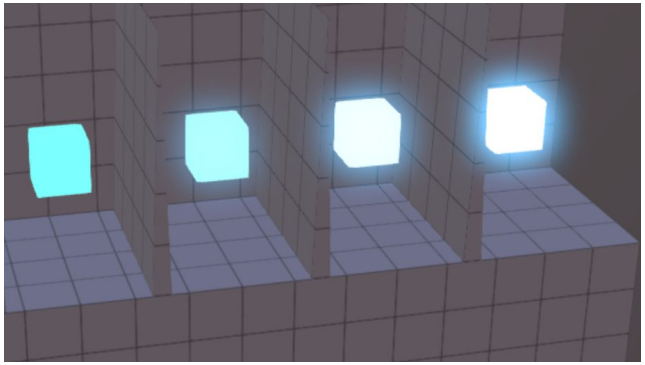


Specular

2017 2020 2021

The Evolution of PBR in glTF

Emissive Strength



Anisotropy

Iridescence

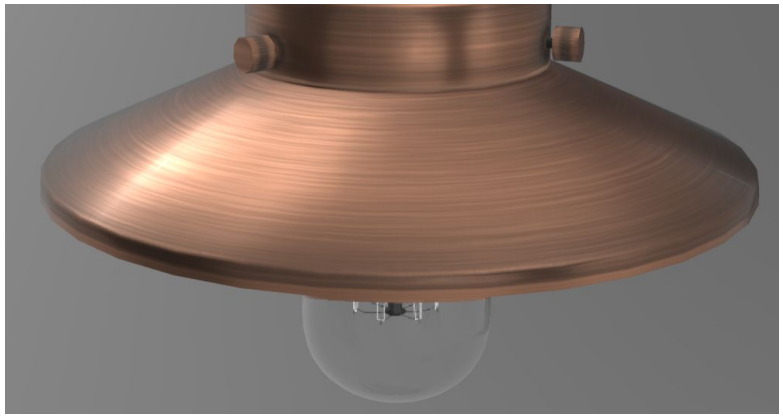
2022

2023

Anisotropy

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

Without Anisotropy
(Blob-shaped reflections)



With Anisotropy
(Reflections perpendicular to grooves)

Anisotropy Parameterization

AnisotropyBarnLamp sample CC-BY Wayfair

`KHR_materials_anisotropy`

- `anisotropyStrength`

  Indicates additional surface roughness is present

- `anisotropyRotation`

  Measured in radians, counter-clockwise from tangent vector

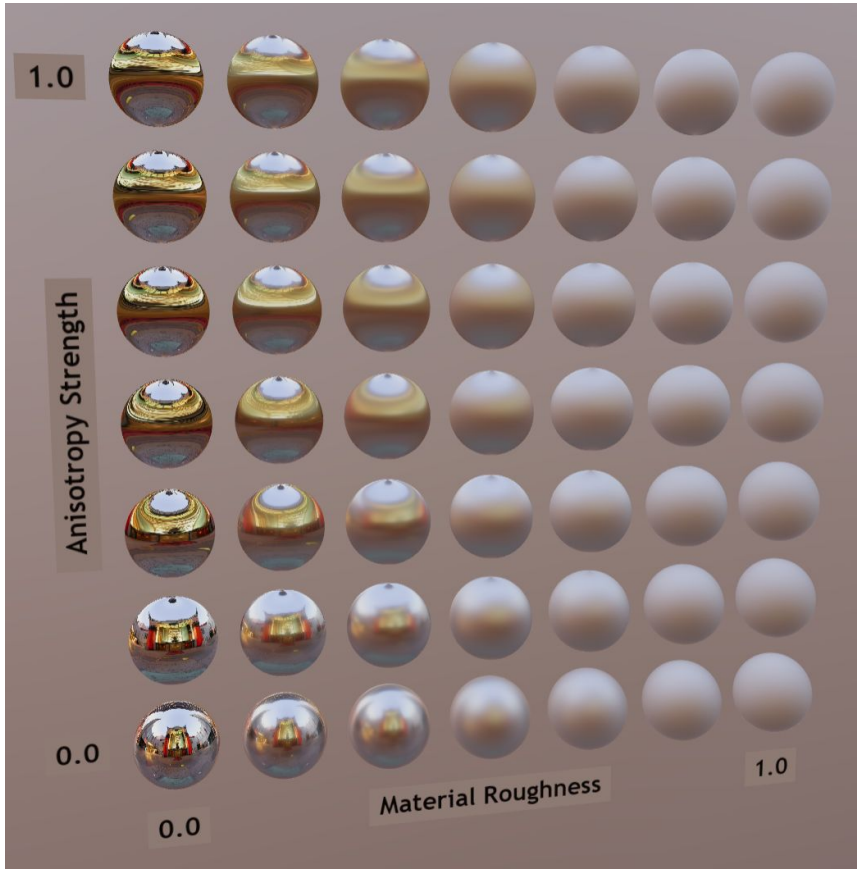
- `anisotropyTexture`

  Red, Green - 2D direction vector

  Blue - Strength

IBL Approximations for Anisotropy

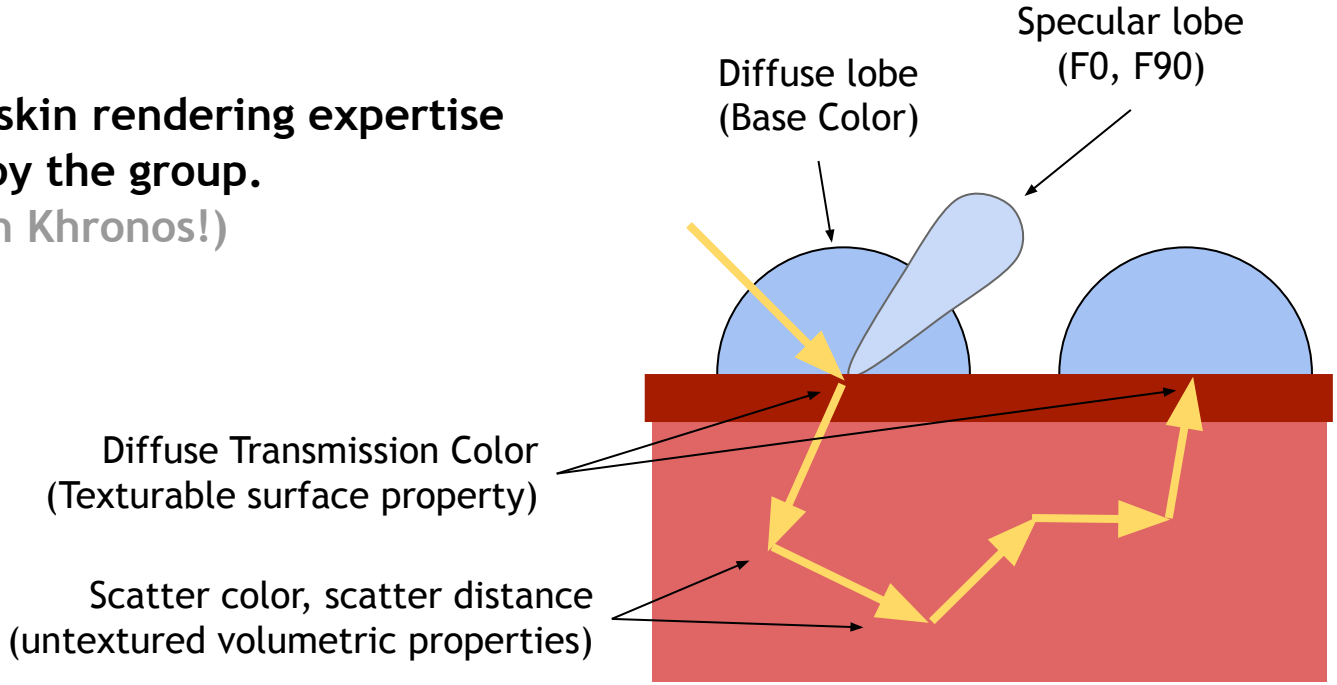
- Specification focuses on physical properties of material, not fast rendering approximations.
- Yet, specification is supportive of fast approximations, such as stretched IBL (shown on right).
- Path tracers can be accurate, rasterizers can go fast, innovators can innovate… all from the same glTF asset.



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

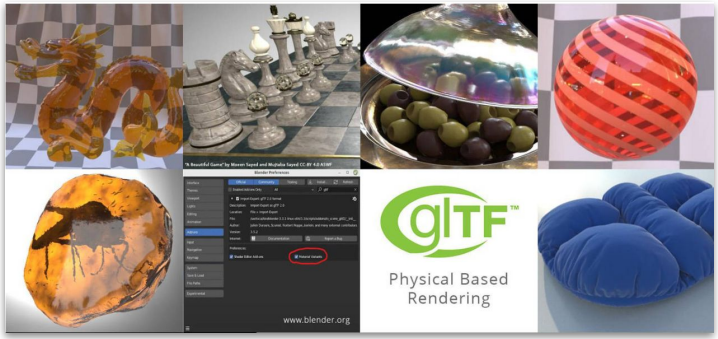
- **Same principle as other Uber shaders**
  - Adobe Standard Material
  - Autodesk Standard Surface
  - Blender Principled BSDF
  - Dassault Enterprise PBR
  - USD Preview Surface

- **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/1Af5Oevq-ES4aEH3BrH6tpzrUtyoPxN2O6wm5YRDgnZE/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

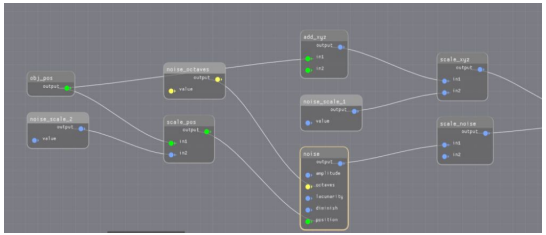


Easy to convert to and from glTF PBR

Relationship with MaterialX

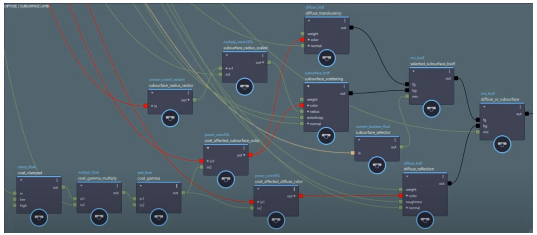
- MaterialX is not a PBR model itself, but a graph based standard to exchange both pattern graphs (texturing) and PBR models across applications and renderers:

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
- …

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.

SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

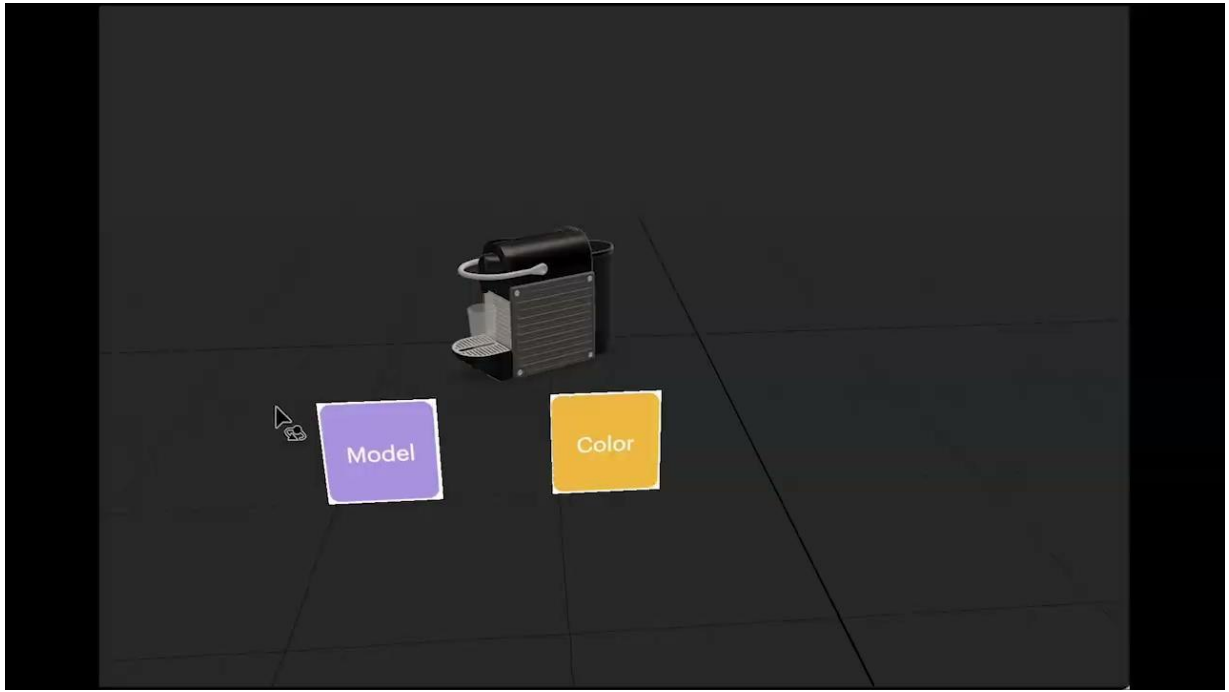
glTF™ 3DCommerce™

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



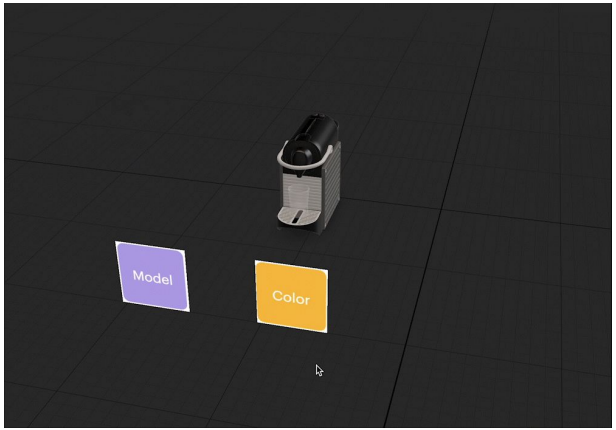
Adding Interactivity to glTF

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

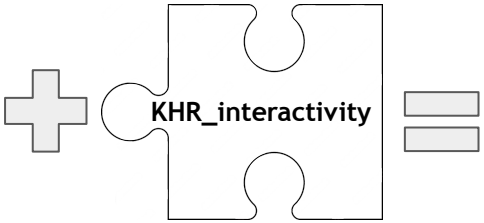
Until now interactivity has been external to glTF, hence hardcoded into the application

Interactive content is not portable to other applications

Adding Interactivity to glTF



glTF TODAY



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…)

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

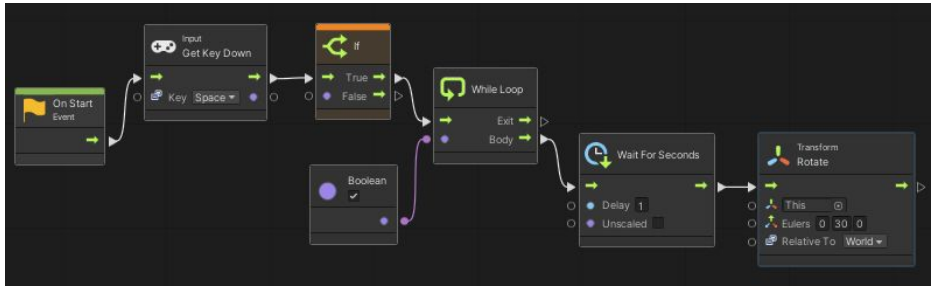
```cpp
#include "GameEngine.h"

class MyGame {
private:
    Object* _object;

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

C++

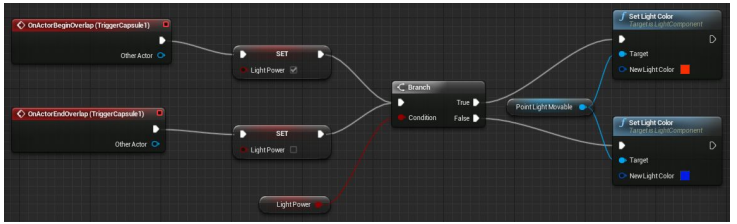
- **Visual Scripting**
  - Creator assembles and connects building blocks
  - Much easier to learn for non engineers (no syntax to learn, no compilation necessary)
  - More portable (lightweight runtime, no sandboxed VM to rely on)
  - Limited set of blocks makes it more secure



Unity Visual Scripting

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), …



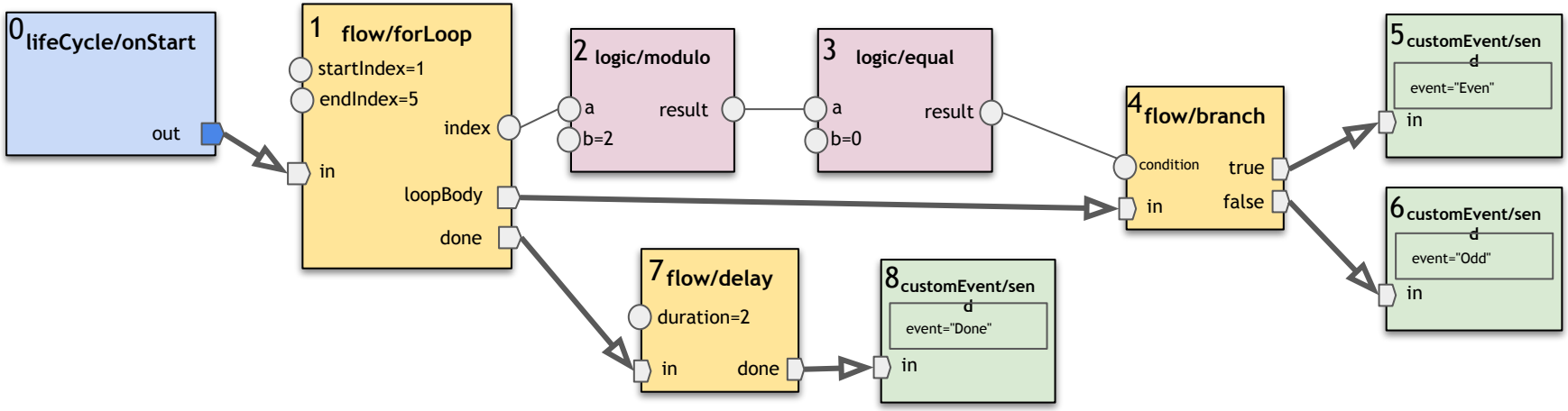
Example Implementation: Unreal Editor

★ **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 *(value % 2) == 0* ?)
- Once done, after 2 seconds, sends custom event "Done"



- Various categories of Node:

lifeCycle/... onStart, onTick...

flow/... forLoop, delay, branch, while...

logic/... modulo, equal, add, subtract...

customEvent/ 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

SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

glTF™ 3DCommerce™

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

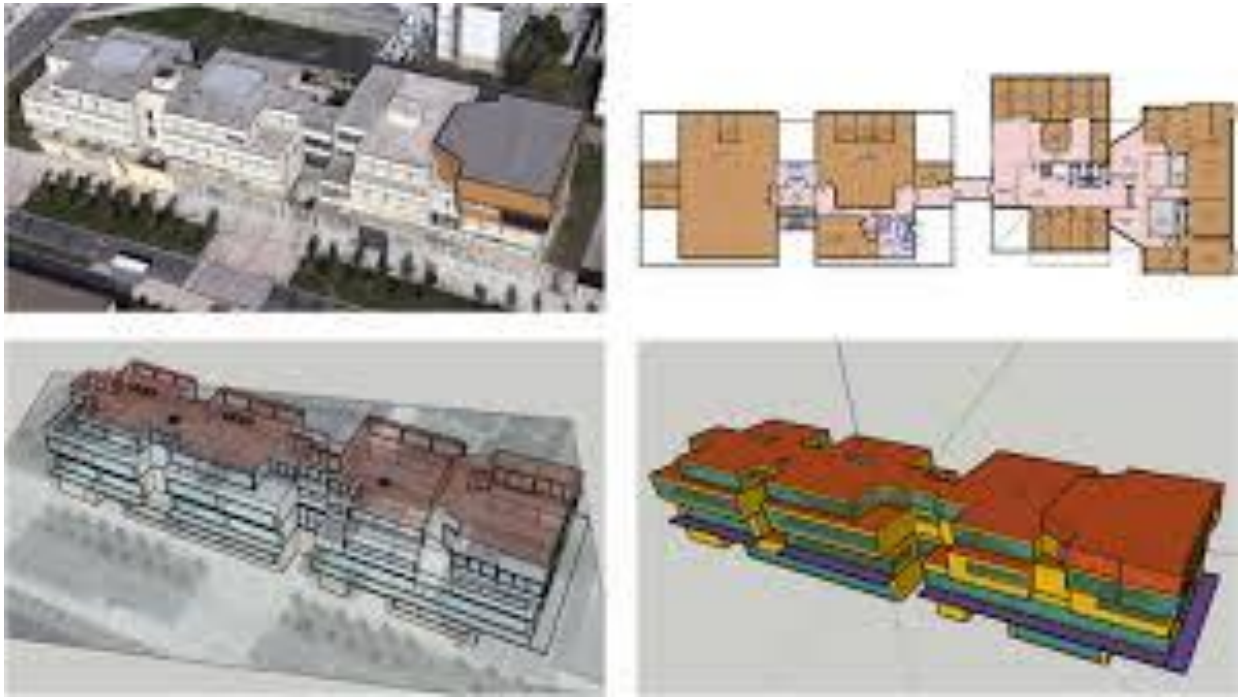
Types of Composition

- **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 navigationn while streaming important data

LOD: Building Information Modeling



Energy and thermal modelling of an office building to develop an artificial neural networks model

IKEA 80 år - vi firar med erbjudanden!

Meny

IKEA

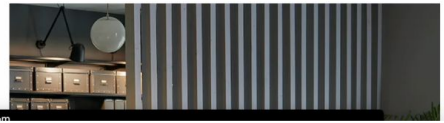
Vad letar du efter?

Logga in/Registrera dig

Produkter Erbjudanden Toppsäljare Alla rum

Ange postnummer Välj varuhus

Produkter › Möbler › Soffor & soffgrupper › Skinnsoffor › 3-sits skinnsoffor › LANDSKRONA 3-sits soffa



LANDSKRONA

3-sits soffa, Grann/Bomstad svart/metall

9 995:-

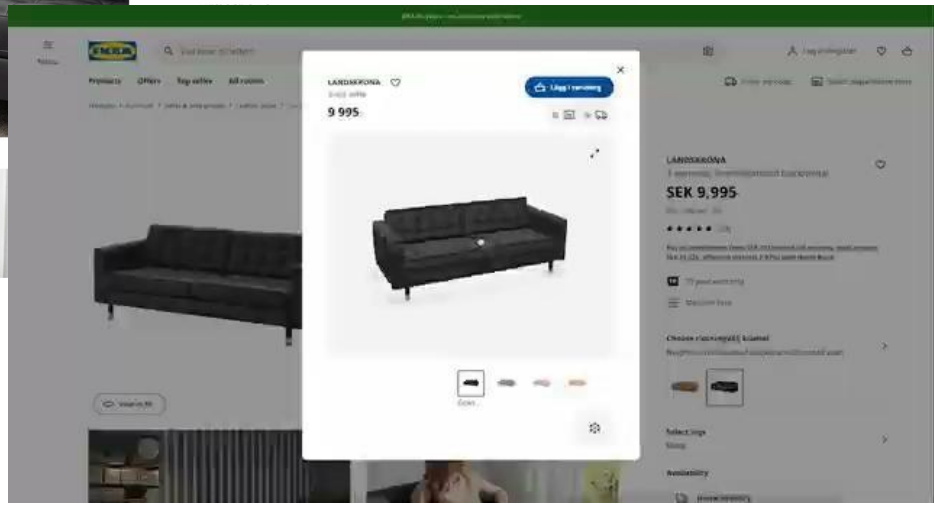
7 996:- exkl. moms

★★★★★ (29)

Delbetala fr. 312:-/mån (36 mån; totalbelopp 11 224:-; eff. ränta 7,97%) med ikano Bank

10 10 års garanti

Medelfast



Waiting for www.ikea.com

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 developement**
  - Use case & Specification development by 3D Commerce
  - Techical 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

SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

glTF™ 3DCommerce™

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

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

Project	Creation	Pipeline /Viewing	Education	Futures	Community /Outreach
KTX Tooling		X			X
Tutorial Videos	X		X		X
glTF-Compressor	X	X			X
glTF Sample Viewer		X	X	X	X
Project Exporer			X		X
Events					X
glTF on iOS		X	X	X	X
Composite Scenes		X	X	X	
Asset Auditor	X	X			X
Metadata		X		X	X
Asset Repository	X	X	X	X	X
Blender	X	X	X	X	X

Content Creation

Tutorial Videos
glTF-Compressor
Asset Auditor
Asset Repository
Blender

Pipeline & Distribution

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

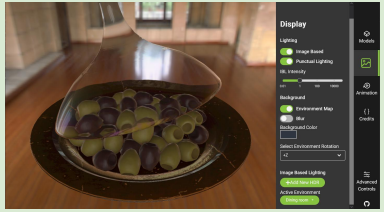
Education

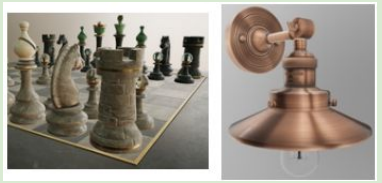
Tutorial Videos
glTF Sample Viewer
Project Explorer
glTF on iOS
Composite Scenes
Asset Repository
Blender

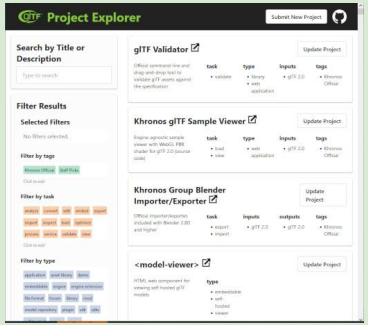
Futures

glTF SampleViewer
glTF on iOS
Composite Scenes
Metadata
Asset Repository
Blender

Education







glTF on iOS

RFP

Content Creation

Pipeline & Distribution

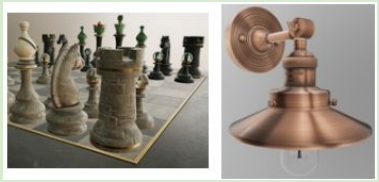
Education

Futures

Content Creation

Lightbulb: created by Freepik at Flaticon (https://www.flaticon.com/free-icons/lightbulb")

Pipeline & Distribution

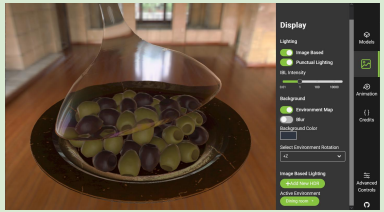


glTF on iOS

RFP

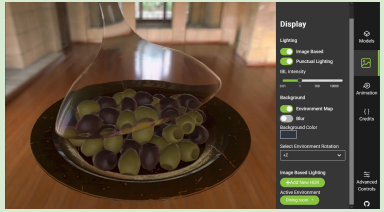
Metadata

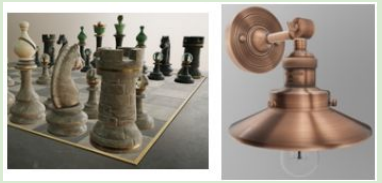
glTF-Transform

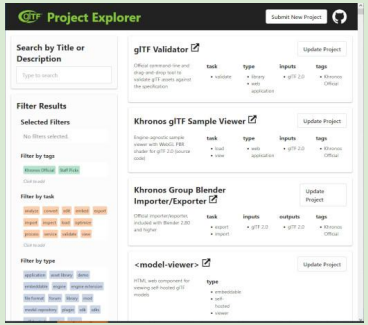


Standford Bunny: ©2010, Lionel Allore, CC-BY-SA. Contact for copy. Utah Teapot: ©2021, casperbengtss05, CG Trader, Royalty Free

Education





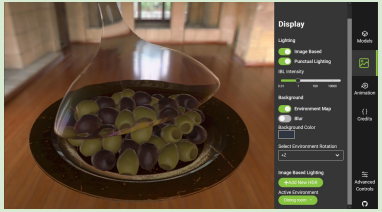


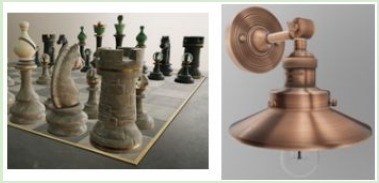
glTF on iOS

RFP

Education: © Steve Schoger at IconBolt. License: CC-BY.

Futures





glTF on iOS

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

Leonard Daly

siggraph@realism.com

Khronos Project Manager

Leonard@KhronosGroup.org

Linked In

SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

glTF™ 3DCommerce™

Q & A

Dan Frith & Alexey Medvedev

SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

ANARI OpenXR WebGL 3DCommerce glTF Vulkan

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!

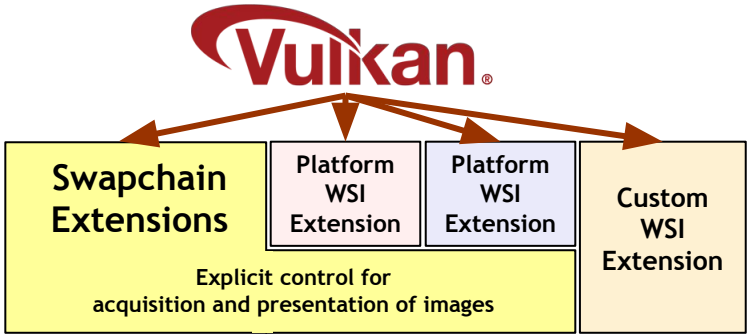
We welcome feedback and cooperation between organizations

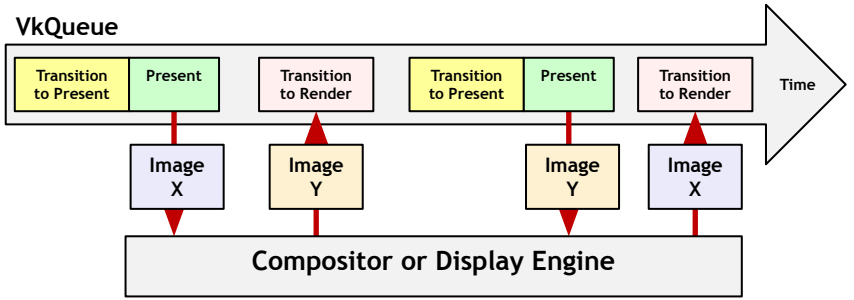
These slides will be available online

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

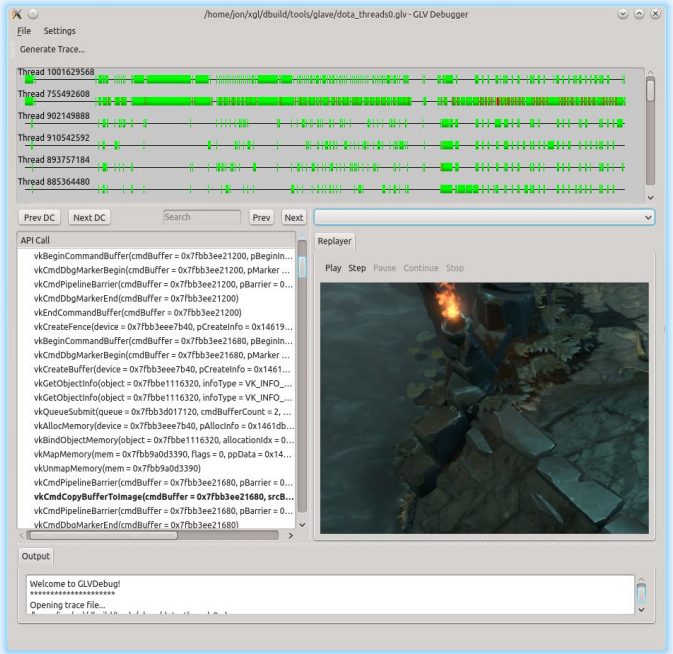
Short Bullets

- To accompany larger graphics

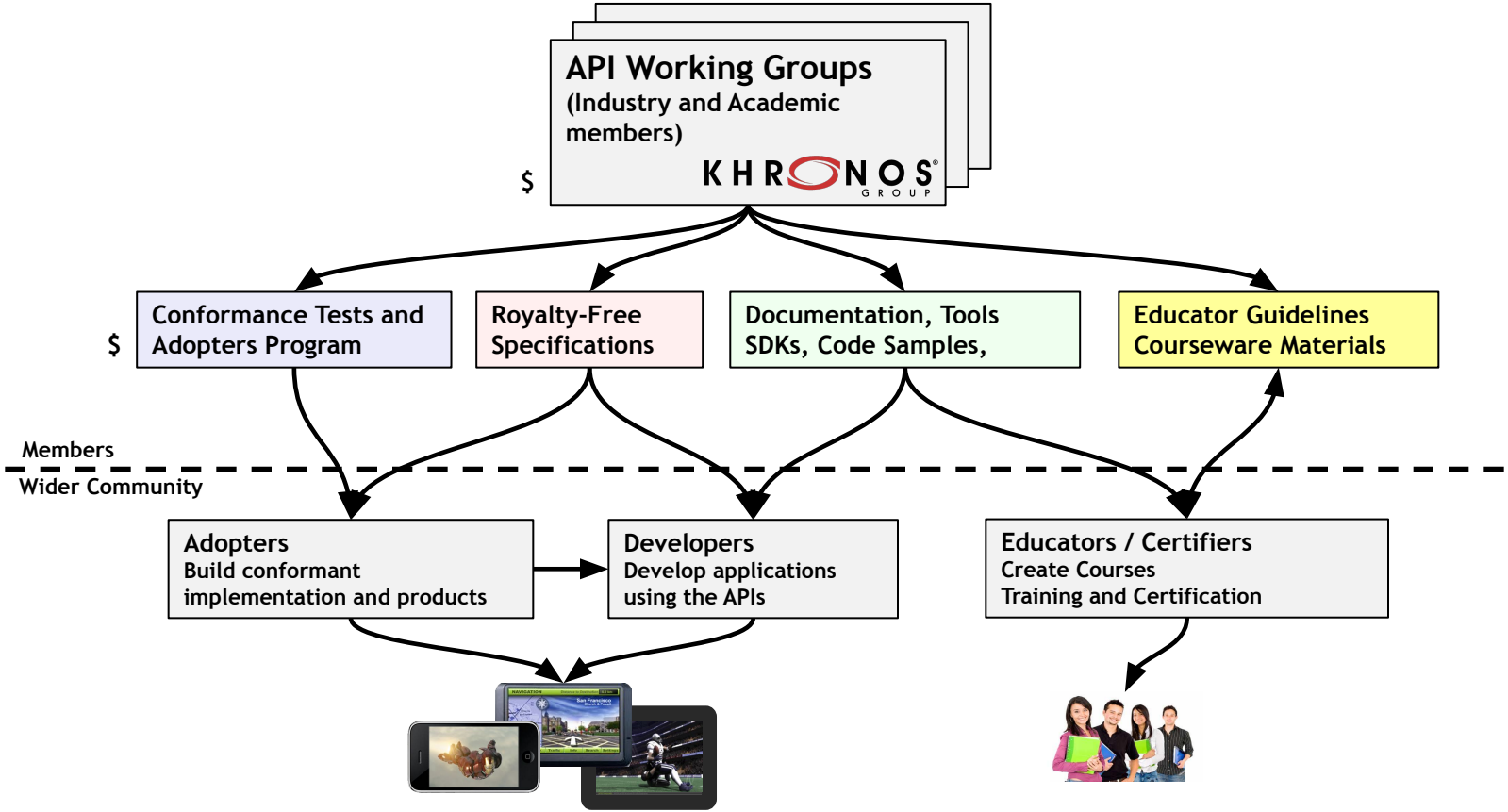
Dual Column Bullets

- 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



KHRONOS GROUP

KHRONOS GROUP

CONNECTING SOFTWARE TO SILICON

KHRONOS GROUP