SIGGRAPH 2023
LOS ANGELES+ 6-10 AUG

KHRONOS GROUP

ANARI OpenXR WebGL 3DCommerce glTF Vulkan

glTF Composition and Interactivity

Dan Frith, Avataar
Gerald Guyomard, Adobe
Leonard Daly, Daly Realism

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KHRONOS GROUP

glTF™ 3DCommerce™

3DCommerce™ & Use Cases

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

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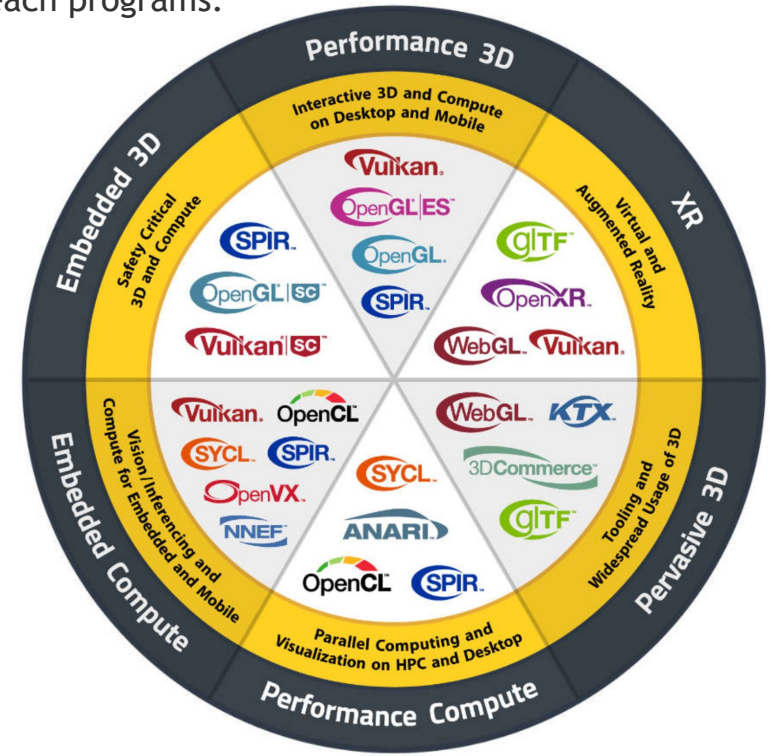
Khronos Ecosystem Segmentation

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.



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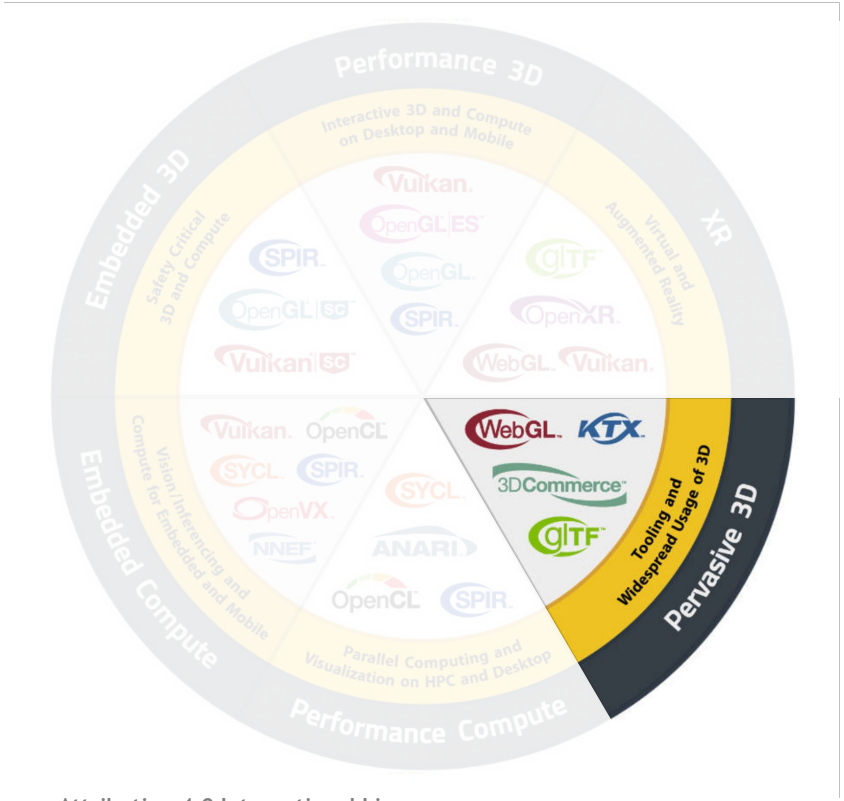
Khronos Ecosystem Segmentation

3D content is already **pervasive** in retail. Virtual representations of products are everywhere from ads, web on mobile & computer, Augmented Reality, Virtual Reality to Mixed Reality devices.



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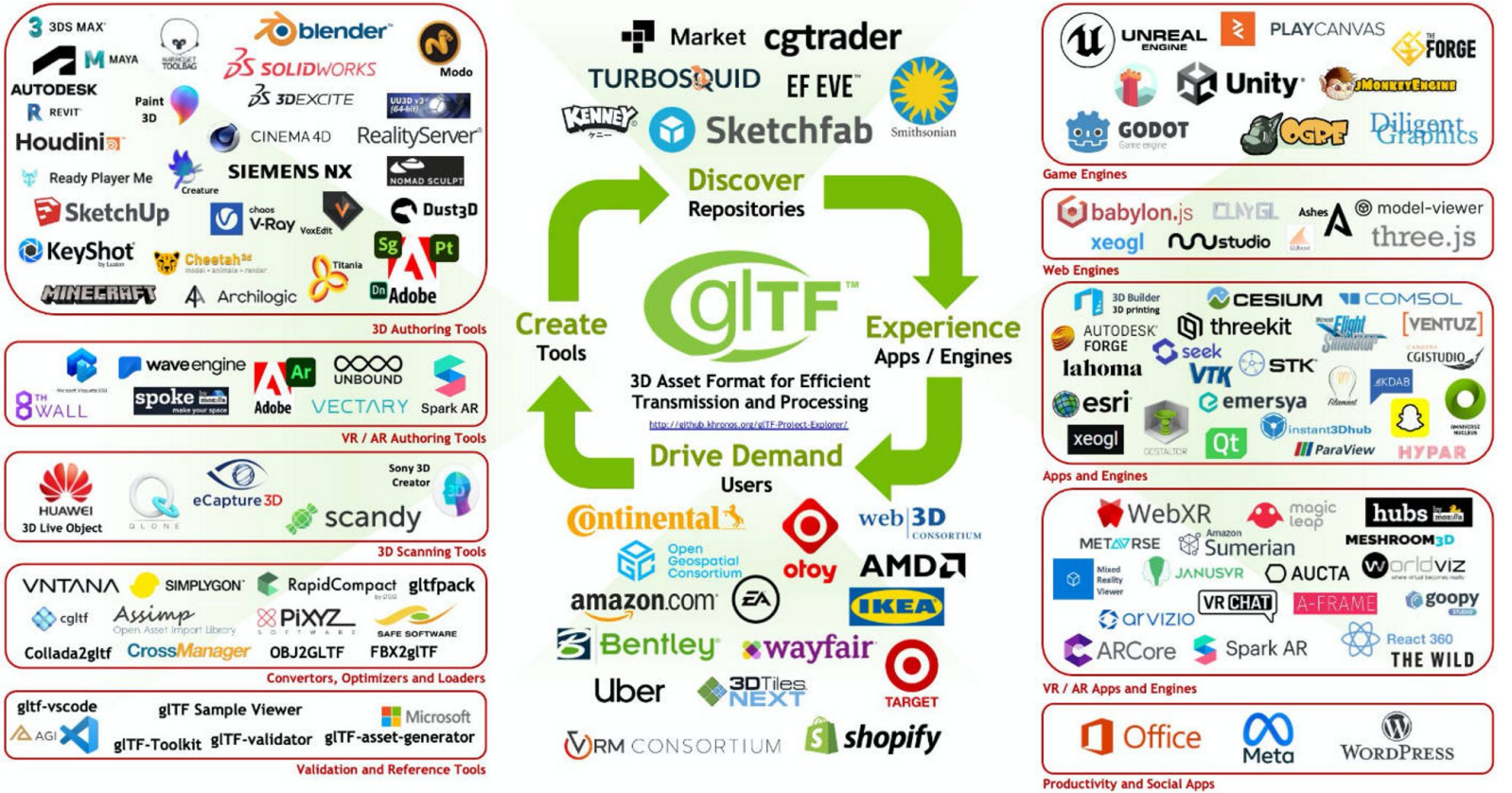
glTF Ecosystem



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glTF Ecosystem & 3D Commerce

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Industry Support glTF & 3D Commerce

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3D Commerce Use Case

Ace Hardware Teams with Epigraph for glTF-based 3D Web & AR Experiences.

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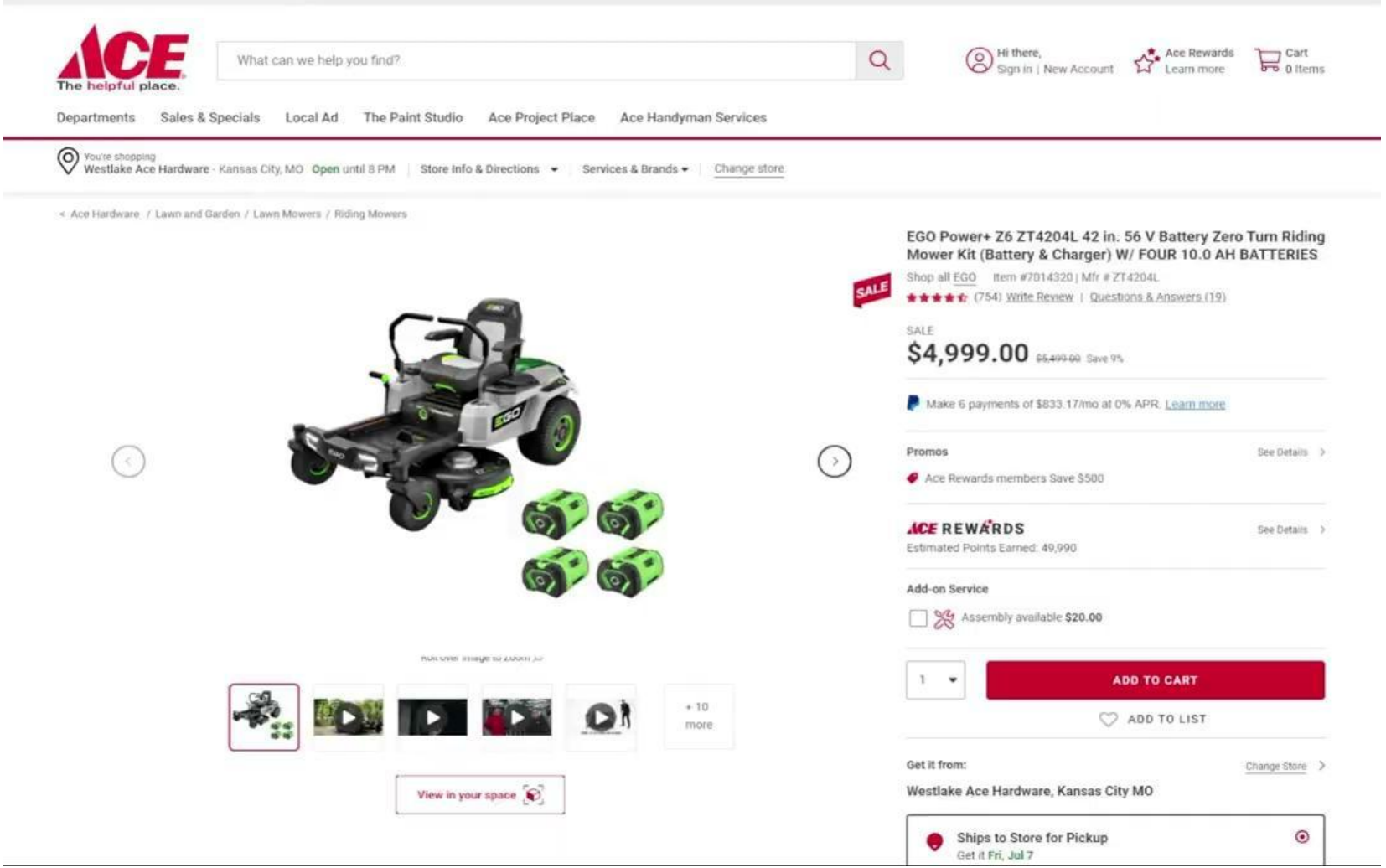

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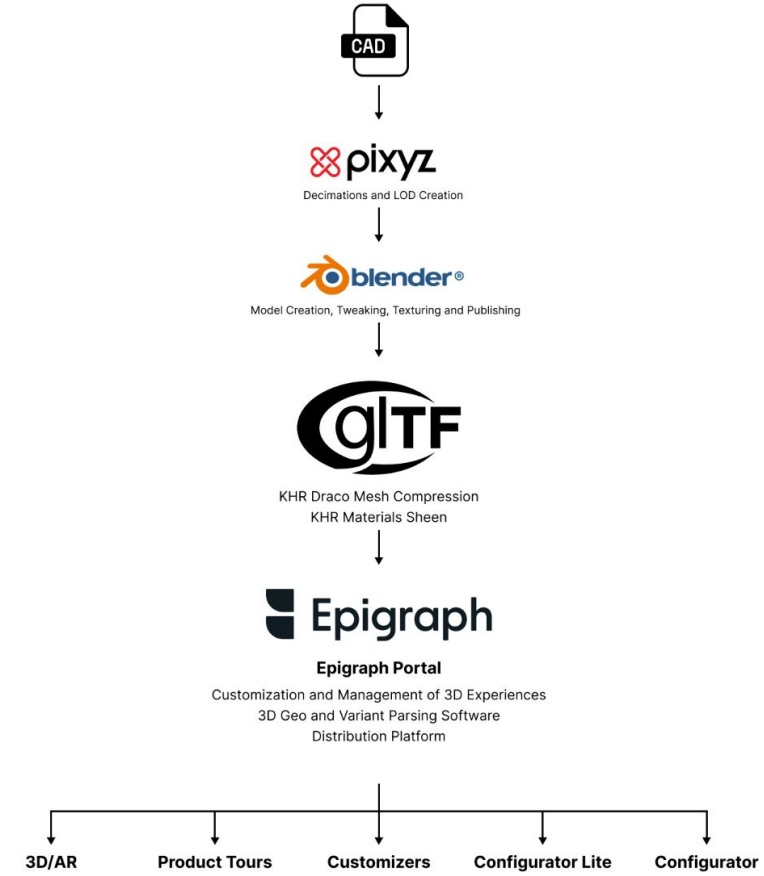
Epigraph > Ace Hardware Pipeline



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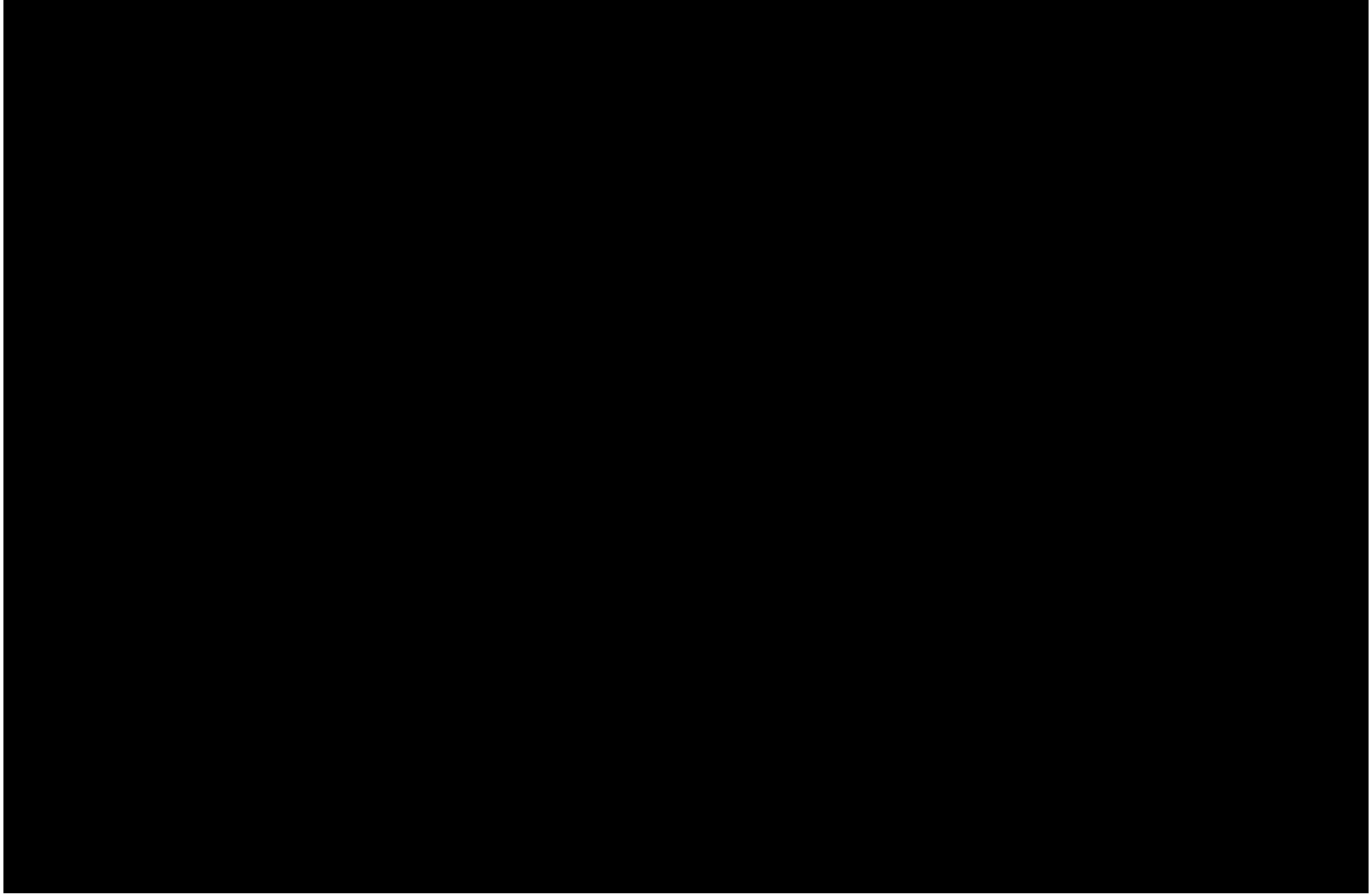

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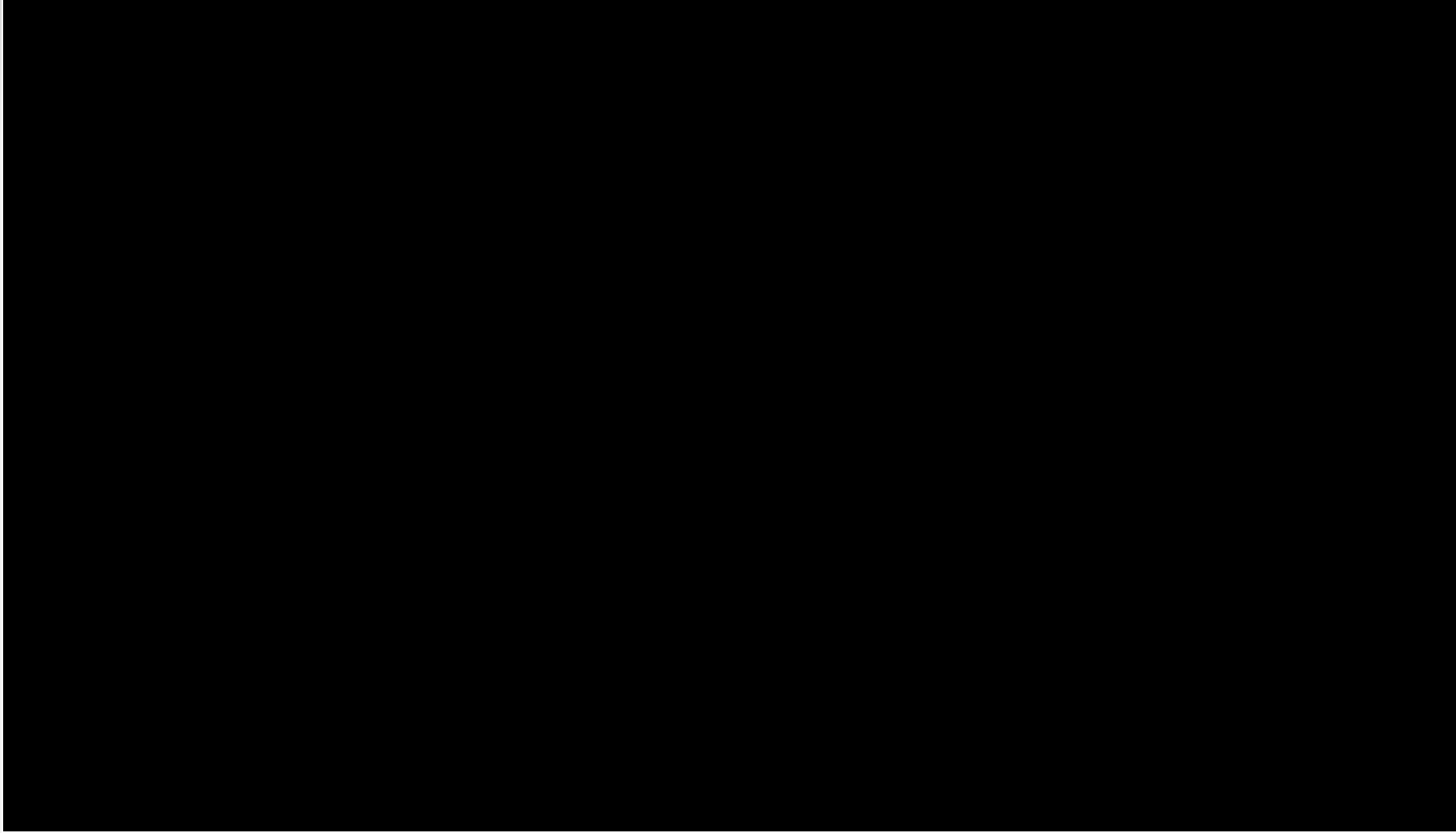

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Importance of standardisation:

- **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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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.

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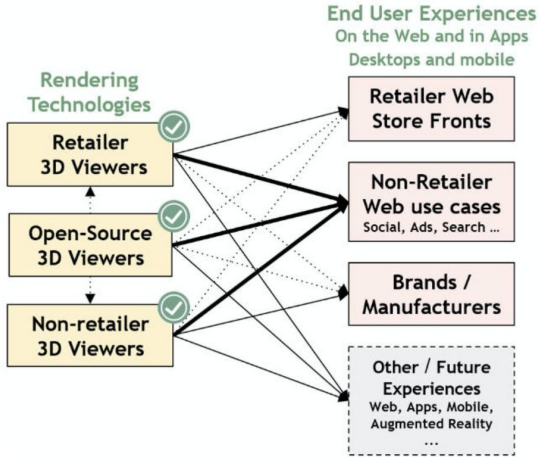
- **Viewer Certification program**



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

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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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- **NeRF (Neural Radiance Fields), Machine Learning & AI in 3D**
  - The use of generative AI in 3D Asset & scene creation whilst following standards

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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.

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glTF™ 3DCommerce™

Scene Interactivity

Gerald Guyomard, Adobe

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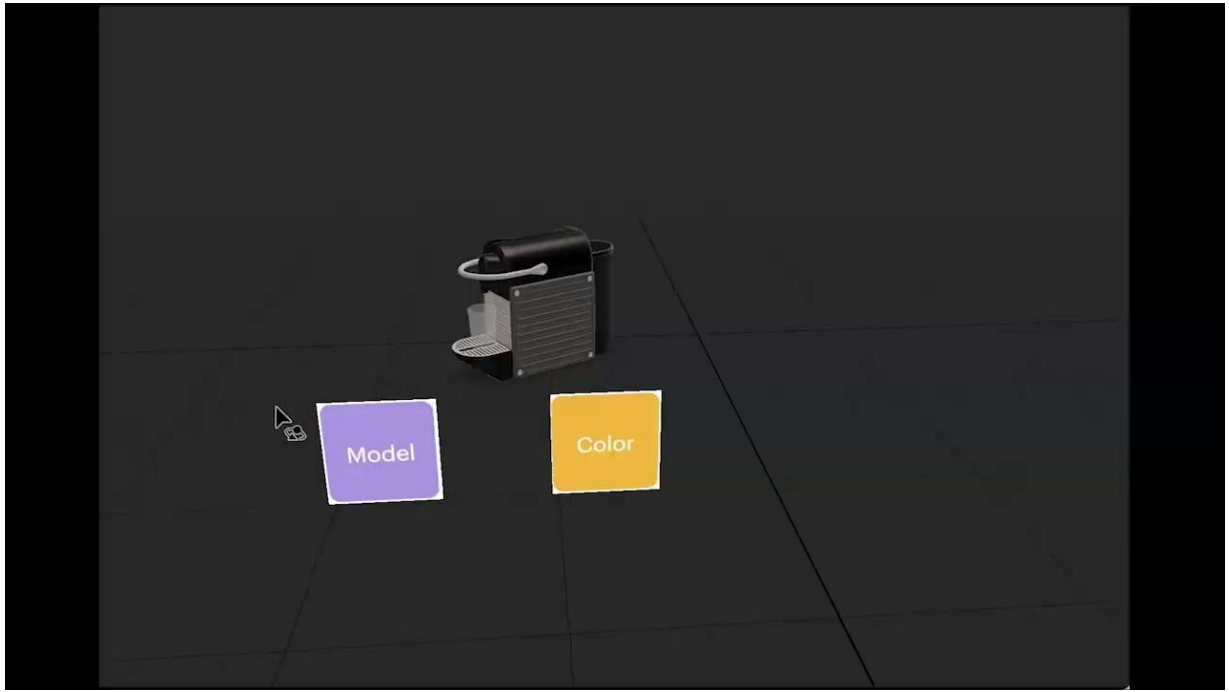
Adding Interactivity to glTF

- **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

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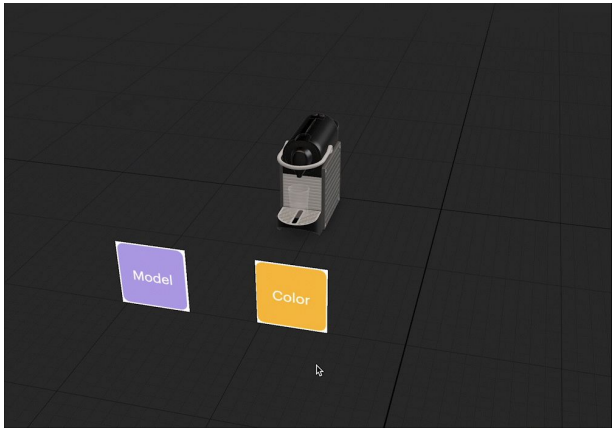
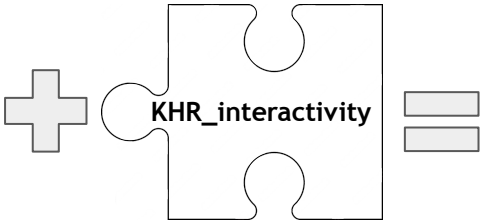
Adding Interactivity to glTF



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

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

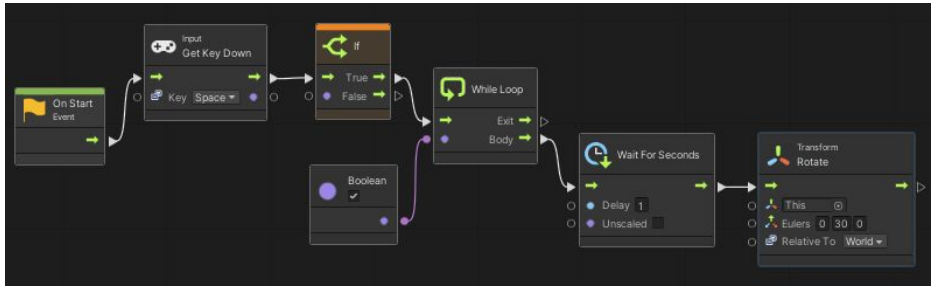
```cpp
#include "GameEngine.h"

class MyGame {
private:
    Object* _object;

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

C++

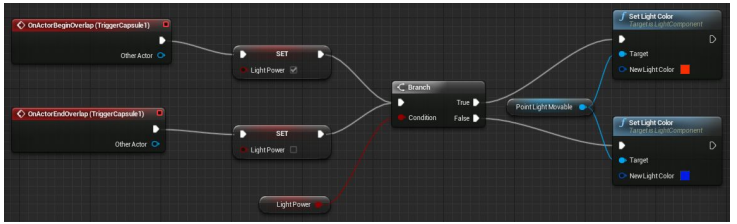
- **Visual Scripting**
  - Creator assembles and connects building blocks
  - Much easier to learn for non engineers (no syntax to learn, no compilation necessary)
  - More portable (lightweight runtime, no sandboxed VM to rely on)
  - Limited set of blocks makes it more secure



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**:

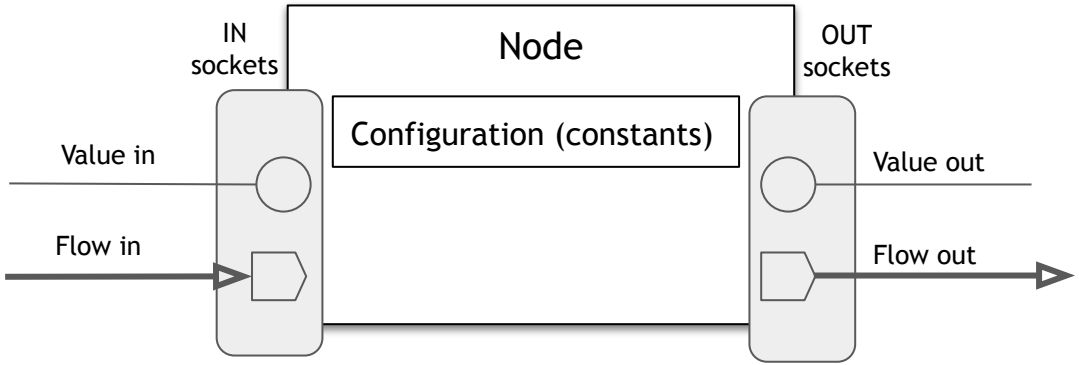
- Accessible and powerful
- Extensible with future extensions
- Compatible with visual editing, but visual editors are not required

KHR_interactivity Principles

An interactivity Graph is a set of connected Nodes forming a Directed Acyclic Graph (no cycles)

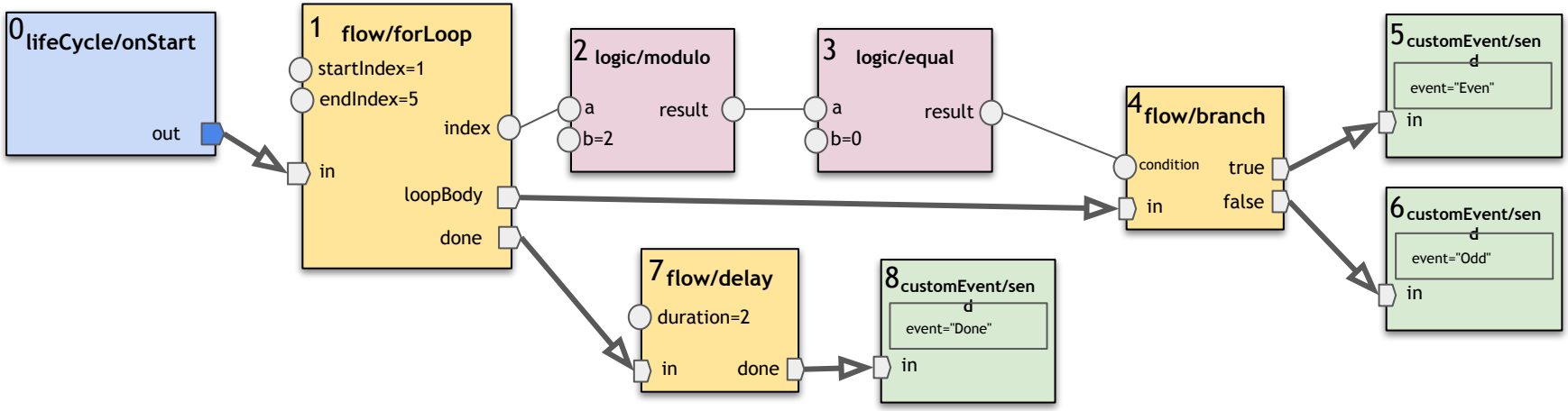
Node characteristics :

- type defining the action (add numbers, listen to an event, branch on a condition…)
- an immutable configuration
- some input sockets (value and flow)
- some output sockets (value and flow)



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
...	

Accessing the Scene Graph from the Behavior Graph

- High level actions change runtime scene state by starting / stopping animations, sounds, etc.

- Direct access to set / get runtime scene state using JSON paths
  - *Set "/nodes/6/translation"*
  - *Set "/nodes/3/scale"*

Extends the proposed *KHR_animation_pointer*'s JSON paths for interactivity

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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

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glTF™ 3DCommerce™

Scene Composition

Leonard Daly, Daly Realism

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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

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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**

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LOD - Geospatial

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

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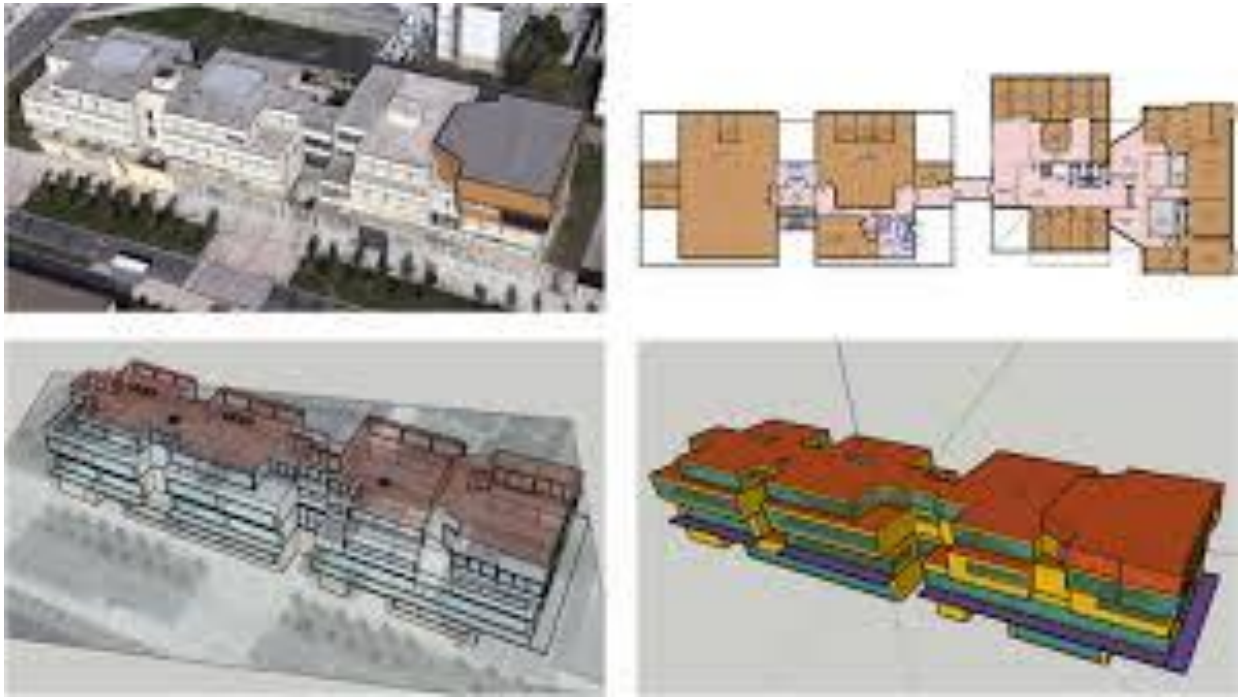
LOD: Building Information Modeling



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

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IKEA 80 år - vi firar med erbjudanden!

Meny

IKEA

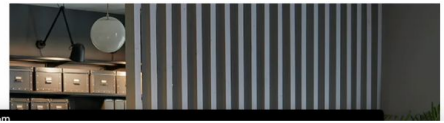
Vad letar du efter?

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



Waiting for www.ikea.com

LANDSKRONA

3-sits soffa, Grann/Bomstad svart/metall

9 995:-

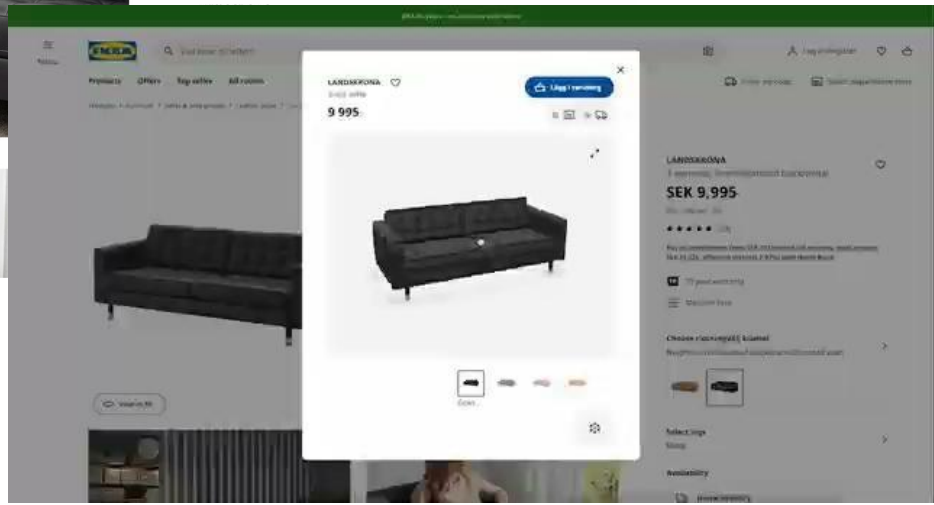
7 996:- exkl. moms

★★★★★ (29)

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

10 10 års garanti

Medelfast



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Work to Date

- Work done in May 2023 as Prototype
- Basic test of current specification
- Note name change to “gltf Composition”
- Video of Demo

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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

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Discussion and Futures

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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

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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!

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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

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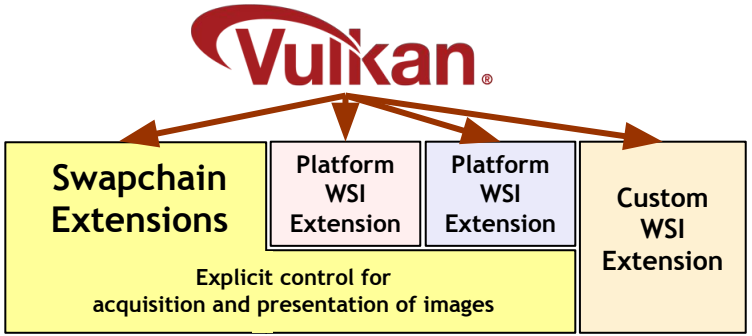
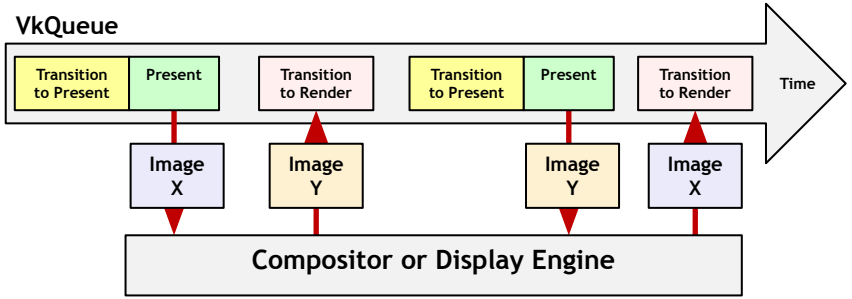
Smaller Font Bullets Make Space for Graphics

- **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





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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

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Short Bullets

- To accompany larger graphics

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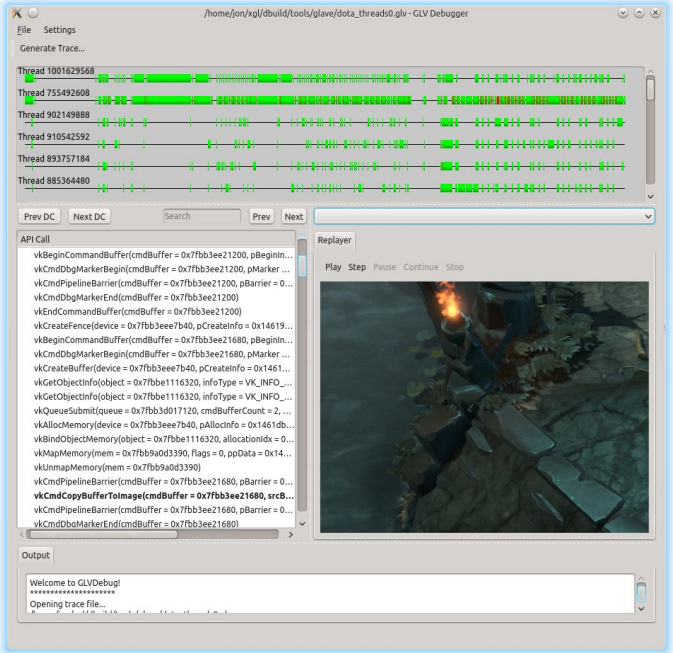
Dual Column Bullets

- 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



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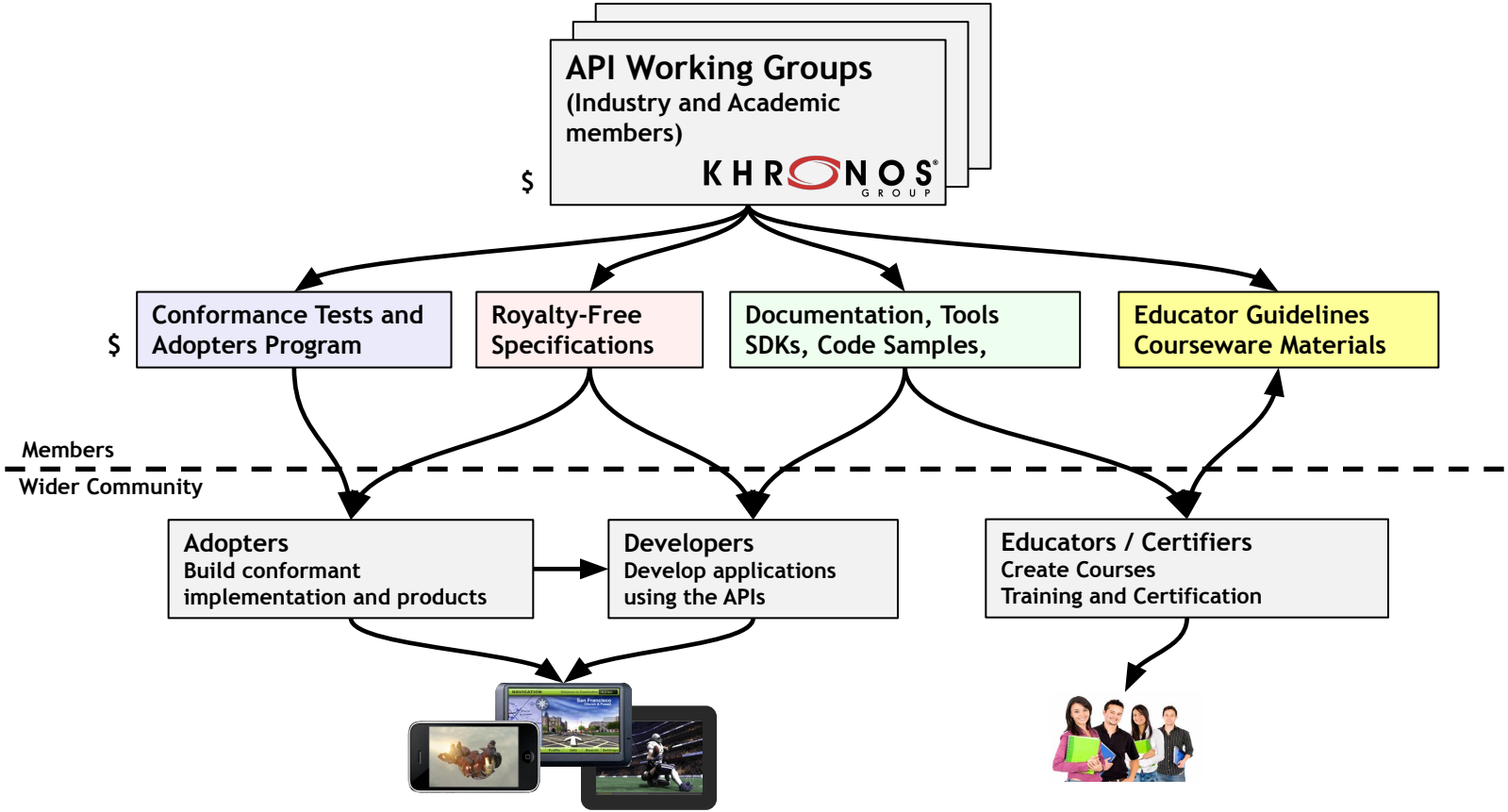
Typical Diagram Using Title Only Layout



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CONNECTING SOFTWARE TO SILICON

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