



Extending 3D Consensus-Based Standards for Modeling and Simulation

WHITEPAPER

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December 2018

Abstract

Legacy 3D mesh formats used in Modeling and Simulation (M&S) are either proprietary or lack the capabilities required for modern M&S requirements. On the other hand, modern 3D mesh formats used for content creation and visualization in AR/VR and WebGL technologies lack the ability to store much of the information that is necessary for virtual, constructive, and live simulation. Consensus standards such as 3D tiles and glTF for 3D and Geospatial data could enable vendor and technology neutral use cases for the entire M&S lifecycle. By working within the consensus-based standards process, the development of M&S extensions to existing 3D data standards such as glTF will enable greater alignment of M&S systems with modern 3D visualization systems, gaming platforms, AR/VR systems, and content creation tools.

Background

Currently, some level of interchangeability for both terrain and 3D model data between different simulation systems is achievable via formats such as OpenFlight. This format at least functions as a widely accepted container in Modeling and Simulation (M&S) for mesh data, including polygonal terrain and 3D models. However, it lacks scalability, and extensibility is only achieved through closed, vendor-specific records.

With the increased use of gaming engines, data interoperability becomes a greater challenge. Content creators and game engine developers rarely support simulation-specific standards, and consequently, the simulation industry as a whole depends on expensive niche tools, and specialized skills required to use them.

Emerging requirements increasingly demand the rapid acquisition and dissemination of fully immersive 3D content. To meet the Army One World Terrain (OWT) requirements, data cannot be tied to a single system or rendering technology. To accomplish these goals, technology and data from the public sector must be leveraged.

Adoption of consensus-based standards such as the OGC CDB within the Modeling and Simulation community is proving to be a driving force for consolidation and reuse of geospatial and simulation data. Consensus-based standards differ from specification such as OpenFlight in that they provide a stable platform for interoperability where all views and objections from any stakeholder are required to be heard and considered in an open forum.

Consensus-based standards provide a level playing

Modeling and Simulation Specific Mesh Data

- Geographic Spatial Reference Systems
- Node Hierarchy
- Lights
- Mission Function and Navigation data
- Collision Volumes
- Relationships to GIS data
- Heat maps/zones
- Multiple Layers of Sensor Data
- Surface Material Codes
- Sounds
- Etc.

field for all participants, compared to a non-consensus based standard, where the entity maintaining it may develop it in a manner that provides a disadvantage to competing entities and ideas. This is especially important for programs like OWT, where 3D data must not be tied specific software or rendering technology. Consensus-based standards can evolve to support emerging technologies, but the standards are stable enough to ensure interoperability.

Potential Solutions

There are several encoding formats for polygonal mesh data including OpenFlight, FBX, P3D, COLLADA, glTF, and OBJ that might be appropriate for use in both the gaming and the simulation industries. Of those, only COLLADA and glTF are consensus standards, both of which are maintained by the Khronos Group, the organization that also maintains the OpenGL and 3D Tiles standards. The glTF format was adopted by the COLLADA working group to provide a format for 3D content that is better suited for streaming and the web. The glTF standard is designed to be the 'JPEG of 3D models', optimized for dissemination across systems such as WebGL. Each glTF file can contain multiple materials and textures, as well as shader programs in a single file. glTF is supported by many content creation tools, as well as game engines such as Unreal and Unity as well as virtual reality frameworks such as A-FRAME. Many open source glTF software libraries and frameworks can be found on GitHub, including several from Microsoft.

The glTF standard is complementary to the 3D tiles terrain standard and is used to encode 3D models within the terrain. The Cesium platform for visualization of 3D terrain and models use 3D tiles and glTF natively.

Microsoft has invested heavily in glTF, announcing it as their 3D asset format across their entire product line. Microsoft's has adopted Cesium to power their Bing Maps platform. Additionally, as the prime contractor for the Integrated Visual Augmentation System (IVAS) program, Microsoft's embrace of glTF will have major implications for the M&S community in the near future. Recognizing the need to store 3D mesh data in CDB, the Open Geospatial Consortium is considering 3D tiles as a possible community standard. Given the momentum of the 3D tiles format, glTF is a natural standard for adoption for mesh data in M&S.

Like most other 3D mesh formats used outside of simulation, glTF currently lacks many of the components necessary for full adoption in modeling and simulation. However, it does have a very powerful extension mechanism. Once an extension to glTF is defined and implemented, it can be promoted to become part of the standard, thus meeting the specific needs of the Modeling and Simulation community, while benefiting from the wider needs of the Gaming and 3D graphics communities.

An M&S extension for glTF and 3D tiles will make it an ideal container for mesh data and point clouds and **would support both the storage and dissemination requirements of the One World Terrain.**

Objectives

The objective of this proposed effort is the research and development of extensions to the glTF encoding standard that meets the needs of Modeling and Simulation while benefiting from the modern capabilities of the tools and platforms that support it. To accomplish this, working with stakeholders within M&S, we will start by performing a gap analysis. The gap analysis will compare the existing capabilities of glTF to OpenFlight, FBX, P3D, OBJ, and other M&S formats. This gap analysis will identify extensions that are required for 3D tiles and glTF in order to be accepted by the M&S communities.

To gain acceptance within M&S stakeholders, we propose the implementation of a reference toolset that can convert existing M&S assets such as moving models and terrain data into glTF, implementing these M&S specific extensions. A complete set of M&S extensions will allow existing data to be converted to and from glTF without losing any information. A demonstration of the ability to use an extended glTF file existing tools and engines without losing M&S data will provide a baseline to the M&S community. Once the initial extension and base implementation are defined, the extension can be promoted as a consensus standard for the M&S industry.

The development and adoption of a modern, consensus-based mesh format that is usable across gaming, 3D modeling, and Modeling and Simulation will allow tools and data to be consolidated. This consolidation will allow for shared data, software, and skill sets without compromising the requirements of Modeling and Simulation and Mission Rehearsal programs.

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