Khronos Updates
GDC 2017

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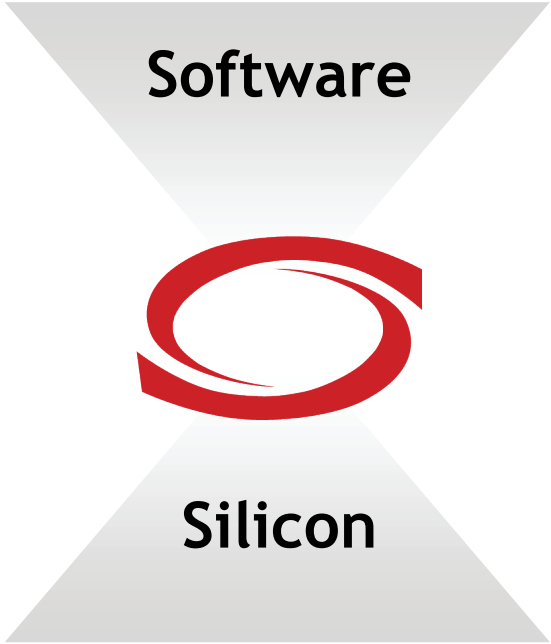
Khronos Mission



Khronos is an International Industry Consortium of over 100 companies creating royalty-free, open standard APIs to enable software to access hardware acceleration for 3D graphics, Virtual and Augmented Reality, Parallel Computing, Neural Networks and Vision Processing

Khronos Standards Ecosystem

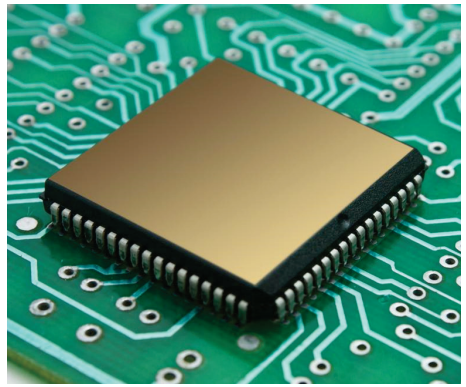
3D for the Web
- Real-time apps and games in-browser
- Efficiently delivering runtime 3D assets

COLLADA
WebGL
glTF

Real-time 2D/3D
- Cross-platform gaming and UI
- VR and AR Displays
- CAD and Product Design
- Safety-critical displays

OpenGL|ES
Vulkan
OpenGL|SC
OpenGL
OpenVG

NNEF
OpenVX
OpenXR



VR, Vision, Neural Networks
- VR/AR system portability
- Tracking and odometry
- Scene analysis/understanding
- Neural Network inferencing

SPIR
OpenCL
SYCL

Parallel Computation
- Machine Learning acceleration
- Embedded vision processing
- High Performance Computing (HPC)

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Khronos News Here at GDC 2017

- **Adoption Grows for Vulkan®; New Features Released**
  - Details here

- **Announcing OpenXR™ for Portable Virtual Reality**
  - https://www.khronos.org/blog/the-openxr-working-group-is-here

- **WebGL™ 2.0 Specification Finalized and Shipping**
  - https://www.khronos.org/blog/webgl-2.0-arrives

- **Call for Participation in 3D Portability Exploratory Group**
  - A native API for rendering code that can run efficiently over Vulkan, DX12 and Metal khronos.org/3dportability

- **Developer preview on glTF™ 2.0**
  - https://www.khronos.org/blog/call-for-feedback-on-gltf-2.0

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Vulkan Games and Game Engines

Dota 2 on Vulkan port of Source 2

'ProtoStar' demo on Vulkan port of Unreal Engine 4

Talos Principle on Vulkan port of Serious Engine

Doom's Vulkan patch is a PC performance game-changer

DOOM on Vulkan port of id Tech 6

CRYENGINE CRYTEK

Vulkan support coming

XENKO Silicon Studio

Vulkan support in V1.8

unity

Developer Preview

Vulkan Momentum Continues to Build

Games Studios publicly confirming that work is ongoing on Vulkan Titles

In first 12months :
#Vulkan Games on PC = 11
In first 18 months
#DX12 Games on PC = 19
https://en.wikipedia.org/wiki/List_of_games_with_Vulkan_support

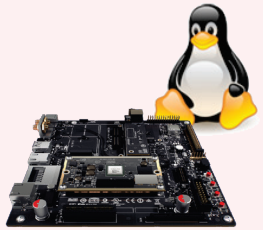
All Major GPU Companies shipping Vulkan Drivers – for Desktop and Mobile Platforms

Mobile, Embedded and Console Platforms Supporting Vulkan

Android 7.0

Nintendo Switch


Android TV


Embedded Linux

New Vulkan Functionality at GDC 2017

- **Vulkan 1.0.42 released with new extension sets for VR and multi-GPU**
  - https://www.khronos.org/registry/vulkan/#apispecs
  - The most requested functionality by developers
  - Building Block approach provides explicit level of control
- **Enables developers with key functionality today**
  - AND gathers experience and feedback for future Vulkan core spec releases
- **First use of KHX extensions**
  - Developed by the working group – and ratified - like traditional KHR extensions
  - But will have TEMPORARY lifetime - should NOT be built into production code
  - Enables developer feedback without polluting long-term extension space
- **New LunarG SDK for Vulkan Header 1.0.42.0 released today!**
  - Includes support for all newly Released Functionality!
- **NVIDIA has published their new Vulkan beta drivers on day of spec release**
  - With full support for all the new v1.0.42 extensions
  - Plus building block Vulkan extensions for VRWorks on Maxwell and Pascal

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Vulkan Extension Sets

- **Multiview extension set**
  - Render geometry to multiple surfaces, each with its own viewing parameters
  - Can efficiently render stereo pairs or environment maps
- **Sharing extension set**
  - Share memory and synchronization primitives across process and instance boundaries
  - Useful for implementing real-time rendering system such as VR runtimes
- **Explicit Multi-GPU extension set**
  - Treat multiple GPUs as a single logical device
  - Application can implement Alternate Frame Rendering, Split Frame Rendering or VR SLI
- **Descriptor Update extension set**
  - Alternate ways to update resource references between draw or compute dispatch calls
  - More efficient when a fixed set of resources must be updated repeatedly
  - More convenient for legacy applications

Vulkan Multi-GPU and Virtual Reality Support

- **Native multi-GPU support for NVIDIA SLI and AMD Crossfire platforms**
  - WDDM must be in “linked display adapter” mode
  - The most common use case – does NOT support dGPU/iGPU
- **Explicit control of how GPUs cooperate to enable a variety of operating modes**
  - AFR (alternate frame), SFR (Sequential frame) and VR SLI Stereo view rendering
- **A “device group” is a set of physical devices that support multi-GPU rendering**
  - Acts as single logical device - makes adding device group support as easy as possible
  - Only access each physical GPU in a device group when need explicit control:
  - Memory allocation and binding resources
  - Command Buffer Recording/Submission
  - Synchronization

Khronos APIs for VR

Khronos APIs Powering VR Rendering Today

OpenGL ES and OpenGL on millions of mobile VR devices
WebVR in browsers power by WebGL
SteamVR Beta using Vulkan

3D API features used by VR compositors

Context priority
Front buffer rendering
Tiled rendering (beam racing)
Multiview

But What About Everything Else for VR..

Device discovery
Multiple sensor tracking
Device Events
Haptics
Parameters for optics corrections etc. etc…

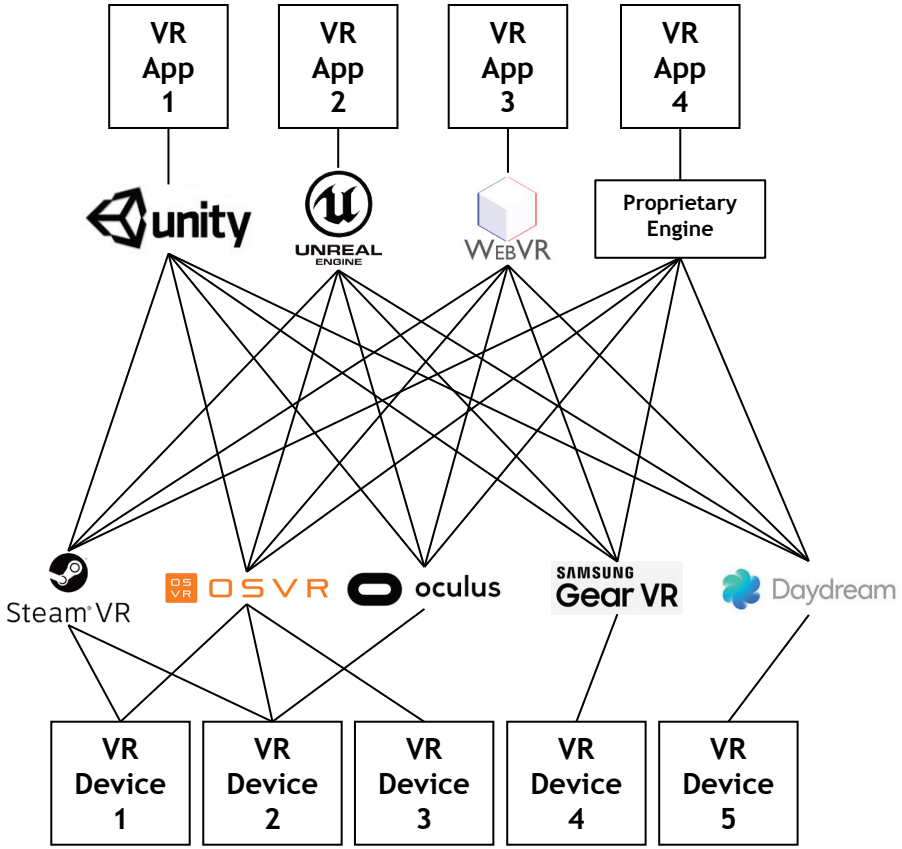
WebVR

WebGL OpenXR

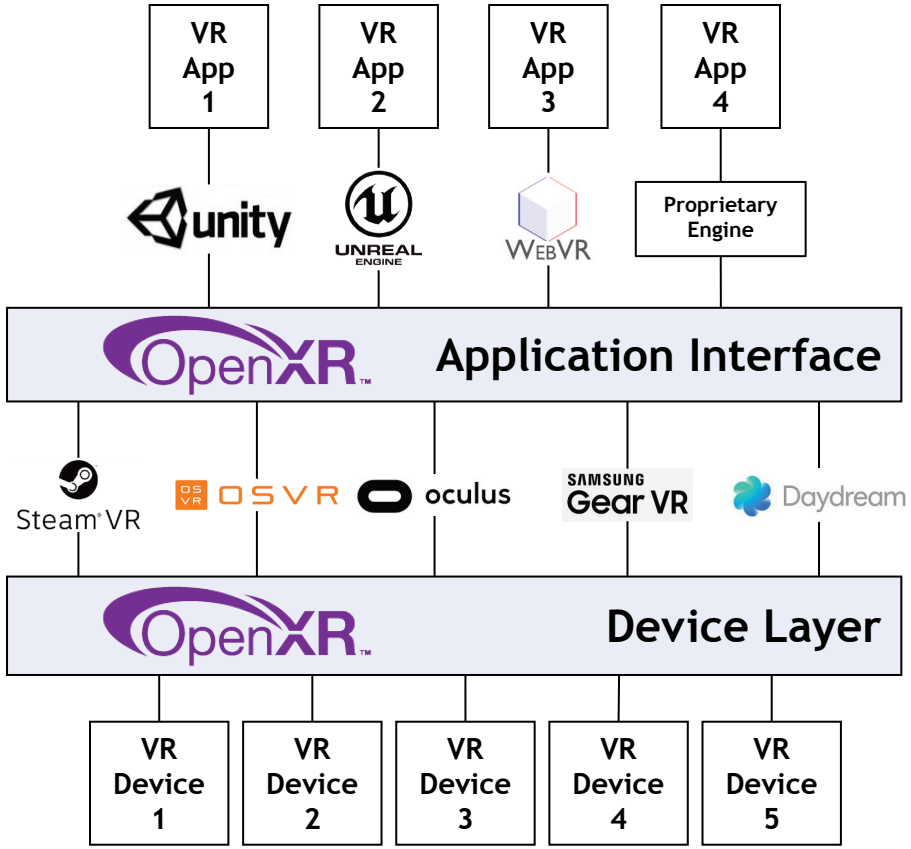
OpenXR!

Cross-Platform, Portable, Virtual Reality
Complements Rendering APIs

OpenXR - Solving VR Fragmentation



Before OpenXR
VR Market Fragmentation



After OpenXR
Wide interoperabilityof VR apps and devices

OpenXR Working Group Members

Design work has started in December 2016
Typically 12-18 months to develop a V1.0 specification

WebGL – 3D for the Web

Content downloaded from the Web

Content
JavaScript, HTML, CSS, ...

Middleware provides accessibility for non-expert programmers
E.g. three.js library

JavaScript Middleware

Low-level WebGL API provide a powerful foundation for a rich JavaScript middleware ecosystem

Browser provides WebGL 3D engine alongside other HTML5 technologies - no plug-in required

WebGL | CSS | JavaScript | HTML5

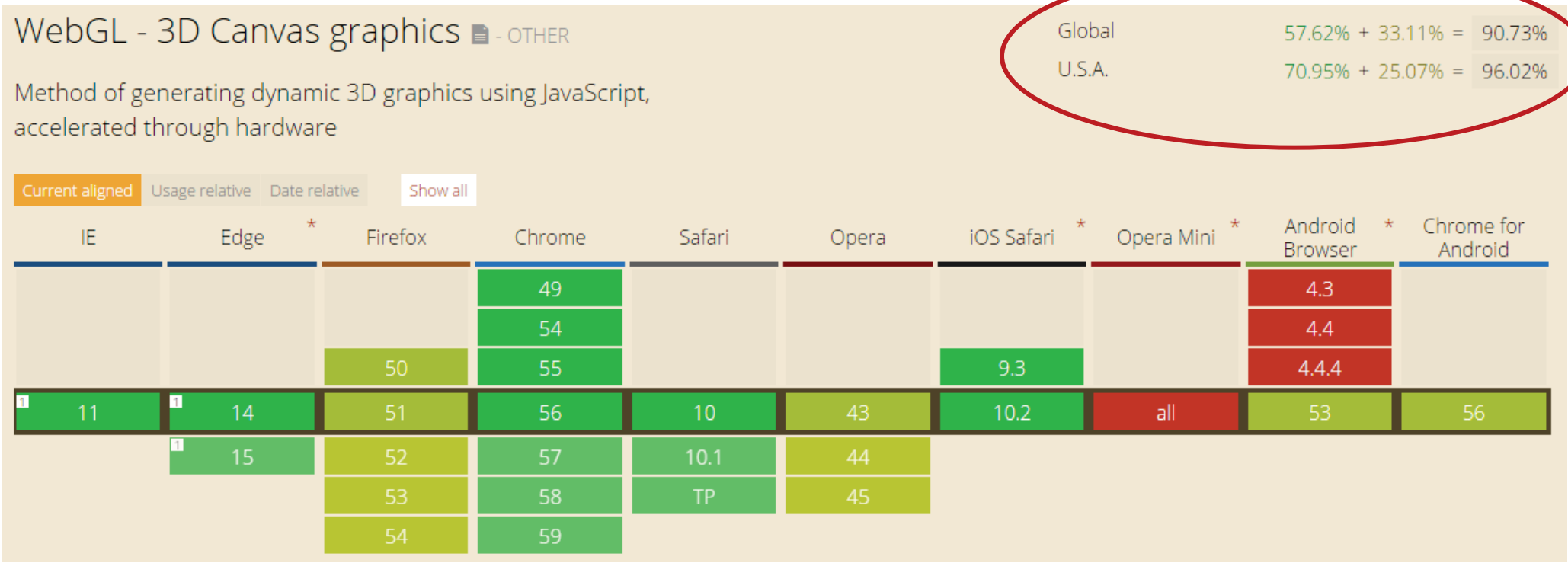
Reliable WebGL relies on work by both GPU and Browser Vendors
->
Khronos has the right membership to enable that cooperation

OS Provided Drivers
WebGL uses OpenGL ES 2.0 or Angle for OpenGL ES 2.0 over DX9

OpenGL ES | OpenGL

Pervasive WebGL 1.0

- **WebGL on EVERY major desktop and mobile browser**



http://caniuse.com/#feat=webgl

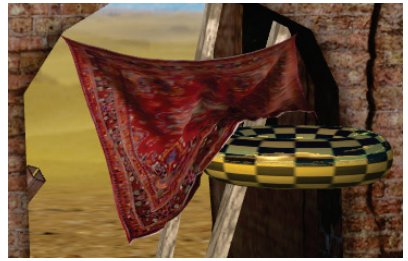
WebGL 2.0 Timeline

Fixed function Pipeline

Programmable Vertex and fragment shaders

32-bit integers and floats
NPOT, 3D/depth textures
Texture arrays
Multiple Render Targets

Compute Shaders



Tessellation and geometry shaders
ASTC Texture Compression
Floating point render targets
Debug and robustness for security

Epic's Rivalry demo using full Unreal Engine 4on mobile
https://www.youtube.com/watch?v=jRr-G95GdaM

Driver Update | Silicon Update | Silicon Update | Driver Update | Silicon Update

2003 1.0 — 2004 1.1 — 2007 2.0 — 2012 3.0 — 2014 3.1 — 2015 3.2

OpenGL ES

WebGL

2011 WebGL 1.0

Vulkan

Possible Compute Shader Extension

GDC 2017! WebGL 2.0

Conformance Testing is vital for Cross-Platform Reliability

WebGL 2.0 conformance tests are very thorough
10x more tests than WebGL 1.0 tests

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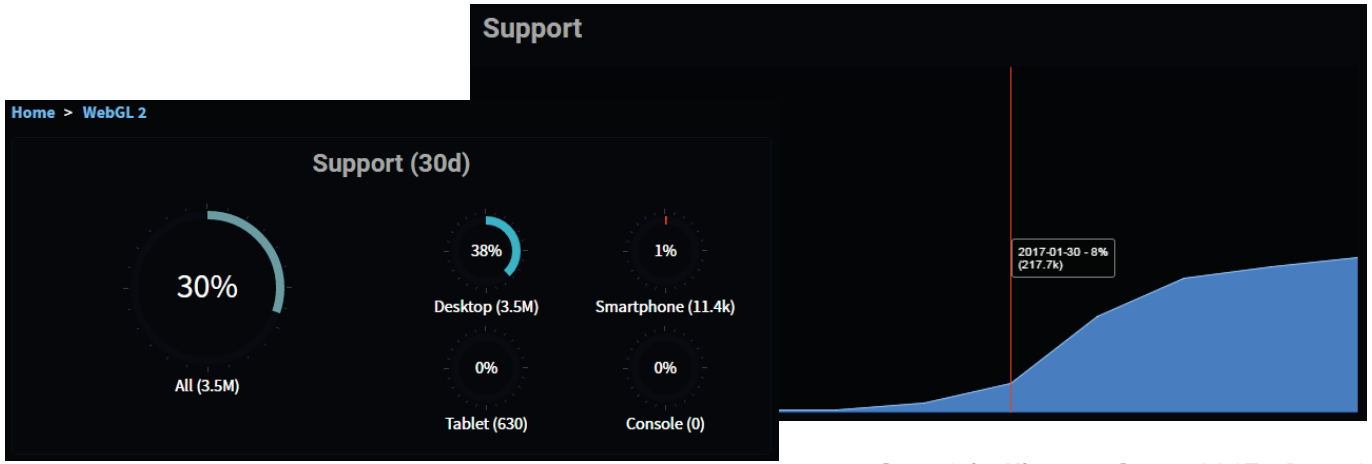
WebGL 2.0 - WebGL 2.0 Spec

- **Enhanced visual quality, performance, features**
  - Instancing Multiple render targets| Uniform buffers | Transform feedback
  - Multisampled Renderbuffers| 3D textures | NPOT textures
  - More texture formats | Occlusion queries | Vertex array objects
  - Sampler objects | Sync objects | Fragment depth | Primitive restart | …
- **WebGL 2.0 now available in Chrome/Firefox!**
  - Chrome: Released to desktop platforms - soon on Android
  - Firefox: Released on all platforms
  - Edge/Safari: plan to ship WebGL 2.0
  - Desktop support at 38% - will continue rising

http://webglstats.com/webgl2

WebVR Running Over WebGL 2.0



WebGL 2.0

PlayCanvas: *After the Flood* [Video]

The 3D Portability Problem

Only Windows 10

Only Apple

Cross Platform

SteamOS

For developers wishing to use the new generation of explicit 3D APIs there is no single API that runs on all desktop and mobile systems!
Problem for native apps that don't use game engines AND nexgen WebGL!

Need for Portability

"The golden age of application portability through OpenGL and OpenGL ES being available on all desktop and mobile systems is passing.

Developers now want to tap into the enhanced performance of the new generation explicit APIs: Vulkan, DX12 and Metal.

Every cross-platform developer, as well as WebGL, is facing the challenge of rendering portably and efficiently across systems using all three of these APIs.

Khronos has been leading the development of cutting-edge native and Web 3D APIs for many years, and is uniquely qualified to solve this urgent issue confronting the industry."

Jon Peddie, President of Jon Peddie Research

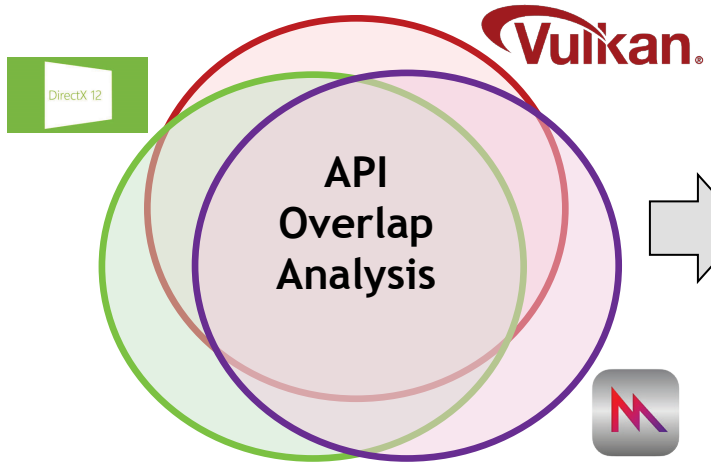
3D Portability API - Call For Participation

'WebGL Next'
Design has started inside Khronos
- Could lift 'Portability API' to JavaScript and WebAssembly
- Provides nexgen graphics *and* GPU compute for the Web

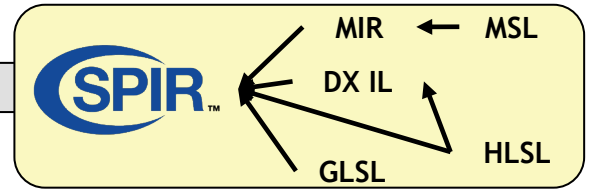
WebGL™

A Portability Solution needs to address APIs *and* shading languages

'Portability Solution'
Portability API Spec
+ Shading Language open source tools



'Portability API' Specification



Open source compilers/translators for shading and intermediate languages

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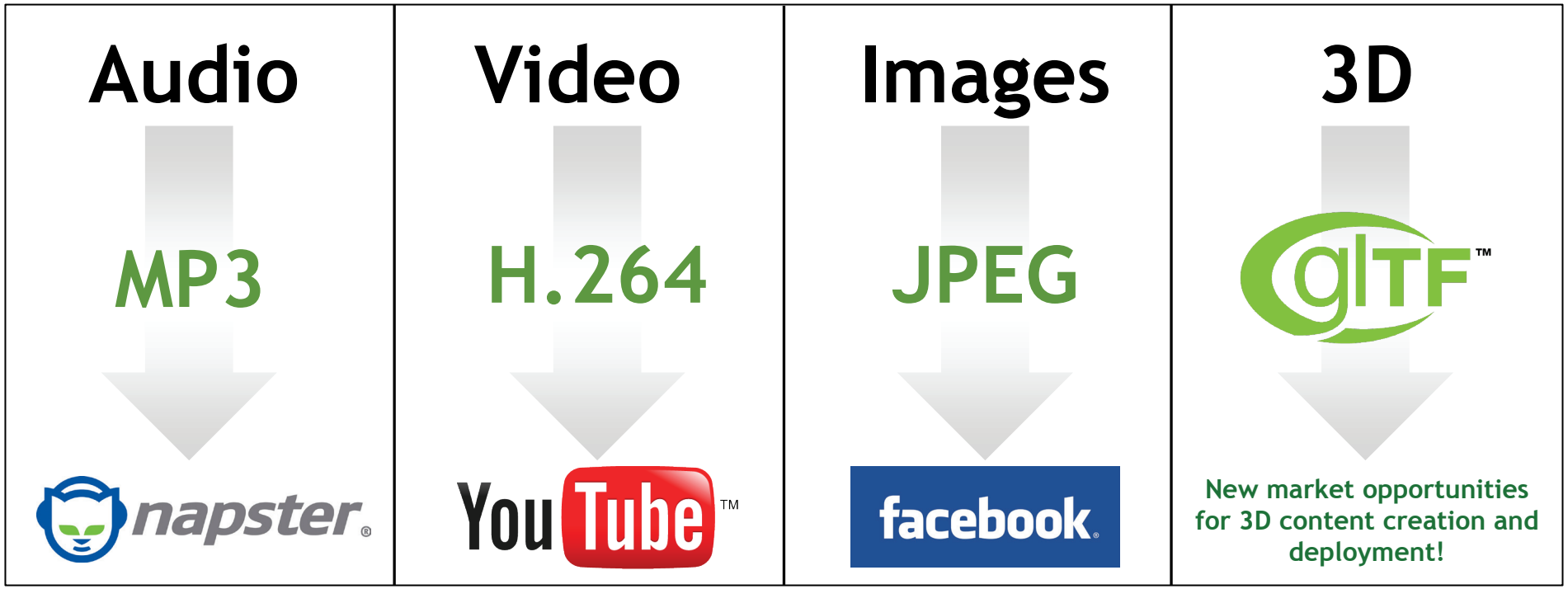
glTF - Runtime 3D Asset Delivery



model/gltf+json MIME type Approved by IANA

Compact to Transmit 

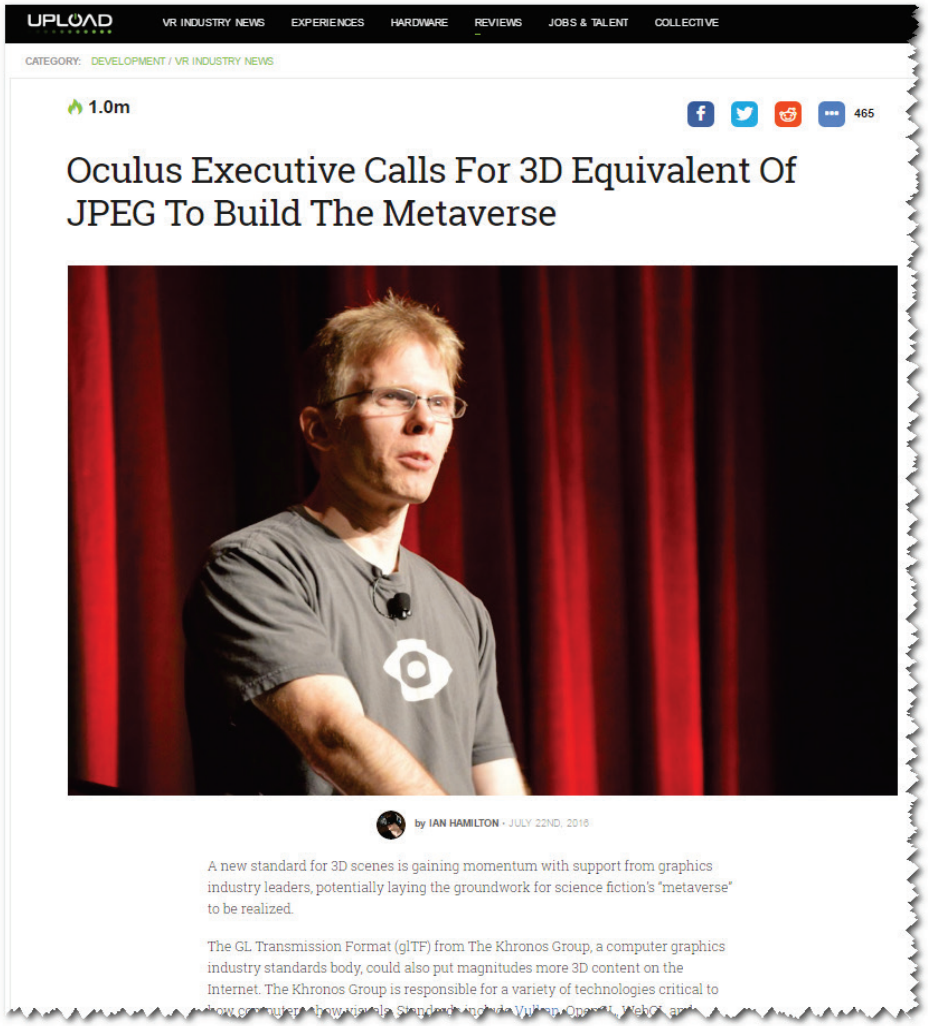
Fast to Load 

Describes Full Scenes 

Runtime Neutral 

Extensible 

Strong glTF Momentum



UPLOAD VR INDUSTRY NEWS EXPERIENCES HARDWARE REVIEWS JOBS & TALENT COLLECTIVE

CATEGORY: DEVELOPMENT / VR INDUSTRY NEWS

1.0m 465

Oculus Executive Calls For 3D Equivalent Of JPEG To Build The Metaverse

by IAN HAMILTON • JULY 22ND, 2016

A new standard for 3D scenes is gaining momentum with support from graphics industry leaders, potentially laying the groundwork for science fiction's "metaverse" to be realized.

The GL Transmission Format (glTF) from The Khronos Group, a computer graphics industry standards body, could also put magnitudes more 3D content on the Internet. The Khronos Group is responsible for a variety of technologies critical to

glTF™

oculus

web 3D CONSORTIUM

MPEG

Adobe

blender™

OGC

box

Microsoft

otoy

Fraunhofer

NVIDIA

AREA Augmented Reality for Enterprise Alliance

Sketchfab

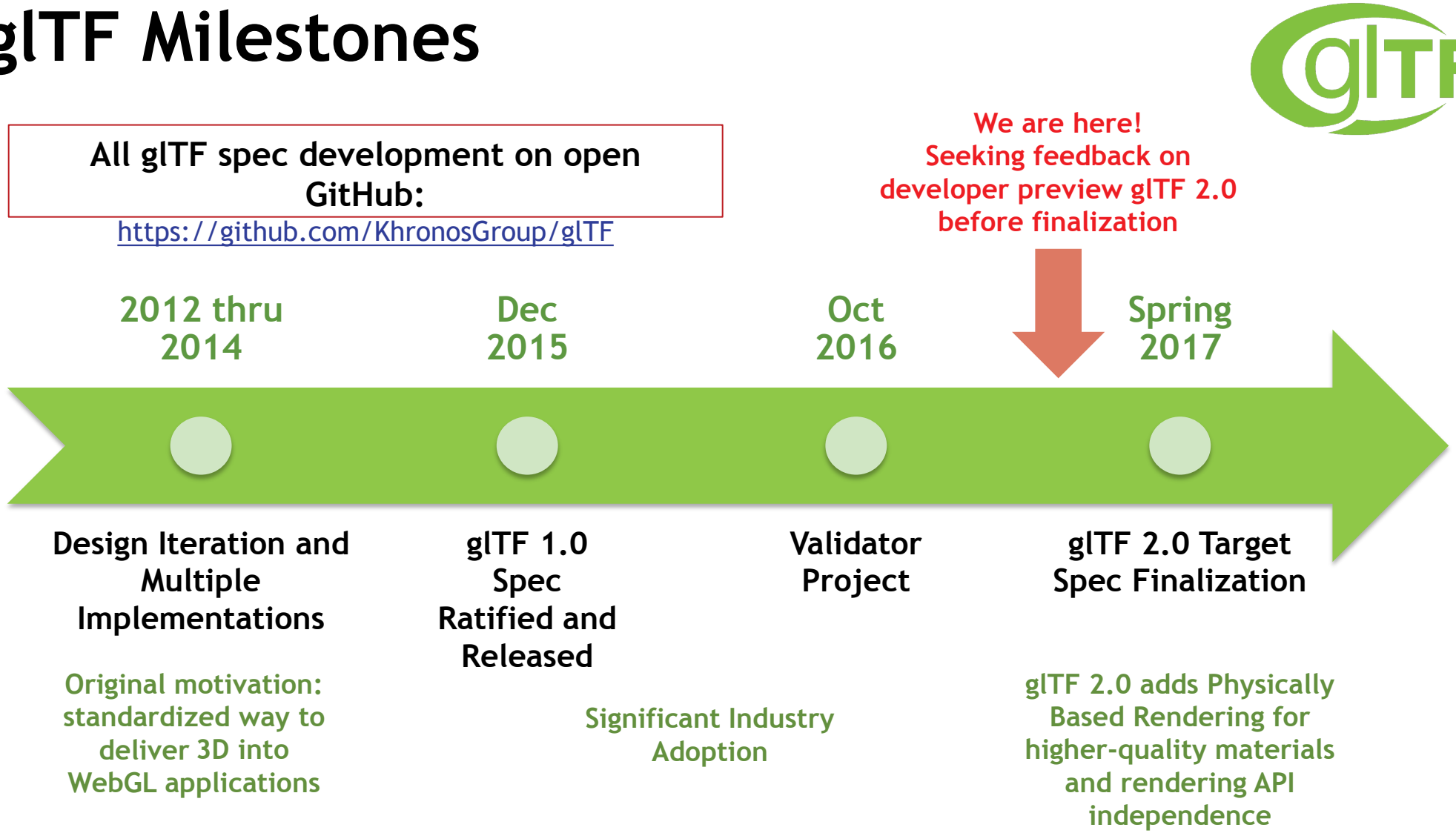
CESIUM

AUTODESK

Google

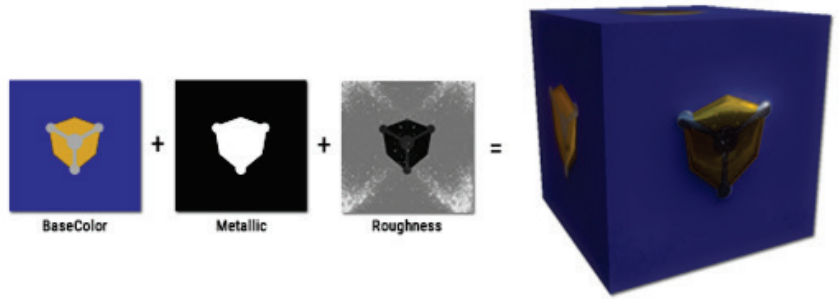
Publicly Stated Support for glTF

glTF Milestones

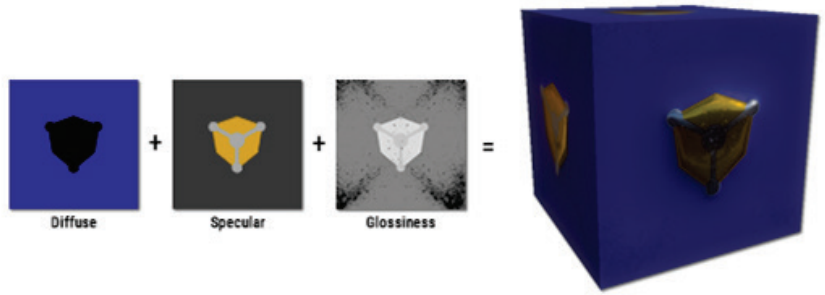


glTF 2.0 Physically Based Rendering

- **In Core: Metallic-Roughness Material model**
  - -baseColor – base color
  - -metallic – metalness
  - -roughness – roughness
- **Simple to implement with small resources**
  - Can be everywhere



- **Extension: Specular-Glossiness Material model**
  - diffuse – reflected diffuse color
  - specular – specular color
  - glossiness – glossiness
- **A little more resource heavy**
  - Optional extension (e.g. on low-power devices)



- **The two models can be combined**

glTF 2.0 PBR materials in various engines

WebGL reference implementation
http://www.seas.upenn.edu/~moneimne/WebGL-PBR/

Laugh Engine running on Vulkan
https://github.com/jian-ru/laugh_engine

Backup Materials

What's new in glTF 2.0

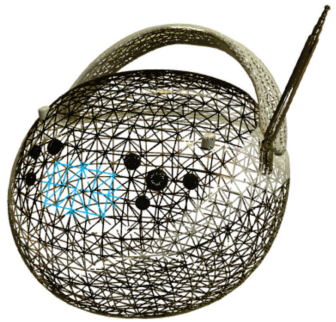
- **Physically Based Rendering (PBR) material definitions**
  - Material information stored in textures
- **Graphics API neutral**
  - GLSL materials moved to extension
  - Proven by implementations using WebGL, Vulkan and Direct3D
- **Improvements**
  - Binary glTF in core
  - Enhanced Performance

glTF 2.0 Scene Description Structure

.gltf (JSON)
Node hierarchy, PBR material textures, cameras

.bin
Geometry: vertices and indices
Animation: key-frames
Skins: inverse-bind matrices

.png
.jpg
...
Textures



Geometry

Texture based PBR materials

Physically Based Rendering

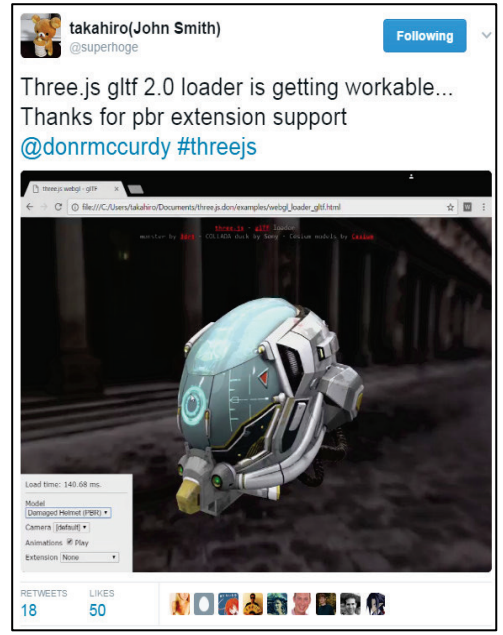
- **Standardize the BRDF inputs for common PBR workflows**
  - Metallic-Roughness and Specular-Glossiness
- **Incredible industry effort**
  - Started by Fraunhofer and supported by Microsoft, Sketchfab, NVIDIA, Autodesk, Marmoset, University of Pennsylvania, and others

Sketchfab User: theblueturtle
https://sketchfab.com/models/b81008d513954189a063ff901f7abfe4

Rapid Transition to glTF 2.0

- **There are breaking changes from 1.0 to 2.0 - but processing is streamlined and simplified**
  - Overwhelming community feedback to take the pain now – NOT significant work to upgrade
- **Industry moving quickly to glTF 2.0 — lots of early adopters**
  - BabylonJS, three.js, Cesium, xeogl, instant3Dhub
- **gltf-pipeline includes glTF 2.0 updates — including glTF 1.0 to glTF 2.0 translator**
  - Open source - use this to support both glTF 1.0 and 2.0 or move your users to 2.0
- **Converters/Translators/Validators glTF 2.0 updates nearly ready**
  - COLLADA2GLTF and obj2gltf translators
  - Khronos Validator and Gltf-test
- **Samples and Tutorials**
  - glTF 2.0 sample models with PBR are emerging
  - Extensive glTF tutorial series in draft

Consider moving your pipeline to glTF 2.0 ASAP



Blender glTF 2.0 Exporter RFQ

- **Khronos-funded project to bring glTF 2.0 export to Blender**
  - Blender, has some early work on glTF export: https://github.com/Kupoman/blendergltf
  - Project is to build out that work to glTF 2.0
  - Resultant code is to be contributed, royalty-free to the Blender open source project
- **RFQ Milestones**
  - 1. February 27th — Khronos Releases RFQ
  - 2. March 17th — RFQ responses received by Khronos
  - 3. March 24th — Contractor selected and notified
  - 4. March 29th — Contract executed and start of work

Details here:
https://www.khronos.org/rfq/
Please Consider Making a Bid!

glTF 2.0 PBR Rendering - Image courtesy Fraunhofer

glTF Roadmap Discussions

- **Mesh Compression**
  - Google Draco team
- **Progressive Geometry Streaming**
  - Fraunhofer SRC
- **Unified Compressed Texture Format for Transmission**
  - Basis format from Binomial
  - Optimized transmission format with efficient local expansion to any GPU format
- **Lighting Extension**
  - Enhanced lighting control
- **Extensions for API and language specifics**
  - Optional hooks for enhanced perf/functionality
  - Vulkan, DX12, Metal, GLSL, HLSL, SPIR-V, Metal C++

Share your roadmap priorities with us!
https://github.com/KhronosGroup/glTF

glTF 2.0 PBR Rendering - Image courtesy instant3Dhub / instantUV - Max Limper