



X3D for 3D Body Processing

IEEE 3DBP WG Meeting
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October 21, 2019





www.web3d.org

Paving the Road to Interoperable 3D Graphics with Open Standards

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Our Standards



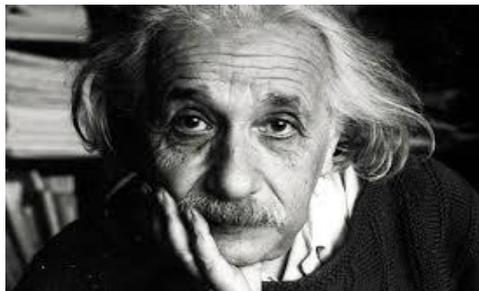
and



Objective:

- Overview of Web3D Standards
- Cross technologies and overlaps
- Use cases for different domains
- IEEE 3DBP WG requirements
- Making knowledge-based 3D technology choices

Current State of 3D on the Web?



Factors Influencing 3D technology today

- **Growth of re-built 3D content**
- **Less hardware and network limitations**
- **Rendering high quality graphics in real-time**
- **Growth of VR devices**
- **Web is our platform**

Two approaches of 3D in HTML

Completes graphics technologies

2D

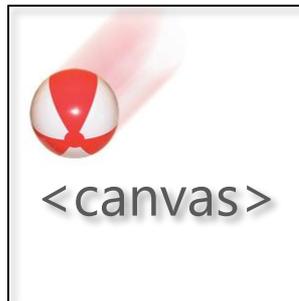
Declarative

Scenegraph
Part of HTML-document
DOM Integration
CSS/ Events



Imperative

Procedural API
Drawing context
Flexible



Web Programmers

3D HTML5



X3D
open
source
solutions



Graphics Programmers



three.js

Why is Declarative 3D important to Enterprise 3D

- Interactive 3D objects in HTML5 web pages
- Allows easy creation and sharing of 3D graphics using HTML
- Bridges the gap between graphics programmers and Web programmers

Declarative

Scenegrph
Part of HTML-document
DOM Integration
CSS/ Events



Founded in 1997, Web3D is an **open**, non-profit, **member-driven** industry consortium developing **royalty-free 3D ISO** standards

Paving the Road to Interoperable 3D Graphics with Open Standards

Our Members

**Academia
Industry
Research Institutes
Universities
Government
Professionals**

We are based in Mountain View, California

The Web3D Vision

An immersive world in which everyone can **securely** access and **share** 3D data **when** and **where** they need it.

The Web3D Mission

To provide standards that empower **efficient** and **secure** 3D Graphics that is **interoperable** and **archiveable**.



Active Web3D Standards



X3D Version 3.3

File Format and Rendering Engine



HAnim Version 2

Humanoid Animation

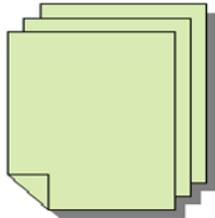
**X3D standards and HANIM
Ratified by
ISO/IEC JTC 1/SC 24**

**Delivering New
Dimensions on the Web**

What is X3D?

Second Generation **VRML** A complete Solution for 3D on the Web * **Enterprise 3D** *

Real-Time * Web Based * Interactive * Animation * Extensible * Scriptable



File Formats:
XML, ClassicVRML, Binary



Run-Time Engine:
Two Open source Implementations –
X_ITE and X3DOM

Meshes * **Lights** * Cameras * **Materials** * Textures * **Shaders** * Annotation * **Volume** *
Audio/Video * **AR/VR** * Security * Metadata

Scene graph for real-time interactive 3D

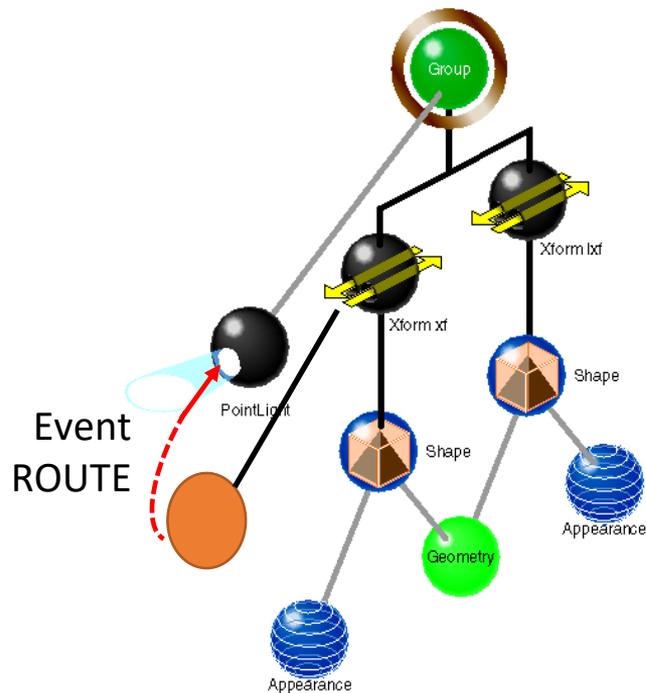
Delivery of virtual environments over the web

Multiple encodings

- XML (.x3d)
- Classic VRML (.x3dv)
- Compressed Binary (.x3db)
- JSON

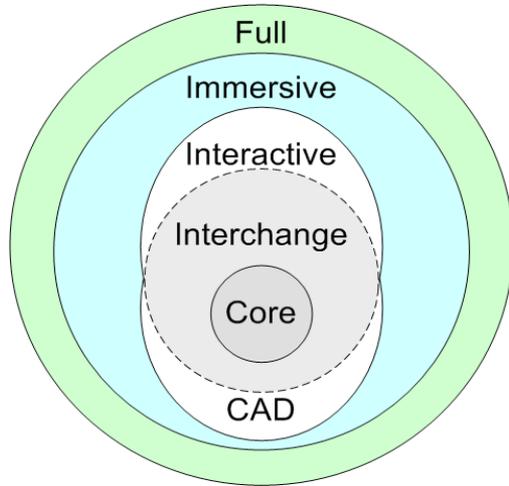
Multiple APIs

- Javascript,
- Java,
- C#, C++, C,
- Python



X3D Profiles

<https://www.web3d.org/x3d/profiles>



Profiles are X3D subsets

- Collection of X3D nodes for author's palette
- Interchange suitable for simple geometry conversion
- Interactive adds simple user interactivity (clicking etc.)
- Immersive matches VRML97, plus a bit more
- Full profile includes all nodes
- Components are collections of X3D nodes that perform similar operations, displays, or functions.

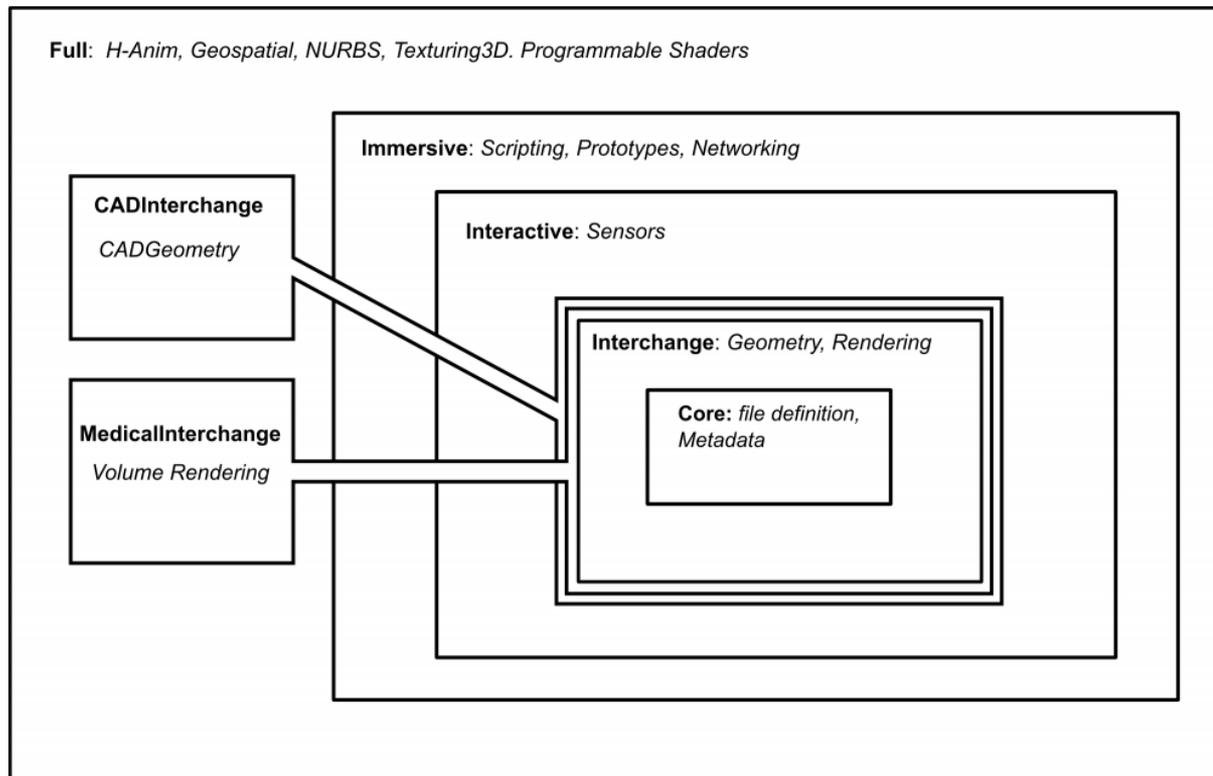
General Goal:

- A 3D visualization component for any runtime environment
- Reduced complexity and implementation effort

X3D Node Set

<https://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/nodeIndex.html>

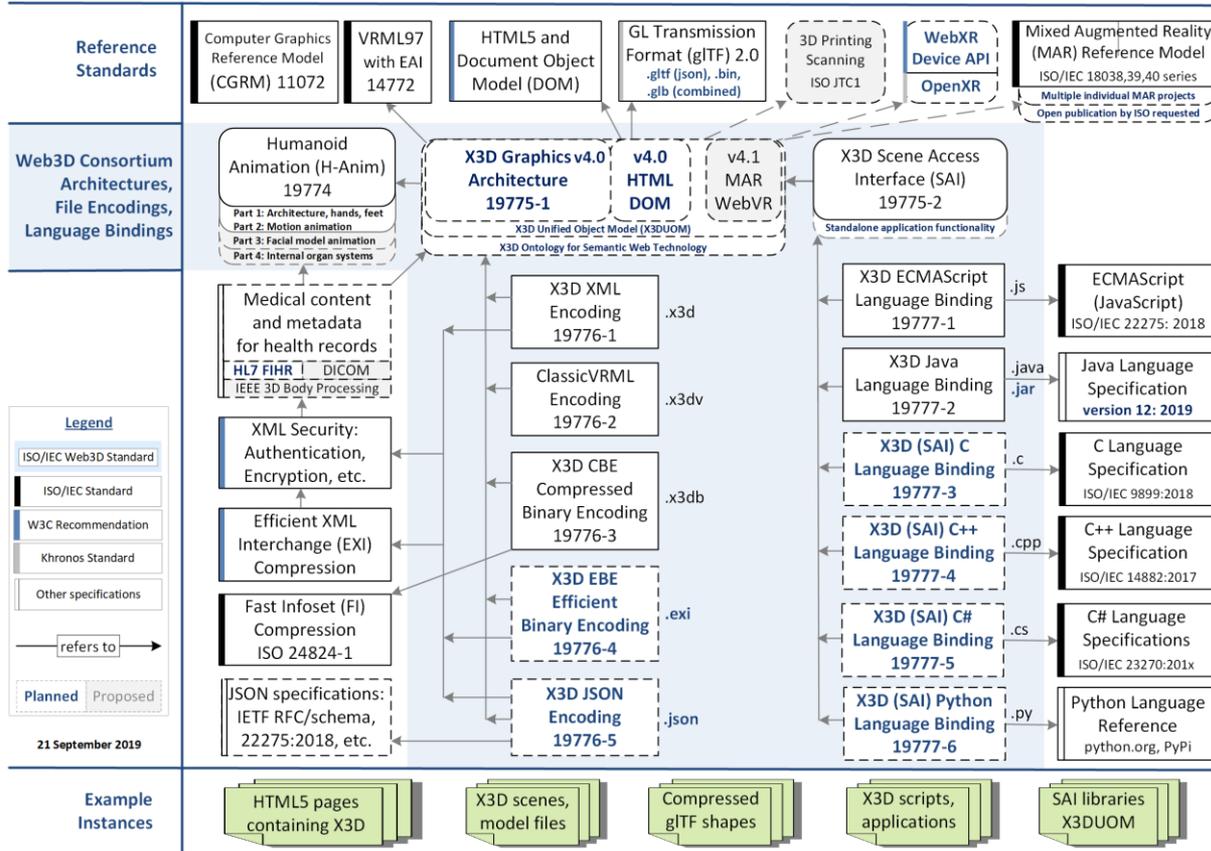
X3D Profile Relationships



Rev: April 4 2018

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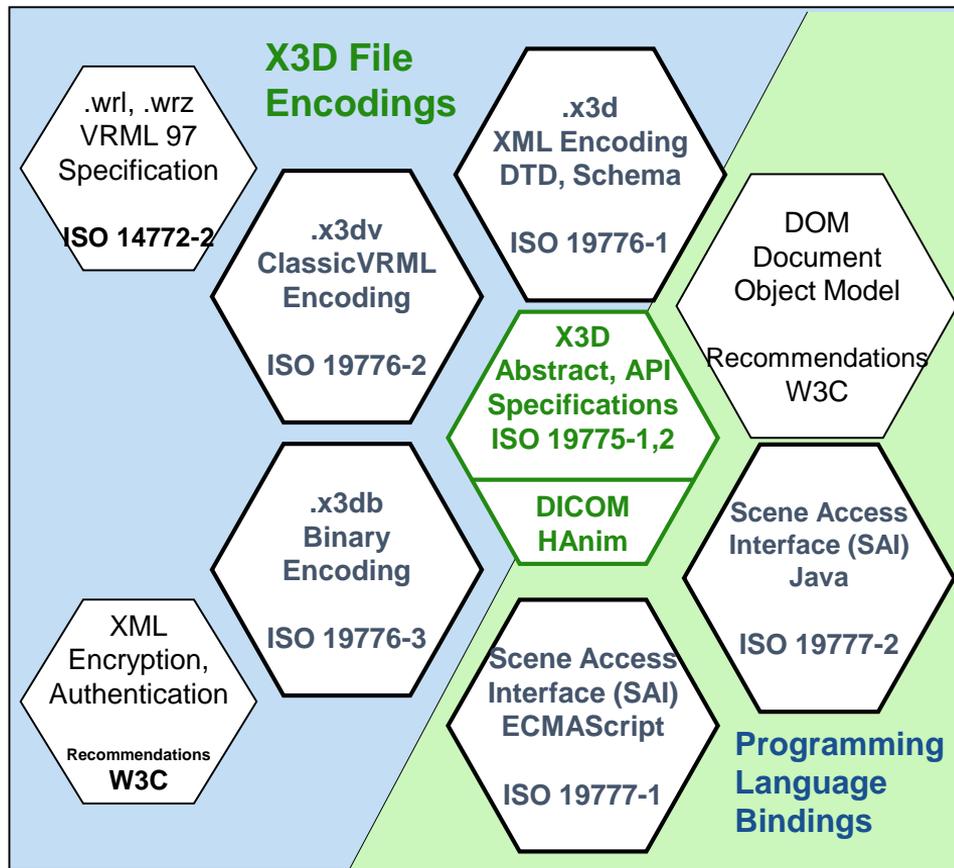
X3D Graphics Standards Relationships



Family of ISO Standards

<https://www.web3d.org/standards>

X3D Specifications



Fundamentals of X3D

Based on VRML, supports several APIs

- Modular components, Extensible, Scriptable
- Efficient and Scalable Open Standards
- **Open source and royalty-free ISO standard**
- Quality Assurance tools for conformance
- Interoperable with other standards
- Secure (Binary Encryption, Digital Signature, Compression)
- Platform Agnostic (All platforms all browsers)
- Stable that stands the test of time (Archiveable)

[IEEE 3DBP WG Feature Needs table](#) (X3D offers most of the feature requests)



X3D is Evolving - X3Dv4

Always backward compatible

X3Dv4 in Development

[X3D Unified Object Model \(X3DUOM\)](#)



X3Dv4
Native in all browsers

X3Dv4 Highlights

- Improve the search-ability of 3D models.
- 3D printing of models
- 3D scanning of objects, and toolchain workflow support for point clouds
- CAD interoperability includes model structure complete metadata.
- Volume visualization
- Annotation
- glTF inline Capabilities
- Archival publishing of cultural and natural heritage

Open-source implementations, [X3DOM](#) and [X_ITE](#)

Timeline - Dec 2019 - Feature set freeze

Draft Specification in 2020 followed by ISO Ratification

Available to members since 2018 in github

<https://github.com/Web3dConsortium>

Released [public draft](#)

Authors have the archival stability of a well-tested long-lasting specification to build upon

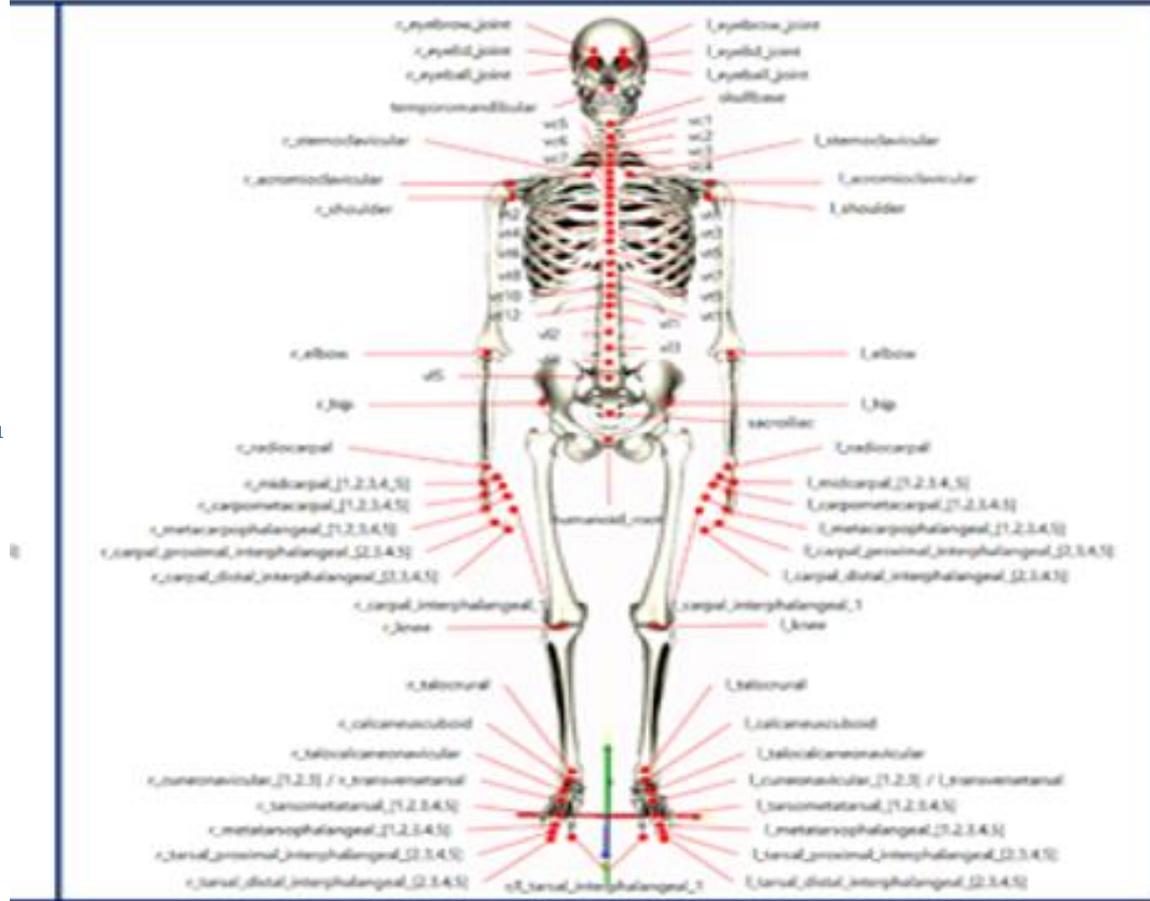
IEEE 3DBP WG Partnership

Extensions that are relevant to 3DBP
Web3D welcomes requirements from
IEEE 3DBP WG

Humanoid Animation v2

ISO-IEC 19774 - 1 :
H-Anim (2018)

Level of articulation (LOA) represents the complexity and detail of joints for a humanoid skeletal hierarchy, and can be used for generating various motions based on the joints.



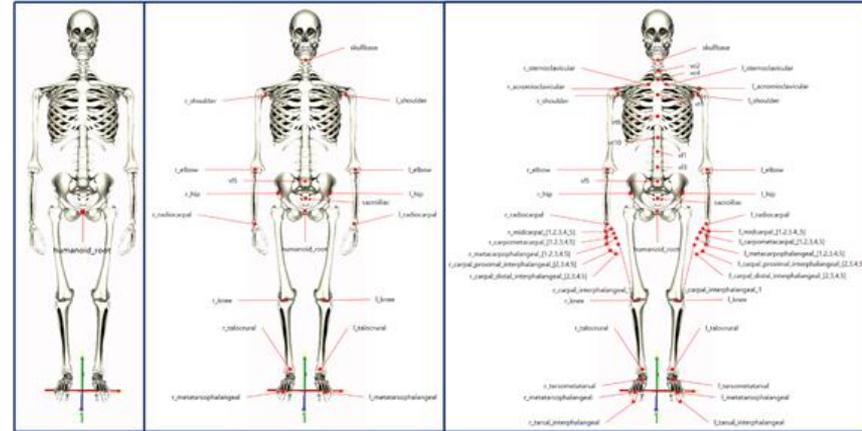
LOA-4

<https://www.web3d.org/standards/h-anim>

Humanoid Animation v2

There are five levels of articulation:

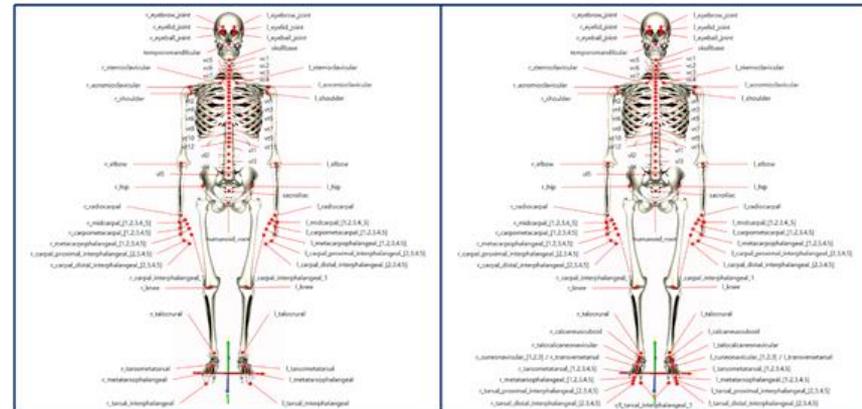
- LOA-0 represents only the humanoid_root Joint object without hierarchy.
- LOA-1 represents the simplest organization and hierarchy of joints for a humanoid. 18 joints and 18 segments. Each segment has a joint in the hierarchy.
- LOA-2 consists of 71 joints and 71 segments.
- LOA-3 consists of 94 joints and 94 segments.
- LOA-4 builds on LOA-3 by adding anatomical details of hands and feet, consisting of 148 joints and 148 segments.



LOA-0

LOA-1

LOA-2



LOA-3

LOA-4

Exercise/Movement

H-Anim 2.0 (ISO-IEC 19774 - 2) specifies the 3D graphics mappings for combining anatomy and Motion Data Animation (e.g. .bvh). These standards data structures are especially important in movement ergonomics.



Web3D Standardization Process

Volunteers and Members work together on Standards

Development

Web3D Working Groups:

X3D

Medical

Geospatial

Mixed Reality

Heritage

Semantics

Design Printing & Scanning

Interoperability

SDO Partnerships:



Adoption Process

1. Identify Standard or Extension to existing standards

- Study Market Trends/Requirements
- Identify Consortium Members' Interest
- Identify if this requirement falls under an existing working group charter
- Form a new working group if this does not

2. Create Standard or Extension

- Follow Consortium's IP Policy, Ensure Open and Consensus based solution
- Identify at least two independent and interoperable
- Create conformance testing suites
- Announce member/public review of 30 days
- Review comments and incorporate or discard with cause.
- Complete standard or extension for submission

3. Submit Standard or Extension for Board approval and Member vote

- Web3D Consortium Board of Directors review
- Board determines if a Web3D Members vote is necessary
- Tabulate Member vote results
- Start ISO certification process after final Board approval

4. ISO Certification - Follows ISO policy for all standards

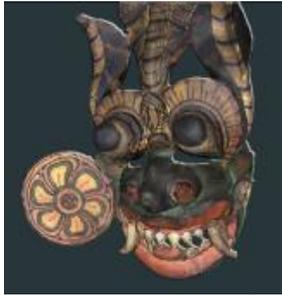
File Format



Rendering Engine

X3D: Used in many Industry Verticals

Cultural Heritage



Geospatial



CAD



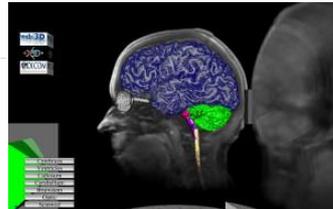
3D Printing



Mixed Augmented Reality



Medical



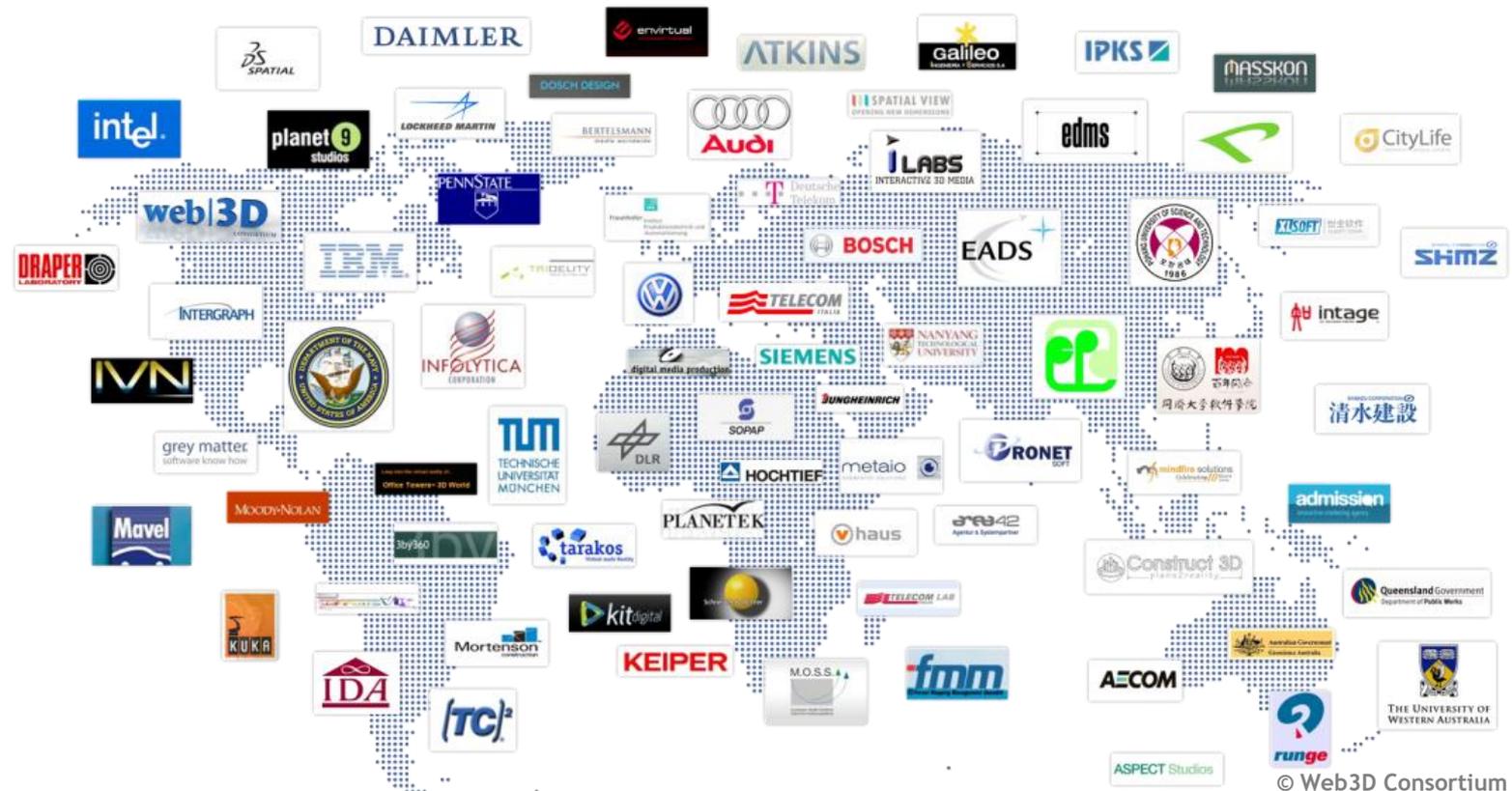
HAnim



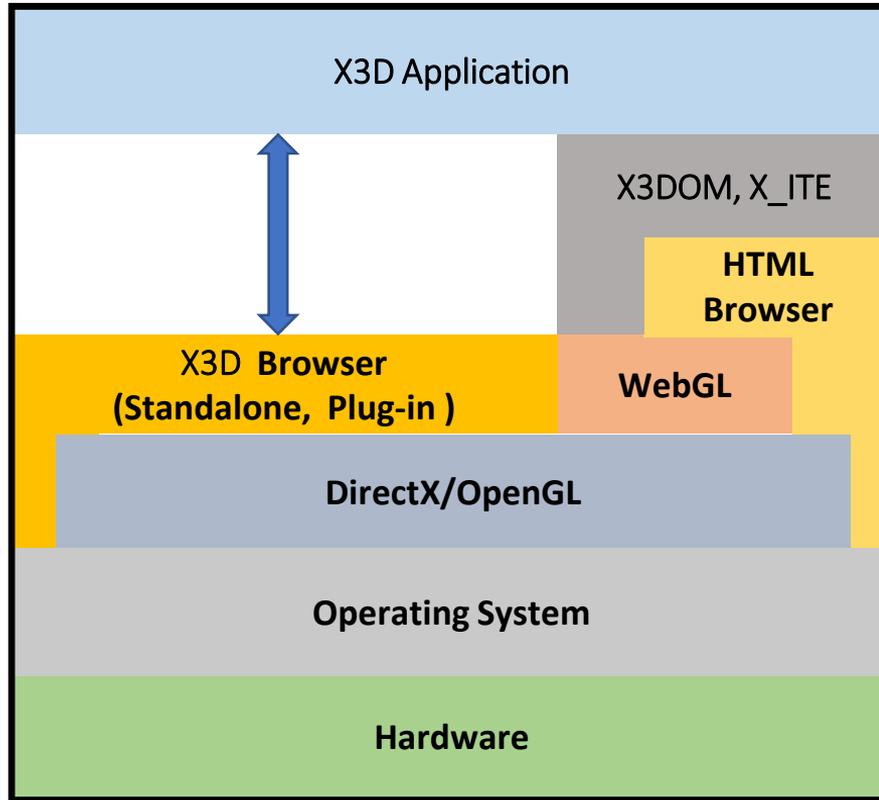
3D Scanning



Who is using X3D?



X3D Graphics Stack



X3D for Web Authors Vs WebGL for 3D graphics application programmers

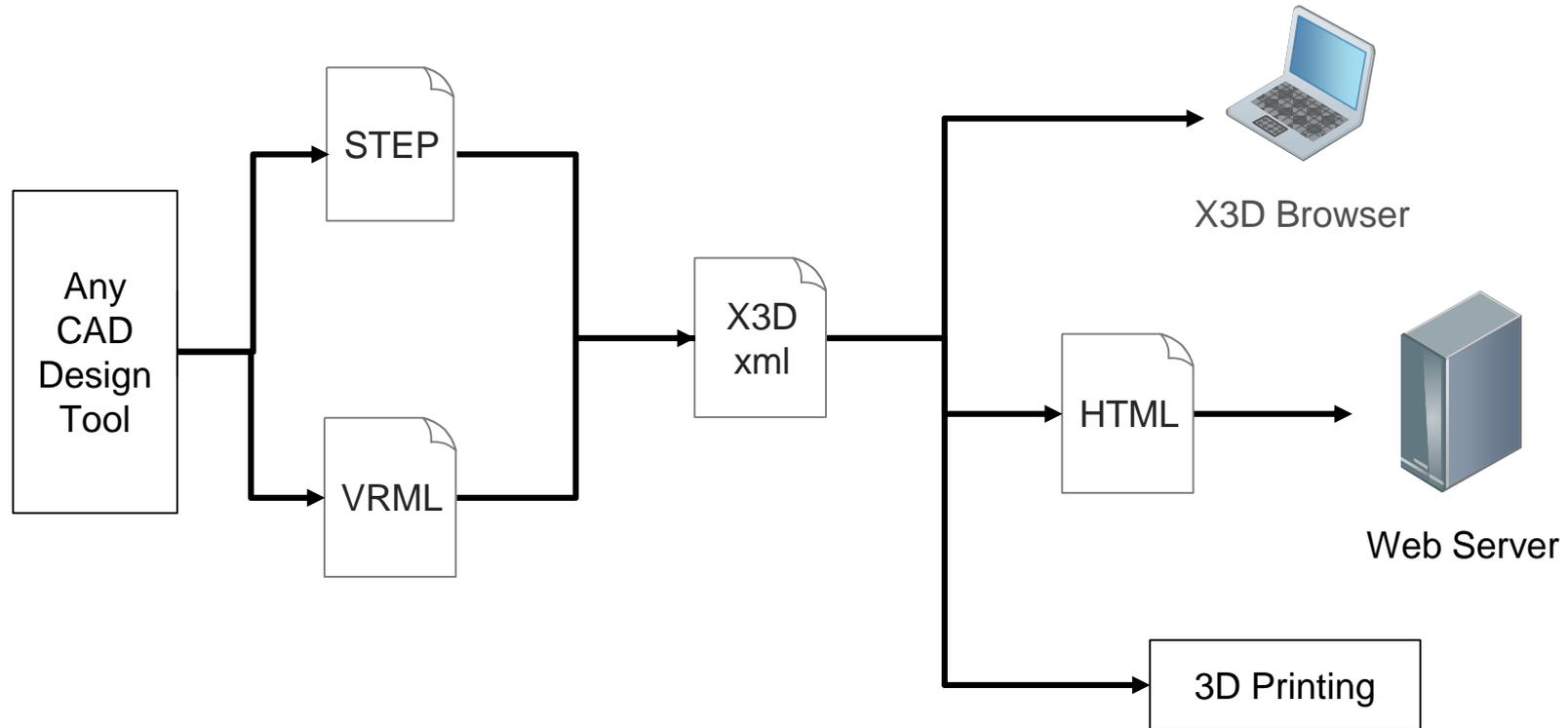
Open Source X3D Browsers

X3DOM <http://www.x3dom.org>

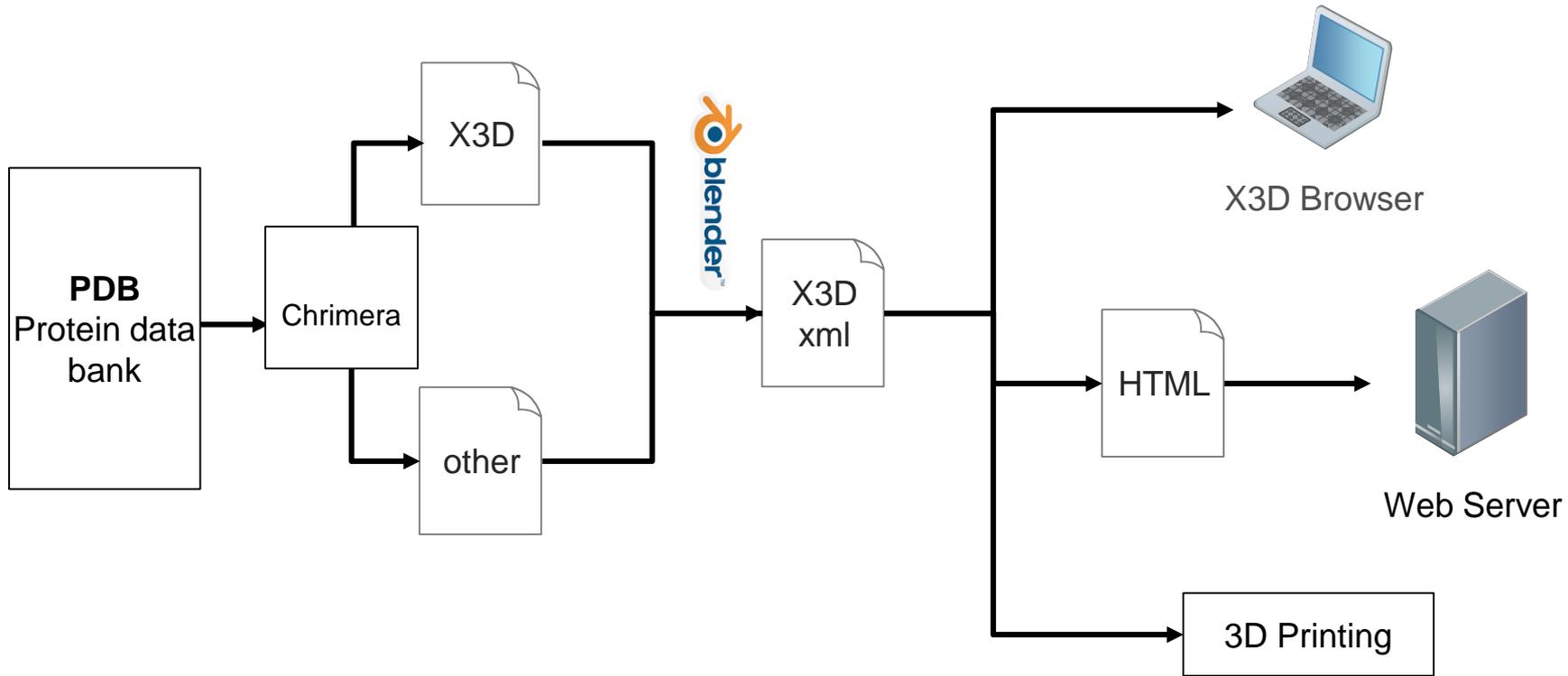
X_ITE http://create3000.de/x_ite

Standalone – Instant Reality

CAD Workflow



Scientific Visualization Workflow



X3D and glTF Comparison



The design goal of glTF 2.0 is to be the **JPEG of 3D**.

X3D and VRML are the **HTML of 3D** - a higher level representation that can compose JPEGs (glTF and others) into a Document: a 3D, VR, or AR World.

glTF's sweet spot is focusing on the asset delivery problem between **network and GPU**.

Core glTF does not represent many of the crucial ingredients for 3D worlds, including **lights, interactivity, and structured metadata functionality**, leaving them up to the application.

glTF is much **closer to the graphics hardware** (lowest common denominator)

X3D is much **closer to the Web and the Application layer** (greatest common denominator).

X3D's sweet spot is **composing interactive scenes** (via its Scene Graph) and connecting them with higher-level logic, APIs, and services.



X3D and glTF Comparison



INTERACTION

Interactive aspects of a model can be represented in X3D/VRML, but not glTF.

X3D offers built-in navigation and avatars for a walk mode, or guided exploration through a scene, with the level of user control managed by the designer. glTF does not

Animation and Other sensors such as visibility, collision, 'dragging' can be described in an X3D scene.

More complex behaviors and event logic can be part of the X3D scene travelling with the model and carrying its interaction semantics.

X3D and glTF Comparison

Rendering

Without Lights, the 3D world is black. lighting placement, type, and color are crucial aspects of the model and its presentation.



X3D and tools support **the classic Lighting model**; in glTF, lighting needs to be set up in the external application, or by use of an optional Extension

Material model - shading Appearances.

X3D and tools support these natively, while glTF requires an (yet to be finalized) extension



GLSL Shaders are also supported by X3D and the HTML5 X3D engines; in glTF, these require an Extension

PBR rendering is compact and visually attractive, but requires many older models be translated to the new paradigm. PBR is natively supported in the HTML5 X3D engines, and the subject of X3Dv4

PBR benefits from environment lights and X3D already includes support **for environmental CubeMaps** through the CubeMapTexturing Component

X3D and glTF Comparison

Web Informatics



Metadata is a central requirement to track an assets' provenance, licensing, or to cross-reference with different vocabularies or ontologies. X3D enables multiple Metadata tags to be attached to any node in the scene. gltf has an extension draft for structured metadata; glTF currently has unstructured metadata



URL/URIs are literally the link to connect information and resources over the Web. In X3D, the Anchor semantic is the same as HTML. glTF also uses URIs to reference its buffers and image resources. glTF scenes cannot link to other glTF scenes. In X3D teleporting to another scene is a core feature.

Rich X3D worlds can also be built by **Inlining glTF assets**, as demonstrated by X3DOM and targeted as a X3D v 4.0 extension!

XML ecosystem and W3C Standards, such as **compression, encryption, and authentication** at the element level.

Leveraging the XML side of HTML5 provides many benefits for quickly **building powerful Web applications**

X3D	GLTF
declarative & DOM-ready	non-declarative
describe complex scenes with multiple models, lighting, and interaction	Describe objects geometry and their optical properties
core support for scene linkage, Inlining, and Metadata	no scene linkage
Phong material + GLSL (X3D 4.0 will support PBR by Inlining glTF 2.0 models)	PBR material
Not-for-profit and ISO-IEC recognition of a Standard	Not-for-profit publication of a Specification

X3D ISO Standard High-Level Features

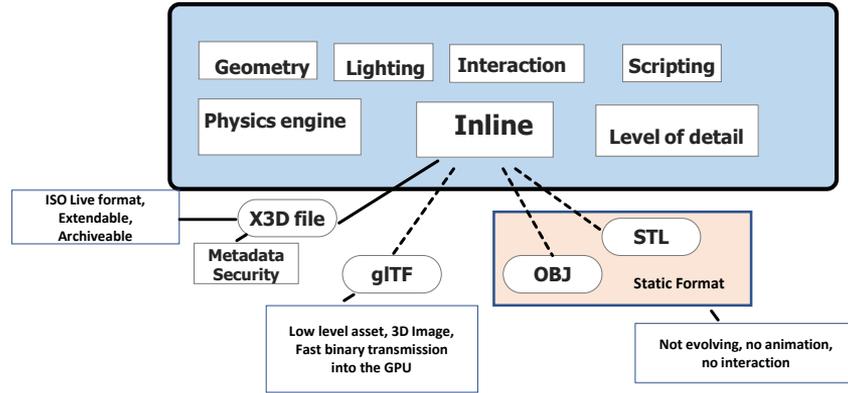


Illustration of the relation between high-level features of X3D enabling constructing dynamic, interactive, 3D scenes; and the ability to load contents, or assets, from external sources including other X3D files.

The ability to include other X3D content is a part of the current ISO standard X3D v 3.3; the inclusion of gITF is planned for the upcoming X3D v4.

Inclusion of gITF, OBJ, STL is already an extension offered by X3D viewers such as X3DOM and Castle Game Engine.

Inline glTF



Load glTF assets into an X3D scene

Including glTF assets in an X3D scene is an extension feature of some X3D viewers, including X3DOM.

This feature is expected to be included in the upcoming X3D v4 standard.

glTF assets loaded into an X3D scene participate in X3D interactive features include touch-events, mouse over, Label and more.

<http://www.kshell.com/pages/gltfassets/sharpdressedman/>

<https://examples.x3dom.org/gltf2/>





High spatial and temporal
resolution body scans

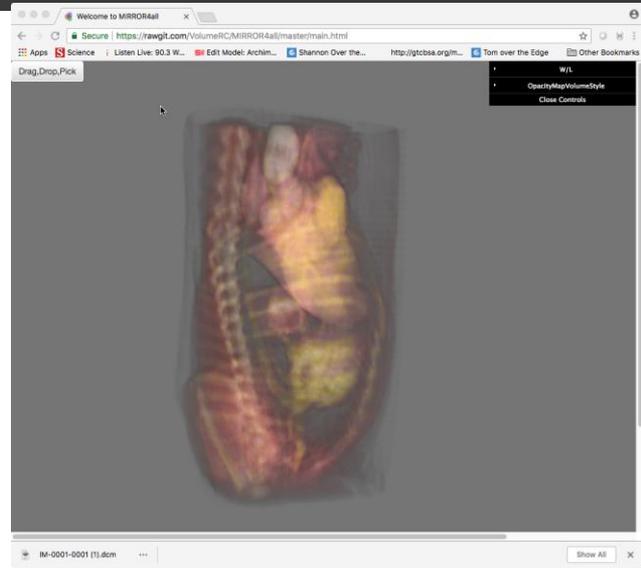
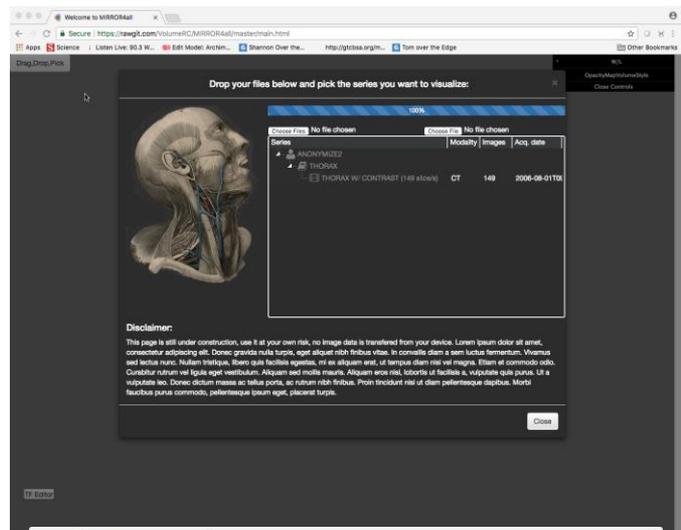
www.3dmd.com



Web Volume Rendering

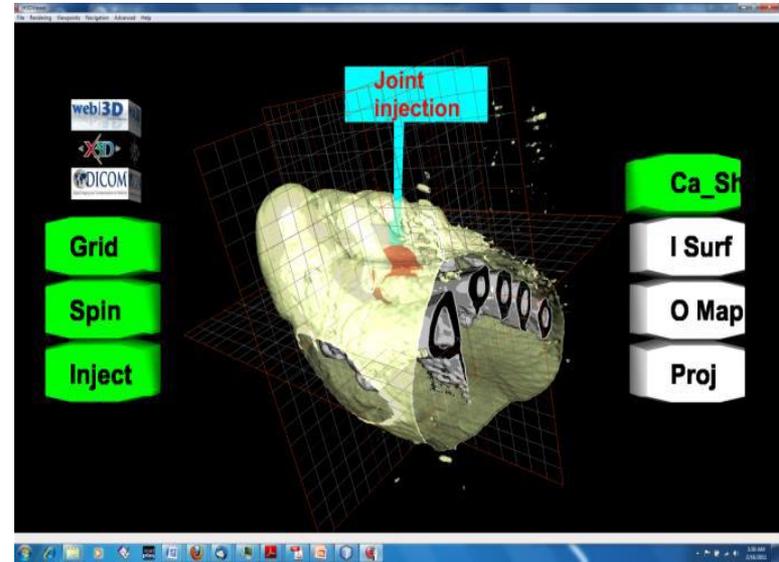
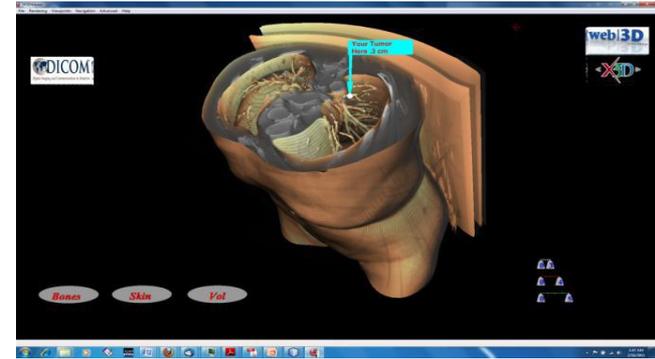
HTML5 + WebGL + X3D

- VICOMTech: Volumerc.org
- Online drag-and-drop service for DICOM:
 - To HTML5/WebGL/X3DOM
 - Mirror4All by VICOMTECH and Kshell



WWW and VR

- X3D: desktop, mobile, immersive VR/MR/AR
- Imaging
 - X3D Volume Rendering
 - TIFF stacks, DICOM, NRRD, PNG
 - Scripted automated conversions
- Molecular Visualization
- Immune Simulation
- Genomic alignment
- Polygons and volumes living together!
- VR and 3D printing !!!



WebVR

X3D and HTML5 files Uses the browser as the platform

Many headsets

Support X3D

Samsung Gear

Oculus



Path Forward

Working with IEEE 3DBP community opens new doors

ISO-IEC provides international ratification and recognition

The X3D and H-Anim open royalty free specifications provide platform-independent 3D graphics relevant to 3DBP

Values for interoperability?

How does X3D play across the 3DBP Enterprise?

Metadata -Vocabularies and reference practices!

Security – Support IEEE 7002 guidelines

Material – Extend the material node

Rigid body Physics – Extend Soft body Physics

Use X3D as a container

Humanoid Animation

WebVR

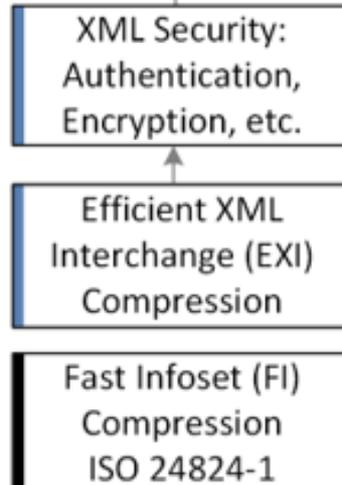
File Format



Rendering Engine



Support IEEE P7002 guidelines



Metadata Node

<https://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/components/core.html#MetadataSet>

X3D Node Set

<https://www.web3d.org/documents/specifications/19775-1/V3.3/Part01/nodeIndex.html>

X3D H-Anim2 deliverable specific expected joint behaviors, implementing **rigid body physics features** into the structure

Web3D International Mobilization



- Annual Outreach activates engage communities of interest
- SIGGRAPH/ Eurographics Web3D Conference (25 years)
- Workshops & exhibits at SIGGRAPH
- VR Hackathons worldwide
- Showcases & regional meetings
- X3D and members appear regularly at:
IEEE VR, Supercomputing, MMVR, IITSEC,
- X3D an enabler in many domains

Web3D Resources

Membership: www.Web3D.org/join

Web3D Standards: www.Web3D.org/standards

Work Groups: www.Web3d.org/working-groups

Workshop: www.Web3d.org/Web3d-quickstart

Examples: www.web3d.org/x3d/content/examples/Basic/

Events: www.Web3D.org/events

Join and Participate

Participants always welcome

- <http://www.web3d.org/join>

Suggestions are always welcome

- x3d-public@web3d.org

Join us at:

- [Web3D 2020](#) June 24-26 – Seoul, South Korea
- [SIGGRAPH 2020](#) July 19-23 – Washington D.C.

Contact

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Thank You for Considering Web3D Standards!

We look forward to the chance to work together

Resources and contacts

- Web3D Website
 - <http://www.web3d.org>
- Nicholas Polys, President
 - npolys@vt.edu
- Chris Lane, Board Member
 - clane@3dmd.com
- Anita Havele, Executive Director
 - anita.havele@web3d.org

