

# The runtime asset format for GL-based applications

Specification Editors Patrick Cozzi | AGI Tony Parisi | Wevr

© Copyright Khronos Group 2016 - Page 1

### **3D Needs a Transmission Format!**

- Bridge the gap between tools and 'GL' based apps
  - Reduce duplicated effort in content pipelines
  - Enable richer 3D representation OBJ, STL etc. too limited
  - Provide common publishing format for content tools and services

Audio	Video	Images	3D
MP3	H.264	JPEG	?
<b>inapster</b> .	You Tube™	facebook	!

A widely adopted format ignites previously unimagined opportunities for a media type

# glTF = "JPEG for 3D"

- 'GL Transmission Format'
  - Runtime asset format for WebGL, OpenGL ES, and OpenGL applications
- Compact representation for download efficiency
  - Binary mesh and animation data
- Loads quickly into memory
  - GL native data types require no additional parsing
- Full-featured
  - 3D constructs (node hierarchy, materials, animation, cameras, lights)
- Runtime Neutral
  - Can be created and used by any tool, app, or runtime
- Flexible Extensibility
  - E.g. payloads with compression and streaming

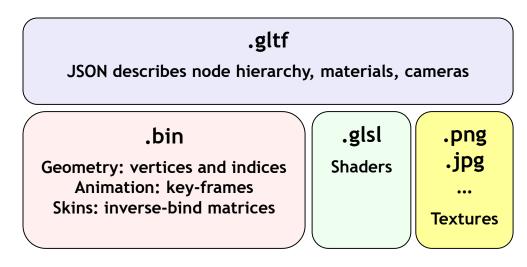


# gITF Internals

- JSON describes node hierarchy
  - Includes cameras
  - References geometry, animations, skins, shaders, textures
- Vertices
  - Uses native typed array format
  - Includes key-frame animations and skinning
- Shaders
  - With extensions for materials

### Textures

- Use existing standard image compression formats e.g. JPEG
- Extras
  - For app-specific data (metadata)



### Three.js

S O 2 Z °

HR

 $\mathbf{\Sigma}$ 

- The most popular WebGL library
  - Github repo: 22k favorites; 7,200 forks; 1,500 watchers
  - Mr.doob 31k Twitter followers
- V1.0 importer integrated into dev branch 8-Mar-2016 with handful of samples
- Importer code also included in main repo with more samples



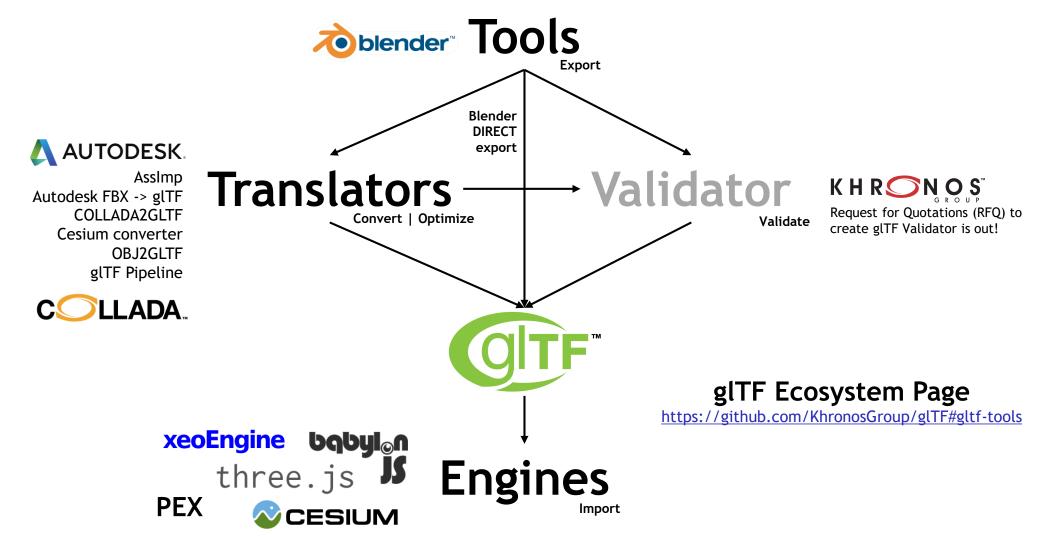
model from 3drt.com

### gITF Ecosystem

2

I

 $\mathbf{Y}$ 



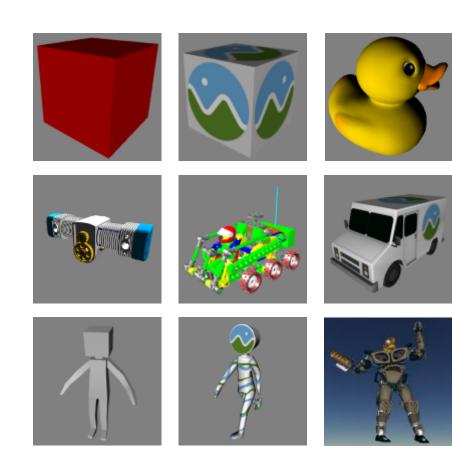
# gITF Ecosystem

### Learn

Sample models Open source code JavaScript, C#, C++ Readable spec

### **Extensions and Derived Formats**

Binary glTF SRC 3D Tiles



### https://github.com/KhronosGroup/glTF

### BabylonJS

• gITF loader with animation and skins



# Cesium 3D Tiles Using glTF

- An open specification for streaming massive 3D geospatial datasets
  - Streams 3D content including buildings, trees, point clouds, and vector data
- Hierarchical Level of Detail (HLOD)
  - Only visible and prioritized tiles are streamed
  - glTF payloads can be compressed, e.g., using <u>3DGC</u> extension



Over 1.1 million OpenStreetMap buildings in New York City



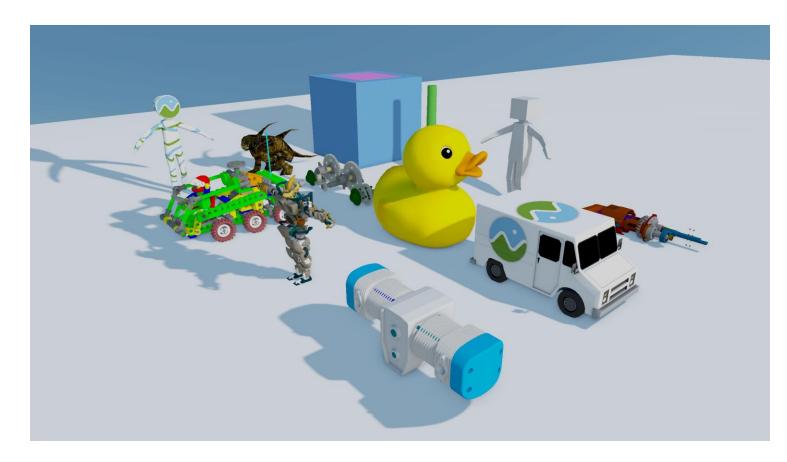
### Cesium 3D Tiles Using glTF



K H R S O N S S S S S

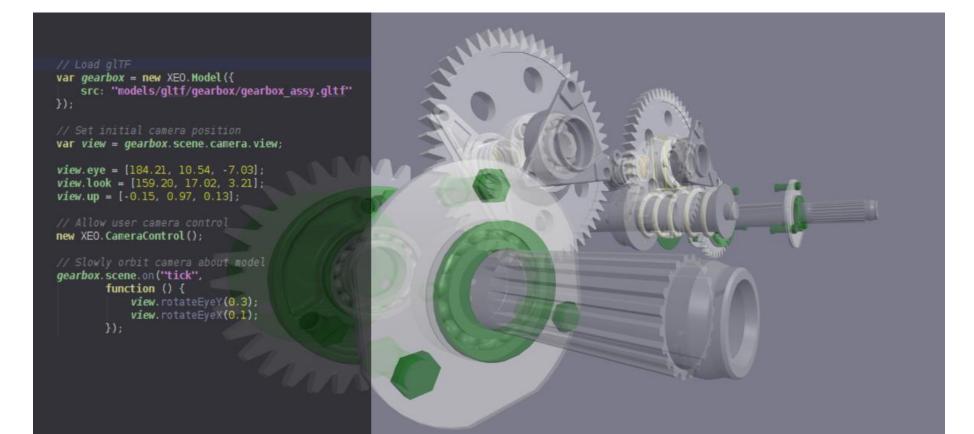
### Pex

- Initial gITF loader (geometry and materials)
- <u>https://github.com/pex-gl/pex-gltf</u>



### xeoEngine

- gITF is native format (geometry and materials)
- Tutorial: <a href="https://github.com/xeolabs/xeoengine/wiki/Importing-glTF">https://github.com/xeolabs/xeoengine/wiki/Importing-glTF</a>



### glTF Validator RFQ! Consider Bidding!!

- Validate gITF assets: geometry, material, animation, and skins
  - Ensure compliance with spec and schema
- Augment gITF sample models to cover corner cases
- Optional features
  - Binary glTF, REST service, drag-and-drop validator, drag-and-drop three.js viewer
- Schedule

່ທຼ

Z°

2

Т

- March 15 Khronos Released RFQ
- March 31 RFQ responses received by Khronos
- April 15 Contractor selected and notified
- April 29 Contract executed and start of work
- <u>https://www.khronos.org/rfq</u>

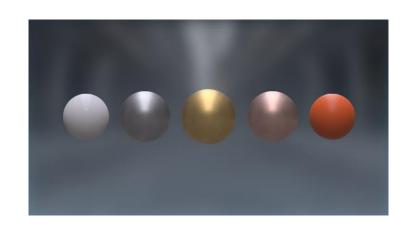


### **Upcoming PBR Extension**

- Will extract from new WebGL 2.0 and ES2015 engine by Fraunhofer
- PBR Shading Model based on Unreal Engine & Marmoset Toolbag
- Albedo color or map
- Metallic factor or map
- Roughness factor or map
- Normal map









© Copyright Khronos Group 2016 - Page 14

### **Please Get Involved!**

- Consider bidding for Validator RFQ
- Create and use gITF exporters and tools
- Generate tutorials on your experience with glTF
- Make gITF examples for Vulkan, OpenGL, and OpenGL ES
- Submit gITF extensions to meet your business needs

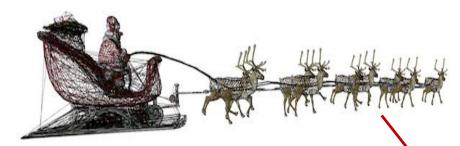
### https://github.com/KhronosGroup/glTF

# Background

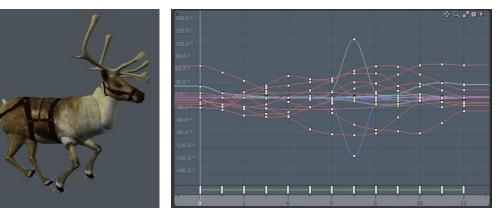


© Copyright Khronos Group 2016 - Page 16

### What's in a 3D Asset or Model?



Scene hierarchy and geometry



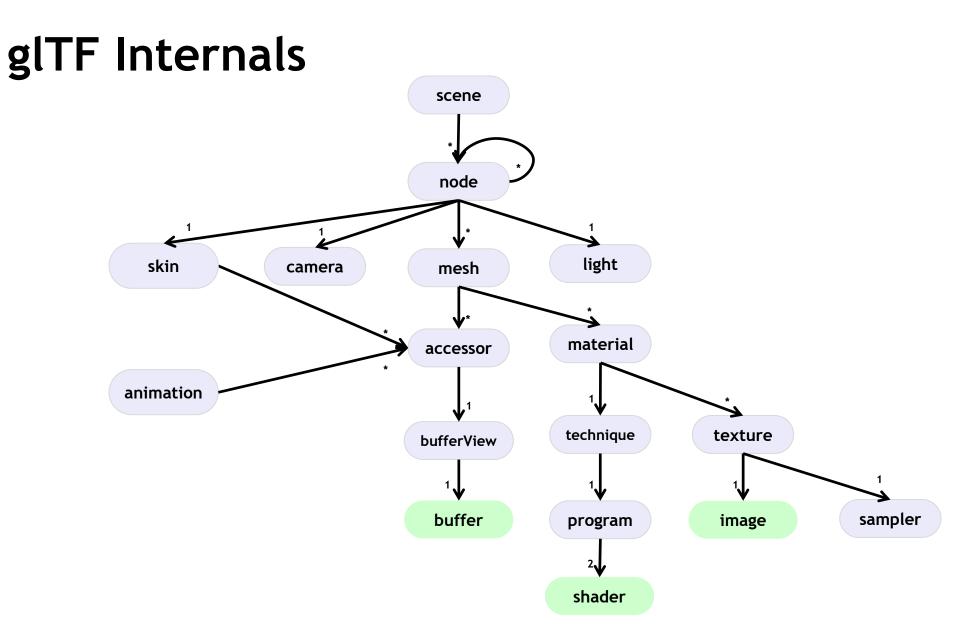
Animations and skins



Materials and textures



Final Asset in Scene

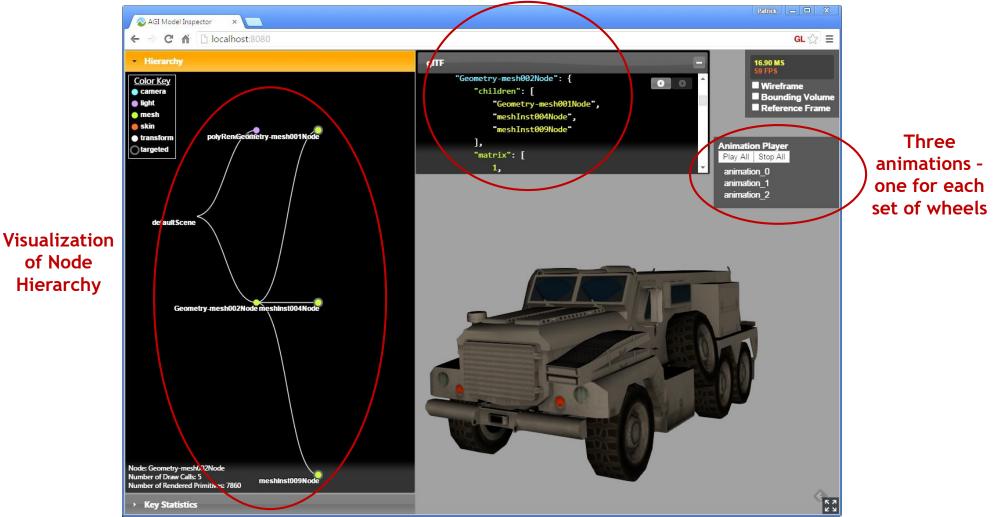


#### © Copyright Khronos Group 2016 - Page 18

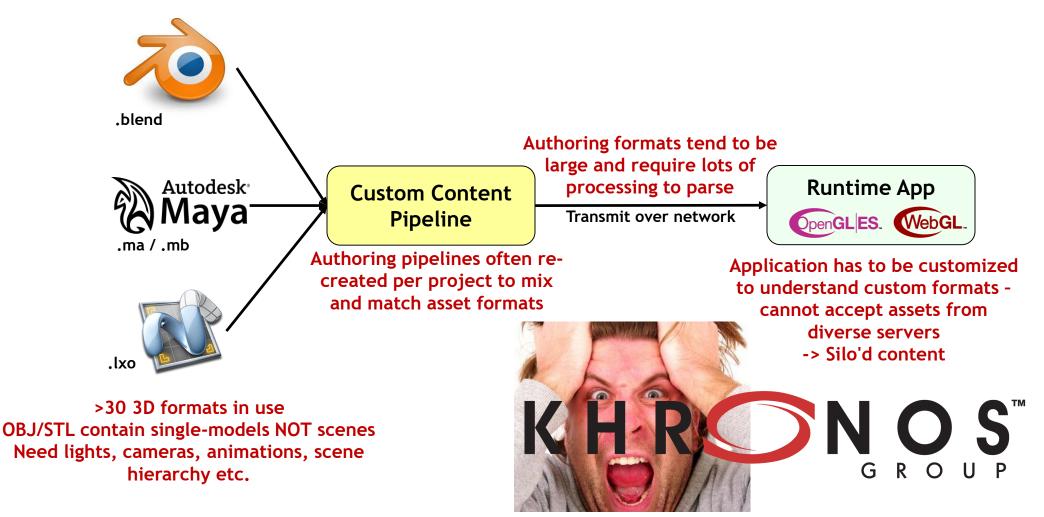
K H R S S S S S S S S S S

# gITF Example

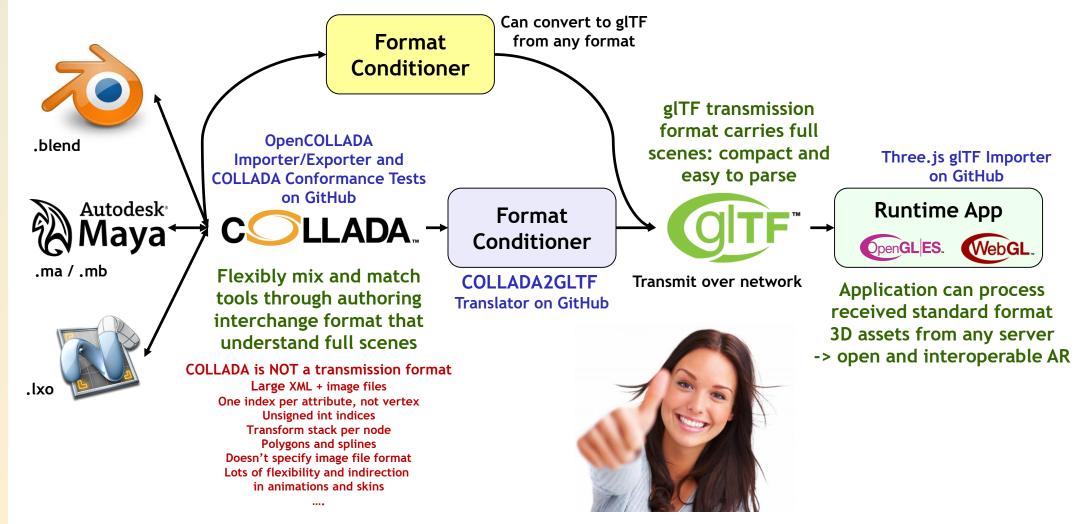
#### JSON Node (the truck) with three children (sets of two wheels)



### **3D Model Creation and Deployment - Today**



### **3D Model Creation and Deployment Standards!**



S O N N

2

I

 $\mathbf{\Sigma}$ 

# glTF Project Status

- Open specification; Open process
  - Specification and multiple loaders and translators in open source
  - <u>https://github.com/KhronosGroup/glTF/blob/spec-1.0/specification/README.md</u>
- gITF 1.0 spec finalized
  - Launched in October 2015!
- Extension mechanisms fully defined
  - Vendor, multi-vendor and official Khronos extensions (mirrors OpenGL)
  - Anyone can ship vendor extensions at any time no permissions needed
  - First extensions included in launch
- More details

້ທຼ

**0**<sup>°</sup> **∠**<sup>°</sup>

2

I

- <u>https://www.khronos.org/gltf/</u>



### Launch Industry Support

"It was obvious for the babylon.js team that gITF was a must have feature in order to integrate well within the 3D ecosystem." David Catuhe, principal program manager at Microsoft and author of babylon.js

المريم محرفي برياني بالمريم والمريم والمتنافع والمتنافع والمراجع والمراجع

"Unlocking 3D content from proprietary desktop applications to the cloud creates massive new opportunities for collaboration. This future is so close we can feel it - the hardware is capable, the browsers are capable, now if only we could solve the content pipeline. Go glTF!" Ross McKegney, Platform @ Box "glTF has some remarkable features that will make it simple for developers to include and run 3D digital assets in their web or mobile applications" Cyrille Fauvel, senior ADN Sparks manager at Autodesk

AN UNITED AND AN AN AN AN AN AN AN AN

"Defining a 3D graphics transmission model is challenging due to the extensive diversity of 3D graphics representations and use cases and the 3D ecosystem is being held back by a lack of a simple and universally efficient data representation. gITF has an important role by defining a foundation on which application specific compression and transmission components can be incrementally added. We are looking forward to gITF extensions to enable efficient MPEG compression technologies for 3D graphics to be widely deployed." Marius Preda of the MPEG Consortium

# gITF Adoption

three.js Loader https://github.com/mrdoob/three.js/



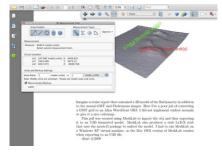








Native import and display of glTF models



PIPELINE TOOLS

collada2gltf converter https://github.com/KhronosGroup/glTF

Online drag and drop COLLADA to glTF converter http://cesiumjs.org/convertmodel.html

FBX to glTF Convertor (in development) Drag and drop convertor coming <u>http://gltf.autodesk.io/</u>



3D Advertising Solutions with native glTF import



AUTODESK

© Copyright Khronos Group 2016 - Page 24

### Initial gITF Extensions

- Any company can define gITF vendor extensions
  - Khronos manages extension name space
  - Popular extensions can be proposed to be adopted into standard extensions and then possibly into core
- KHR\_binary\_glTF (Khronos extension)
  - Enables a gITF file to use binary asset packages
- EXT\_quantized\_attributes (vendor extension)
  - Quantization-based attribute compression
  - Decompression in vertex shader

່ທຼ

Z

2

Т

- MPEG 3D mesh compression (in progress)
  - MPEG-SC3DMC codec (Scalable Complexity 3D Mesh Compression)
  - Uses Open3DGC open source C++ encoder/decoder + JavaScript decoder
  - 40-80% compression for many 3D assets
  - Extensions inserts decompression between file buffer and vertex data
  - Building support into the COLLADA2GLTF converter and Cesium loader

K H R S N O S





### **Open3DGC gITF Extension Initial Results**

Model	Vertices	Tris	Flat + Gzip	Open3DGC + Gzip	Compression Amount	JavaScript Execution Time
COLLADA Duck	2.1k	4.2k	54 KiB	14 KiB	-74%	24 ms
Stanford Bunny	2.5k	5.0k	105 KiB	56 KiB	-47%	30 ms
Stanford Dragon	435k	871k	7792 KiB	2141 KiB	-73%	630 ms
3D Tile	12.8k	6.5k	102 KiB	59 KiB	-42%	_
OpenStreetMap NYC	_	—	337 MiB	207 MiB	-39%	(Streamed)

Google Chrome 44.0, Windows 8.1, Intel i7-4980HQ @ 2.80GHz

### Some JSON

#### Describing scene structure

#### Defining a mesh

**λ** 

```
"meshes": {
    "LOD3spShape-lib": {
      "name": "LOD3spShape",
       "primitives": [
            "attributes": {
              "NORMAL": "accessor_25",
              "POSITION": "accessor 23",
              "TEXCOORD 0": "accessor 27"
            },
            "indices": "accessor_21",
            "material": "blinn3-fx",
            "primitive": 4
```

#### **Referencing buffers**

```
"bufferViews": {
    "bufferView_29": {
        "buffer": "duck",
        "byteLength": 25272,
        "byteOffset": 0,
        "target": 34963
    },
    "bufferView_30": {
        "buffer": "duck",
        "byteLength": 76768,
        "byteOffset": 25272,
        "target": 34962
    }
}
```

λ,

# glTF Extensibility

### • glTF

- Simple format
- Need more?
  - Extras and extensions on any object
- Extras
  - For app-specific data
    - mesh.extras.description: { ... }
- Extensions
  - For new general-purpose functionality specs
    - bufferView.extensions.mesh\_compression\_open3dgc: { ... }

### Shaders -> Material Descriptions

- Physically Based Rendering (PBR) is hot topic in 3D graphics
  - Describe the *properties* of each material not a literal shader
  - Easy for content creators

K

I

- Realism of materials can scale to the platform capabilities
- Reach out to existing projects to include in transmission format?

### NVIDIA MDL (material description language)



http://www.nvidia-arc.com/fileadmin/user\_upload/iray\_2013/documents/mdl\_introduction.121115.pdf

### **Open Shading Language**



http://www.openshading.com/

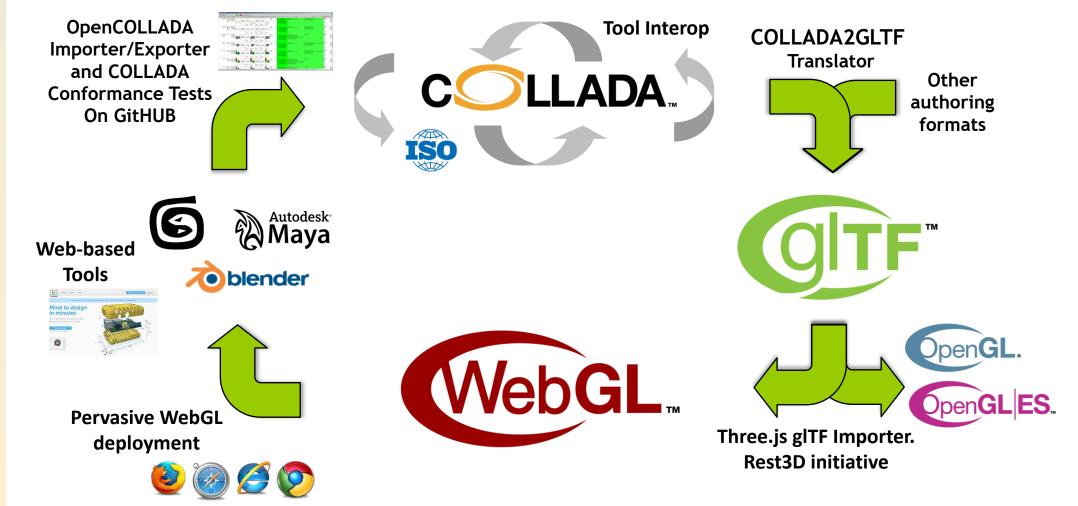
© Copyright Khronos Group 2016 - Page 29

### **COLLADA and gITF Ecosystem**

2

Т

 $\mathbf{\mathbf{\Sigma}}$ 



### Get Involved with gITF!

### glTF specification

- Review and use the specification:

https://github.com/KhronosGroup/glTF/blob/spec-1.0/specification/README.md

- More details
  - https://www.khronos.org/gltf/
- Questions and supportive quotes
  - ntrevett@nvidia.com
  - <u>@neiltd3d</u>
  - <u>#gltf</u>

22

I

