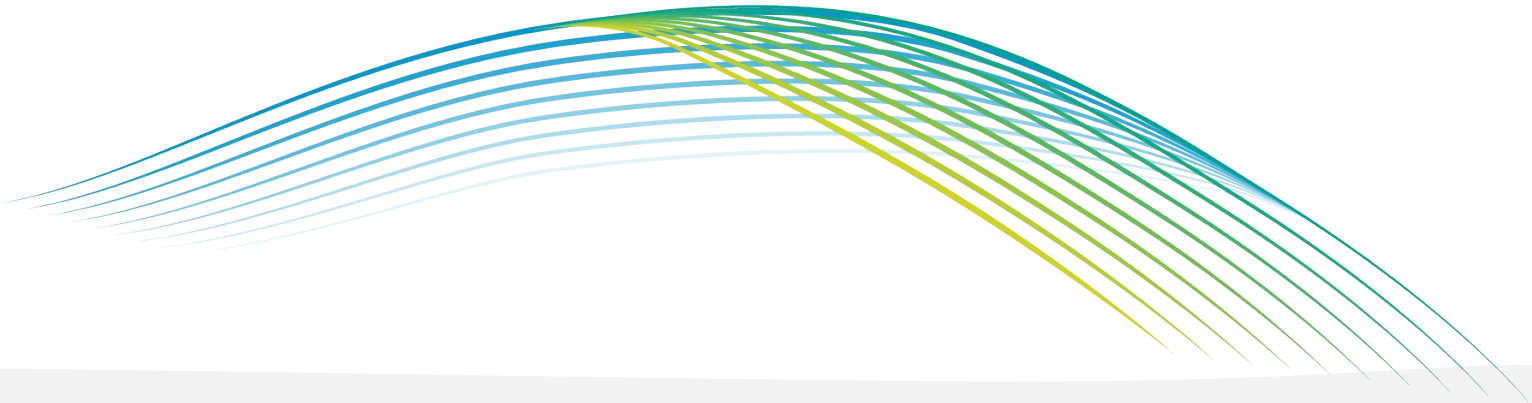
Metaverse
STANDARDS FORUM™

SIGGRAPH 2026
Los Angeles 19–23 JUL

3D Assets: New features, Tooling, and What Comes Next



glTF - Character and Avatar Extensions

Siggraph
July 2026

Character and Avatar Extensions:
A Khronos glTF and VRM Consortium Effort

- **October 2024** - Khronos and the VRM Consortium (VRMC) announced a collaboration to evolve both glTF and VRM as global open standards to support interoperable 3D avatars
- **December 2024-October 2025** - Khronos and VRMC work together on the initial phase of general-purpose character and avatar extensions (which you can view on github)
- **October 2025** - The Khronos 3D Format Working Group established the Character and Avatar TSG (CATSG) to focus on the problem space of characters and avatars
- **Today** - Both groups have continued to collaborate, and are making steady progress on the extension set and example tooling

VRM CONSORTIUM

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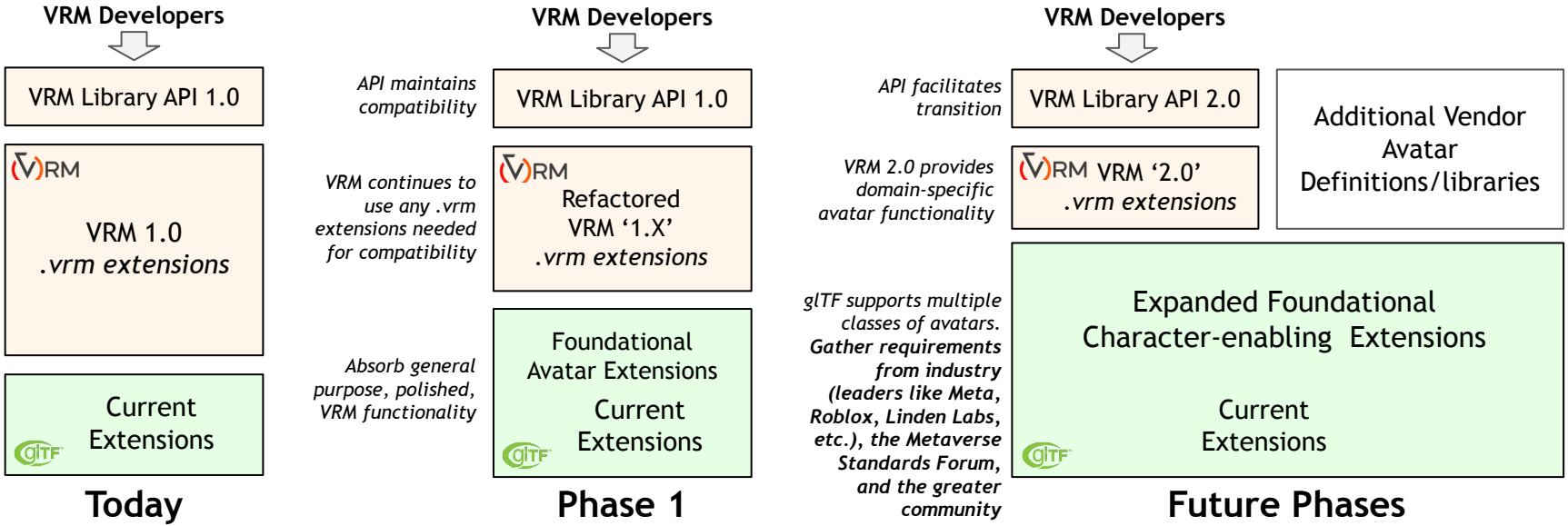
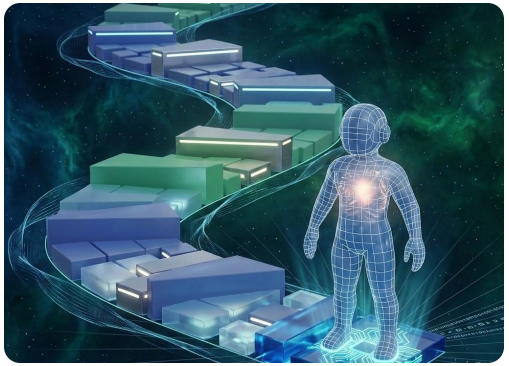
glTF VRM - Character Extension Convergence



Goals and Philosophy

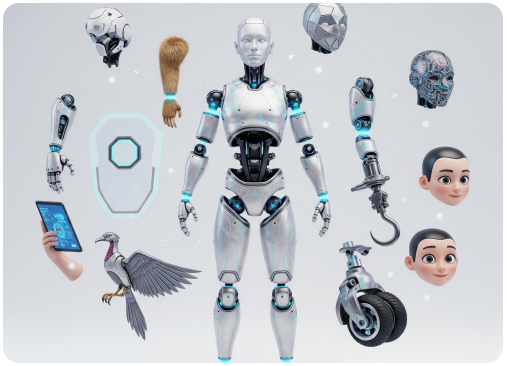
Building Blocks

Create a series of building-block standard extensions for characters and avatars.



Extension Path

Provide a path for self-describing characters and avatars through glTF extension composition.



Flexible Basis

Create a flexible basis, ratify what we know won't change, and don't prevent use of heavily opinionated properties.

Balancing Rigid Structure and Flexibility

To foster wider adoption, we are prioritizing flexibility. Establishing rigid skeletal and expression standards too early creates barriers for organizations looking to integrate these extensions.

For CATSG, this translates into us contributing to open source work on translation as well as push conversations around standardization for common character/avatar concepts

At the same time, achieving interoperability necessitates that we either standardize data composition or establish effective methods for translating shared concepts.

Interoperability Challenges

Visual & Data Structure

- Rigging & Animation Differences
- Expression & Behavior Systems
- Material & Shader Inconsistency

Dynamic Behavior

- Physics Simulation Variance
- Real-time Tracking Compatibility

Performance & Opt.

- Performance Optimization
- Level of Detail (LOD) Management

Standards Fragmentation

- Platform-Specific Features
- Standard Format Compatibility

Identity & Asset Rights

- Identity & Ownership Verification
- Asset Rights Management

Open-Source Neighbors

As part of all of this, we're actively working with the Metaverse Standards Forum and AOUSD.

- We have representation in AOUSD's Character Interest Group to ensure our ongoing standard and their upcoming work is interoperable/compatible as much as possible.
- We'll be working with the Metaverse Standards Forum with their upcoming work on Character/Avatar translation frameworks.

Example Implementations (Work in Progress)

Runtime Implementations*

Leveraged/referenced by VRM and Khronos example scenes and tools

- Three.js-based sample viewer for reference
- **Unity** Gltf branch & Testbed Project

Shared Libraries*

For KHR base implementations

Three.js **and Unity/C#**

*** Prone to change in the next few months as we move towards Release Candidate status.**

Three.js Testbed

Live viewer sandbox, VRM converter, and reference library

Unity Testbed

Reference runtime scene and tools

UnityGltf Plugin Branch

KHR_character plugin code

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Base Extension

KHR_character

Serves as the mandatory root-level metadata extension for identifying glTF models as characters.

It enables runtime discovery, allowing engines to recognize character assets and apply relevant behaviors for all dependent character extensions.

Expressions

KHR_character_expression*

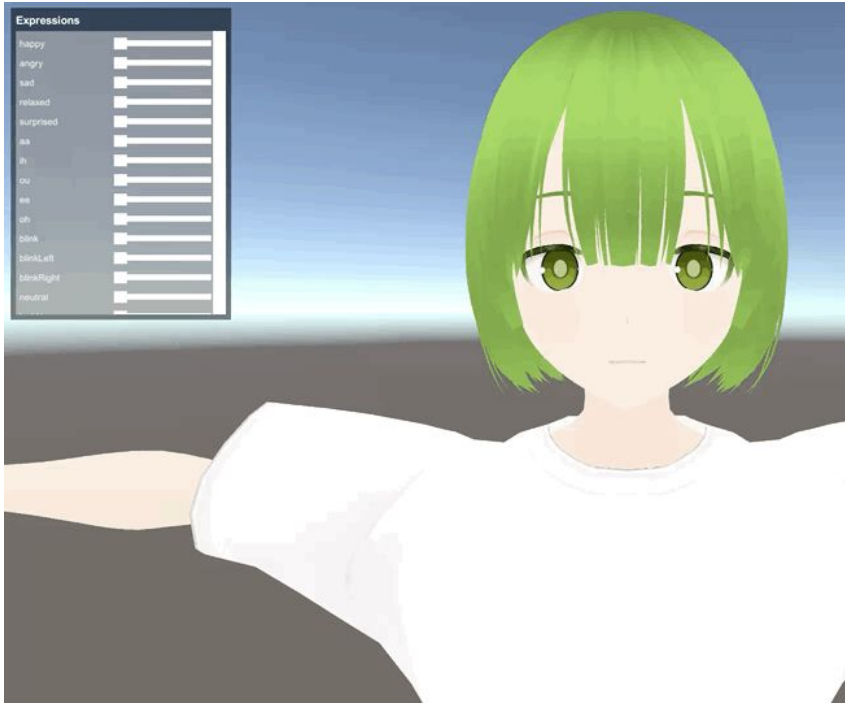
defines expressions, weights, overrides, and masks via morph targets, joints, and textures, creating a unified interface.

KHR_character_expression_mask

assists in preventing expression conflicts (e.g., speech/mouth overrides).

KHR_character_expression_mapping

enables mapping expressions to standard or internal vocabularies (e.g., ARKit, VRM).



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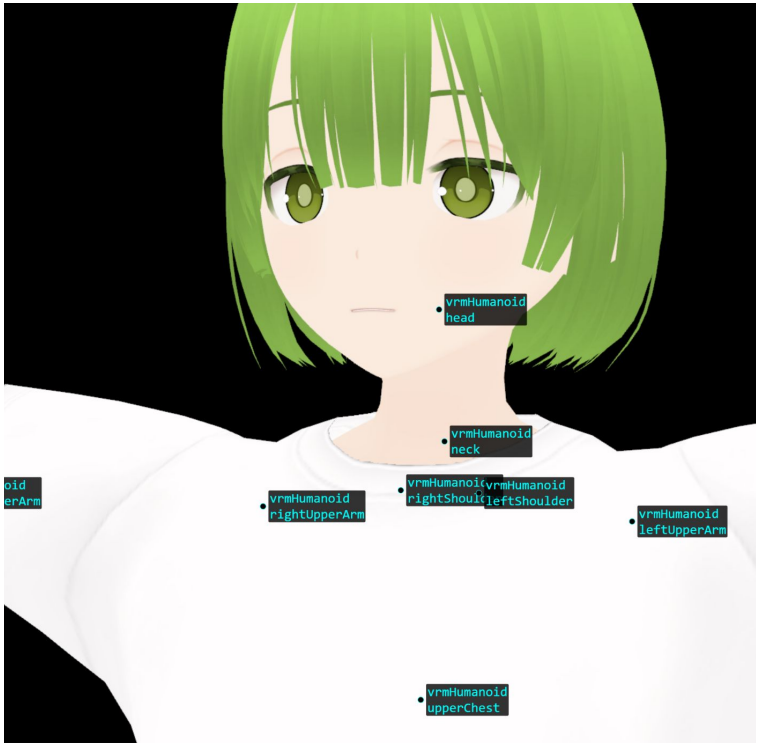
Skeleton Mapping and Reference Poses

KHR_character_skeleton_mapping

maps character rigs to standard vocabularies; supports multiple mappings for characters with multiple surfaces.

KHR_character_reference_pose

establishes canonical reference poses for animation retargeting, deformation validation, and toolchain consistency by tagging glTF animations with semantic pose data. Stored as single-frame animations.



Node and Mesh Primitive Utilities

KHR_node_lookat

Look-at behaviors are ubiquitous in 3D applications, yet lack a standard method for identifying targets.

This extension standardizes target identification across all engines.

KHR_node_camera_hint

Provides runtime camera framing hints (e.g., first-person, third-person, selfie, custom, etc.).

Leverages glTF Camera structures to ensure consistent metadata and framing across platforms and UIs.

KHR_node_visibility_hint & KHR_mesh_primitive_visibility_hint

Provides a way to indicate what meshes and nodes are visible for a subset of the camera_hints vocabulary (first-person, third-person, always, custom).

Next Focus Areas

ACTIVE FOCUS AREAS

Animation

Types, Layers, Events, and integrating into Interactivity.

Secondary Animation & Physics

Springbone Extensions based on VRM's implementations, and skeletal geometry explorations.

FUTURE TOPICS UNDER DISCUSSION

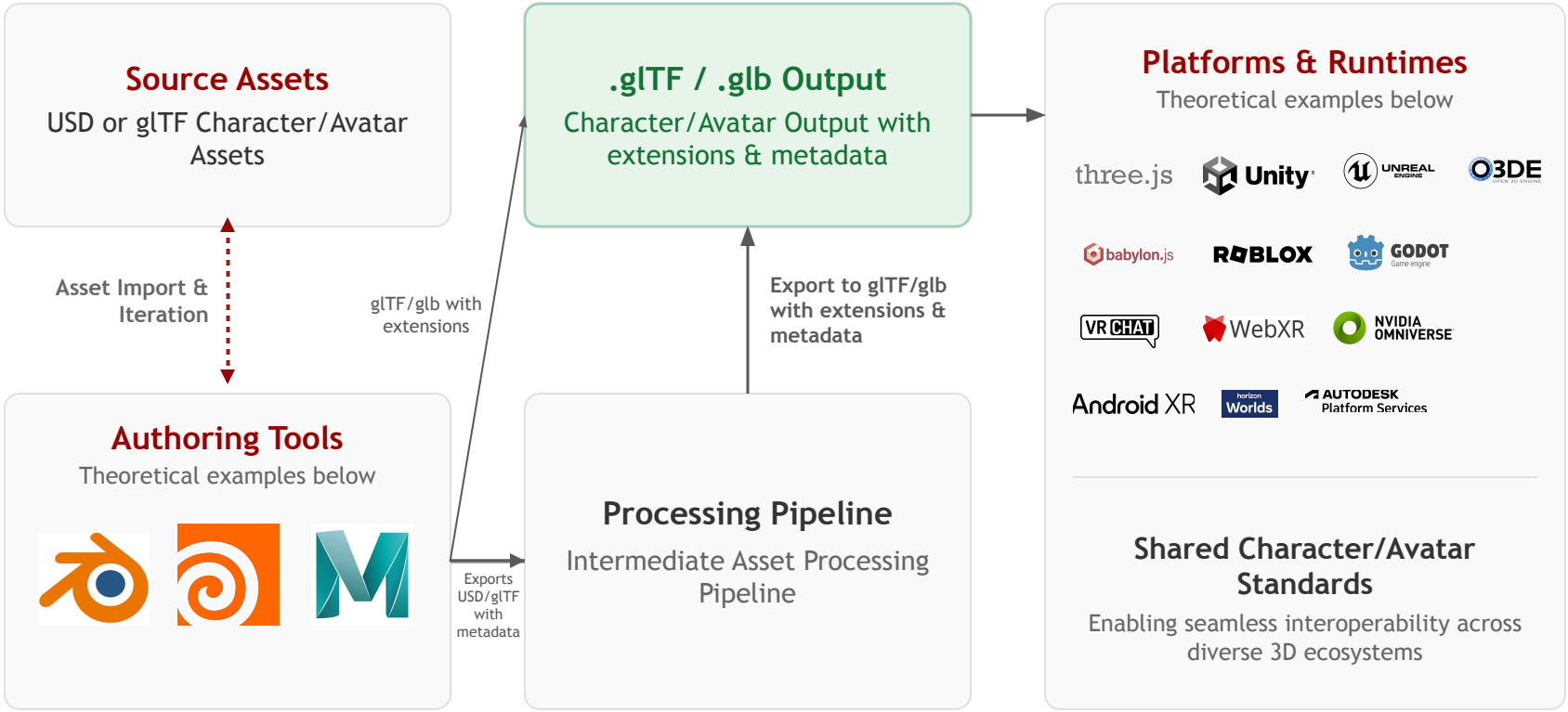
Metadata & Runtime

- **Metadata Ontologies:** Standardize asset attribution, licensing, and usage rights.
- **Mesh Annotation & LODs:** Manage runtime labels and levels of detail.
- **Skeleton Biped Standards:** Collaborate with AOUSD and MSF on common humanoid bone vocabularies.

Materials & Rendering

Toon shading for anime-style avatars and VRM compatibility.

Example Asset Flow



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Thank You!

Your contributions shape the future of 3D asset standards. Here is how you can actively participate and get involved:

1. Contribute to PRs

Directly drive the specification forward by providing feedback on active pull requests and submitting your proposals.

- Review the open extension PR
- Submit specification updates
- Share implementation findings

2. Join Khronos

Become an official member to secure voting rights and collaborate on tooling, standards, and ecosystem projects.

- Collaborate on key standards
- Gain voting opportunities
- Access member-only resources

3. Join 3DF Meetings

Participate in weekly 3D Formats Working Group meetings to synchronize with the community and track progress.

- Weekly Character/Avatar TSG meetings
- Align on character features
- Network with industry experts

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Alliance for OpenUSD

Characters Motion and Interactivity Interest Group

Interest Group

- Film
- Games
- Robotics

Goals

- Rich representation of interoperable character components
- Rich representation for simulation/interactive systems related to characters
- Foundational OpenUSD components shared across Robotics, Film and Games

- UsdSkel
- OpenExec

Existing Tech

Output

- Mapping the current landscape of related efforts and ensuring coordination with ongoing initiatives
- Working Groups

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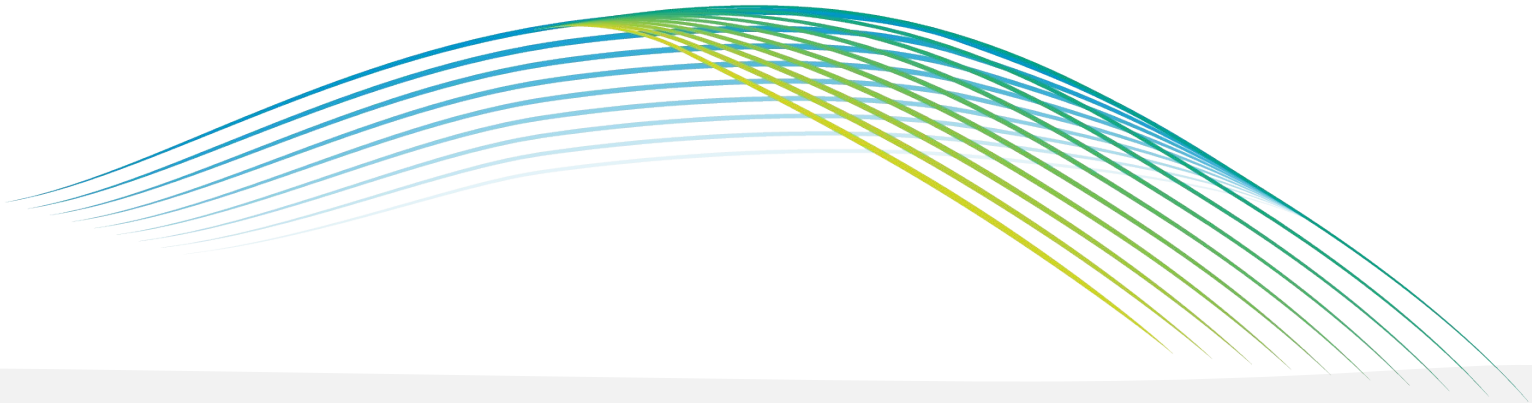
3D Assets: glTF, OpenUSD, 3D Tiles, OpenPBR, MaterialX – Recent Developments & Tooling

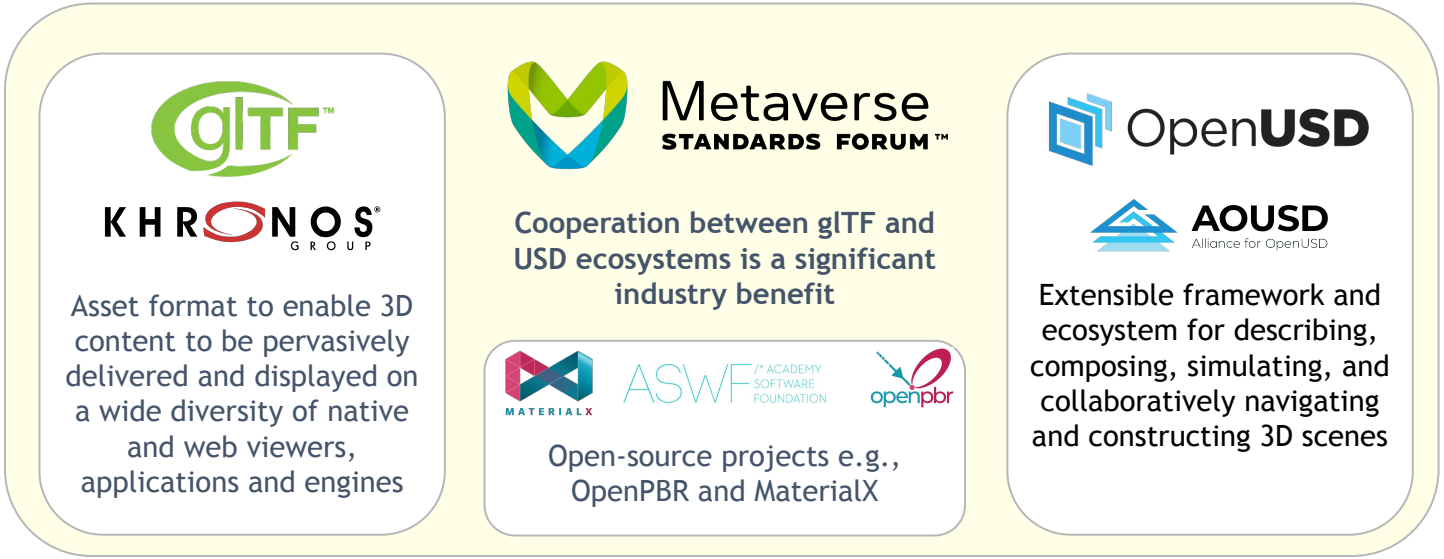
Henrik Edstrom, Senior Principal Software Engineer, Cesium / Bentley Systems



3D Assets Working Group

Standardization is a cooperative endeavor

Cooperation between glTF and USD ecosystems is a significant industry benefit
Enabling discussions over technologies, requirements and potential roadmap alignments



Authoring vs. Delivery Workflows

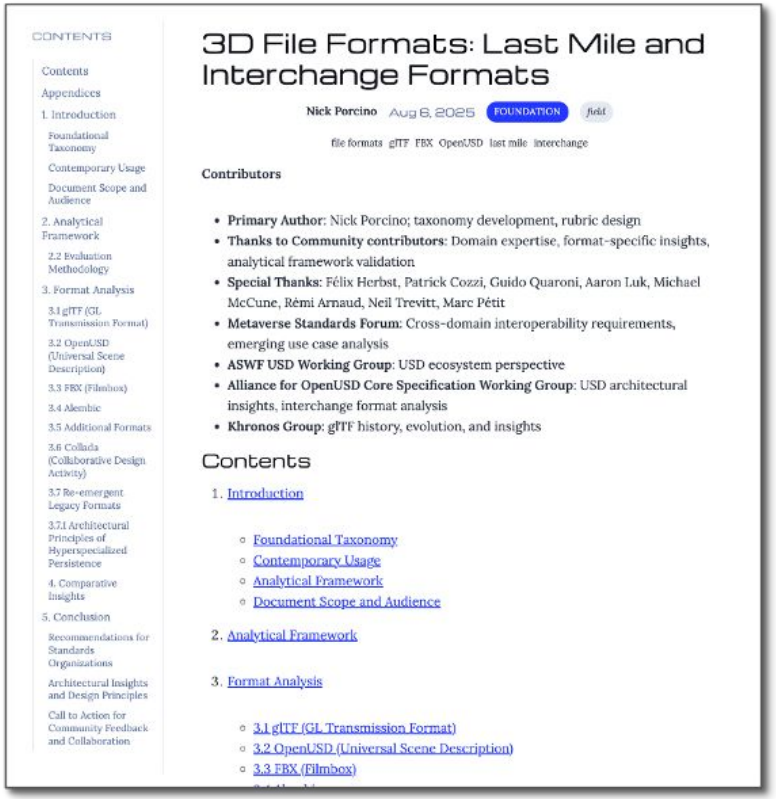
Authoring

- "Source of truth" data
- Everything is editable
- Cross-tool/vendor workflows

Delivery

- Derived data
- "Baked" – limited editing
- Optimized for transmission

Last Mile Formats & Interchange Formats



CONTENTS

3D File Formats: Last Mile and Interchange Formats

Nick Porcino Aug 6, 2025 FOUNDATION field

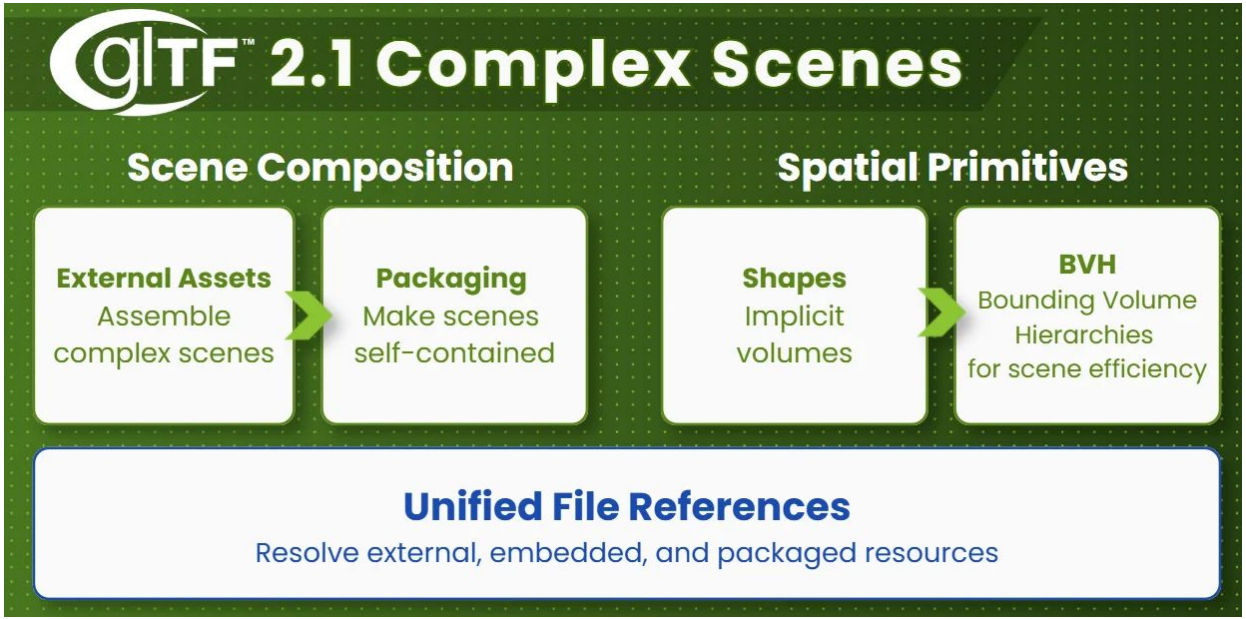
file formats glTF FBX OpenUSD last mile interchange

Contributors

- **Primary Author:** Nick Porcino; taxonomy development, rubric design
- **Thanks to Community contributors:** Domain expertise, format-specific insights, analytical framework validation
- **Special Thanks:** Félix Herbst, Patrick Cozzi, Guido Quaroni, Aaron Luk, Michael McCune, Rémi Arnaud, Neil Trevitt, Marc Pétit
- **Metaverse Standards Forum:** Cross-domain interoperability requirements, emerging use case analysis
- **ASWF USD Working Group:** USD ecosystem perspective
- **Alliance for OpenUSD Core Specification Working Group:** USD architectural insights, interchange format analysis
- **Khronos Group:** glTF history, evolution, and insights

Contents

glTF 2.1



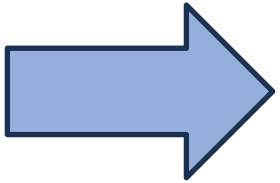
BOF: glTF 2.1 and Beyond: Building Interactive and Spatial 3D Experiences

Wednesday, July 22 | 10:00 am - 11:30 am PDT | JW Marriott Los Angeles L.A. LIVE, Diamond 1-2

Blog: Introducing glTF 2.1 with Complex Scenes

“Baselining” 3D Tiles 2.0 on glTF 2.1

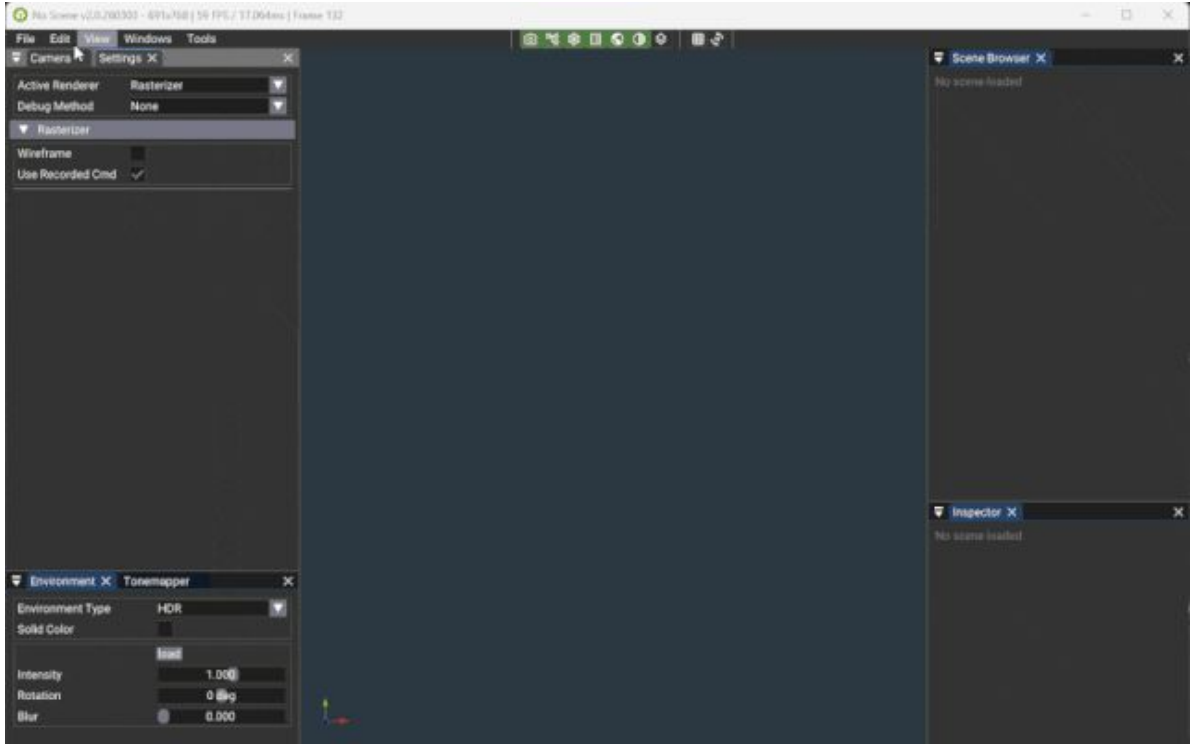
Version 2.0
Hierarchical LOD
CRS
New Content Types



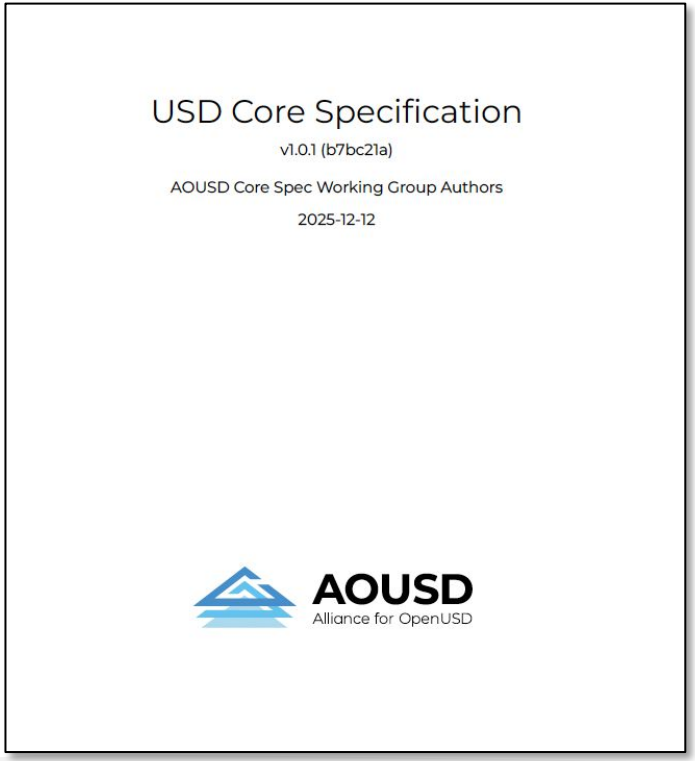
Version 2.1
External References
Bounding Volume Hierarchy (BVH)
External glTF References
Meshes
Materials
…

vk_gltf_renderer - glTF 2.1 preview implementation

NVIDIA Pro Samples / Martin-Karl Lefrancois



OpenUSD

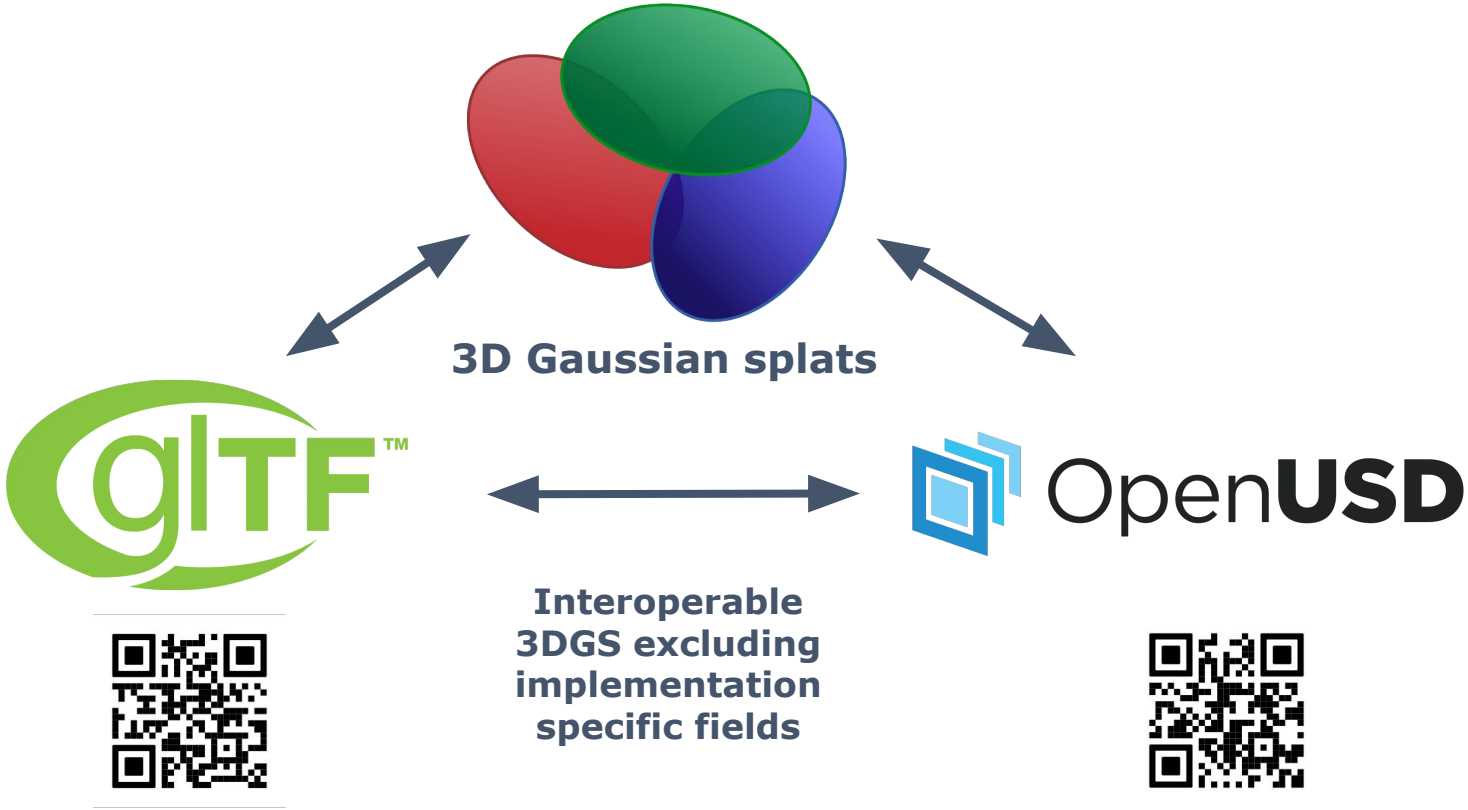


OpenUSD Core Spec 1.0

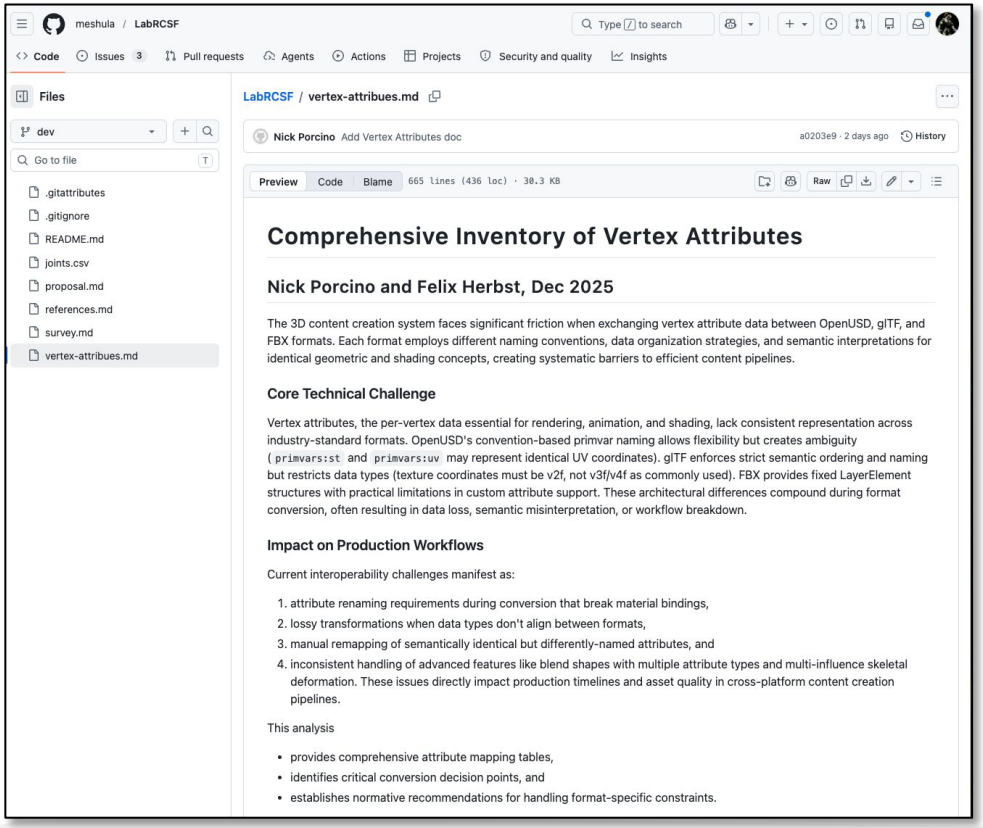
Level of Detail (LOD) API for USD

USD Profiles and Capabilities

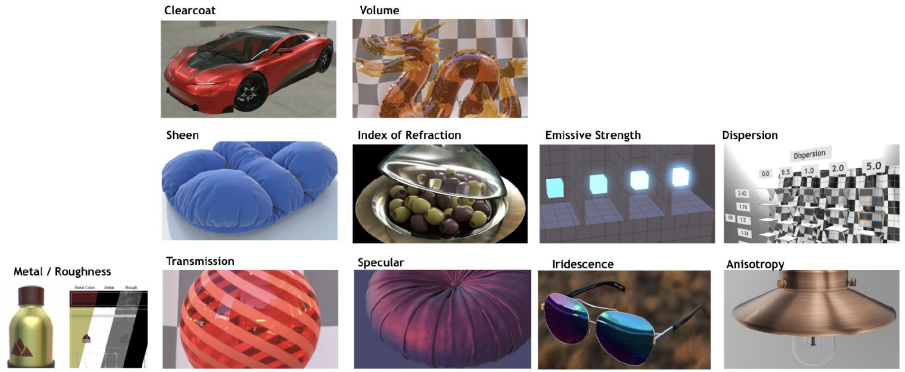
3D Gaussian Splats in OpenUSD and glTF



Vertex Attributes in OpenUSD and glTF (and FBX)



MaterialX, OpenPBR and glTF PBR Alignment



openpbr

MATERIALX

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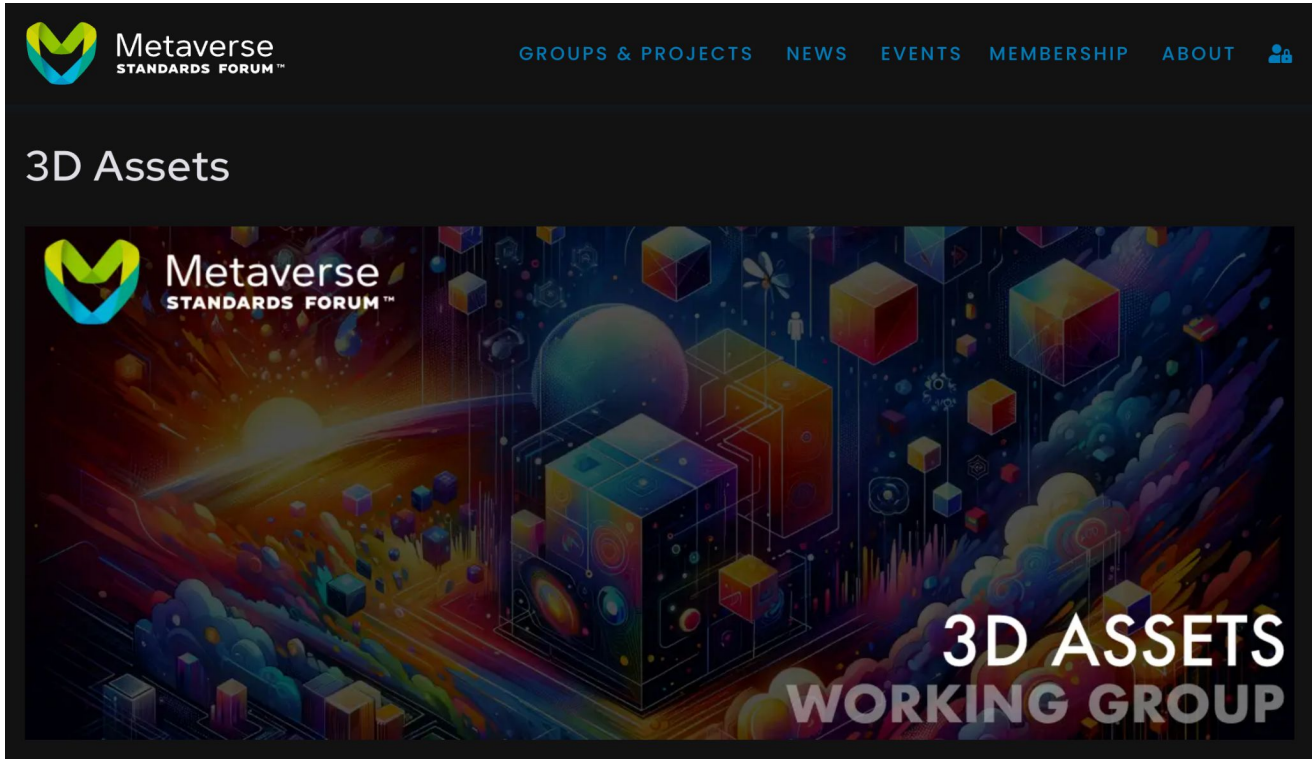
USD File Format Plugins

github.com/adobe/USD-Fileformat-plugins

- Built with the ecosystem in mind
  - Adobe is an AOUSD founding member
  - Participating in Khronos glTF standards work
- Open-source USD plugins — 7 file formats, cross-platform
  - glTF 2.0, FBX, OBJ, PLY, SBSAR, SPZ, STL
  - Windows / macOS / Linux
- 2026.07 release: transitioning to the OpenPBR standard
  - OpenPBR-native material processing authored as MaterialX on USD
  - Expanded glTF/USD material translation

glTF plugin release contributors: Mike Bond, Filip Baba, Angus Davis, Florian Hecht, Paul Edmondson (Lead)

MSF 3D Assets Working Group



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