
**Information technology — Runtime
3D asset delivery format — Khronos
glTF™ 2.0**

*Technologies de l'information — Format de livraison d'actifs 3D
d'exécution — Khronos glTF™ 2.0*

This document is a preview generated by EUS



COPYRIGHT PROTECTED DOCUMENT

© ISO/IEC 2022

All rights reserved. Unless otherwise specified, or required in the context of its implementation, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Foreword

ISO (the International Organization for Standardization) and IEC (the International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted (see www.iso.org/directives or www.iec.ch/members_experts/refdocs).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO and IEC shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents) or the IEC list of patent declarations received (see <https://patents.iec.ch>).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html. In the IEC, see www.iec.ch/understanding-standards.

This document was prepared by Khronos (as glTF™ 2.0 Specification) and drafted in accordance with its editorial rules. It was adopted, under the JTC 1 PAS procedure, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html and www.iec.ch/national-committees.

Table of Contents

1. Foreword	1
2. Introduction	2
2.1. General	2
2.2. Document Conventions	2
2.2.1. Normative Terminology and References	2
2.2.2. Informative Language	2
2.2.3. Technical Terminology	3
2.2.4. Normative References	5
2.2.4.1. External Specifications	5
2.2.4.2. Media Type Registrations	6
2.3. Motivation and Design Goals (Informative)	7
2.4. glTF Basics	8
2.5. Versioning	8
2.6. File Extensions and Media Types	8
2.7. JSON Encoding	9
2.8. URIs	11
3. Concepts	13
3.1. General	13
3.2. Asset	13
3.3. Indices and Names	14
3.4. Coordinate System and Units	15
3.5. Scenes	15
3.5.1. Overview	15
3.5.2. Nodes and Hierarchy	16
3.5.3. Transformations	17
3.6. Binary Data Storage	19
3.6.1. Buffers and Buffer Views	19
3.6.1.1. Overview	19
3.6.1.2. GLB-stored Buffer	21
3.6.2. Accessors	22
3.6.2.1. Overview	22
3.6.2.2. Accessor Data Types	23
3.6.2.3. Sparse Accessors	24
3.6.2.4. Data Alignment	25
3.6.2.5. Accessors Bounds	28
3.7. Geometry	28
3.7.1. Overview	28
3.7.2. Meshes	28

3.7.2.1. Overview	28
3.7.2.2. Morph Targets	32
3.7.3. Skins	35
3.7.3.1. Overview	35
3.7.3.2. Joint Hierarchy	36
3.7.3.3. Skinned Mesh Attributes	37
3.7.4. Instantiation	39
3.8. Texture Data	41
3.8.1. Overview	41
3.8.2. Textures	42
3.8.3. Images	42
3.8.4. Samplers	44
3.8.4.1. Overview	44
3.8.4.2. Filtering	44
3.8.4.3. Wrapping	45
3.8.4.4. Example	45
3.8.4.5. Non-power-of-two Textures	46
3.9. Materials	46
3.9.1. Overview	46
3.9.2. Metallic-Roughness Material	47
3.9.3. Additional Textures	49
3.9.4. Alpha Coverage	51
3.9.5. Double Sided	52
3.9.6. Default Material	52
3.9.7. Point and Line Materials	52
3.10. Cameras	53
3.10.1. Overview	53
3.10.2. View Matrix	53
3.10.3. Projection Matrices	53
3.10.3.1. Overview	53
3.10.3.2. Infinite perspective projection	54
3.10.3.3. Finite perspective projection	55
3.10.3.4. Orthographic projection	55
3.11. Animations	55
3.12. Specifying Extensions	61
4. GLB File Format Specification	63
4.1. General (Informative)	63
4.2. Structure	63
4.3. File Extension & Media Type	63
4.4. Binary glTF Layout	63
4.4.1. Overview	63

4.4.2. Header	64
4.4.3. Chunks	64
4.4.3.1. Overview	64
4.4.3.2. Structured JSON Content	65
4.4.3.3. Binary buffer	65
5. Properties Reference	66
5.1. Accessor	66
5.1.1. accessor.bufferView	67
5.1.2. accessor.byteOffset	67
5.1.3. accessor.componentType	67
5.1.4. accessor.normalized	68
5.1.5. accessor.count	68
5.1.6. accessor.type	68
5.1.7. accessor.max	68
5.1.8. accessor.min	69
5.1.9. accessor.sparse	69
5.1.10. accessor.name	69
5.1.11. accessor.extensions	69
5.1.12. accessor.extras	69
5.2. Accessor Sparse	70
5.2.1. accessor.sparse.count	70
5.2.2. accessor.sparse.indices	70
5.2.3. accessor.sparse.values	71
5.2.4. accessor.sparse.extensions	71
5.2.5. accessor.sparse.extras	71
5.3. Accessor Sparse Indices	71
5.3.1. accessor.sparse.indices.bufferView	72
5.3.2. accessor.sparse.indices.byteOffset	72
5.3.3. accessor.sparse.indices.componentType	72
5.3.4. accessor.sparse.indices.extensions	73
5.3.5. accessor.sparse.indices.extras	73
5.4. Accessor Sparse Values	73
5.4.1. accessor.sparse.values.bufferView	74
5.4.2. accessor.sparse.values.byteOffset	74
5.4.3. accessor.sparse.values.extensions	74
5.4.4. accessor.sparse.values.extras	74
5.5. Animation	74
5.5.1. animation.channels	75
5.5.2. animation.samplers	75
5.5.3. animation.name	76
5.5.4. animation.extensions	76

5.5.5. animation.extras	76
5.6. Animation Channel	76
5.6.1. animation.channel.sampler	77
5.6.2. animation.channel.target	77
5.6.3. animation.channel.extensions	77
5.6.4. animation.channel.extras	77
5.7. Animation Channel Target	77
5.7.1. animation.channel.target.node	78
5.7.2. animation.channel.target.path	79
5.7.3. animation.channel.target.extensions	79
5.7.4. animation.channel.target.extras	79
5.8. Animation Sampler	79
5.8.1. animation.sampler.input	80
5.8.2. animation.sampler.interpolation	80
5.8.3. animation.sampler.output	81
5.8.4. animation.sampler.extensions	81
5.8.5. animation.sampler.extras	81
5.9. Asset	81
5.9.1. asset.copyright	82
5.9.2. asset.generator	82
5.9.3. asset.version	82
5.9.4. asset.minVersion	82
5.9.5. asset.extensions	83
5.9.6. asset.extras	83
5.10. Buffer	83
5.10.1. buffer.uri	83
5.10.2. buffer.byteLength	84
5.10.3. buffer.name	84
5.10.4. buffer.extensions	84
5.10.5. buffer.extras	84
5.11. Buffer View	84
5.11.1. bufferView.buffer	85
5.11.2. bufferView.byteOffset	85
5.11.3. bufferView.byteLength	85
5.11.4. bufferView.byteStride	86
5.11.5. bufferView.target	86
5.11.6. bufferView.name	86
5.11.7. bufferView.extensions	86
5.11.8. bufferView.extras	86
5.12. Camera	87
5.12.1. camera.orthographic	87

5.12.2. camera.perspective	88
5.12.3. camera.type	88
5.12.4. camera.name	88
5.12.5. camera.extensions	88
5.12.6. camera.extras	88
5.13. Camera Orthographic	89
5.13.1. camera.orthographic.xmag	89
5.13.2. camera.orthographic.ymag	90
5.13.3. camera.orthographic.zfar	90
5.13.4. camera.orthographic.znear	90
5.13.5. camera.orthographic.extensions	90
5.13.6. camera.orthographic.extras	90
5.14. Camera Perspective	91
5.14.1. camera.perspective.aspectRatio	91
5.14.2. camera.perspective.yfov	91
5.14.3. camera.perspective.zfar	92
5.14.4. camera.perspective.znear	92
5.14.5. camera.perspective.extensions	92
5.14.6. camera.perspective.extras	92
5.15. Extension	92
5.16. Extras	93
5.17. glTF	93
5.17.1. glTF.extensionsUsed	94
5.17.2. glTF.extensionsRequired	94
5.17.3. glTF.accessors	94
5.17.4. glTF.animations	94
5.17.5. glTF.asset	94
5.17.6. glTF.buffers	95
5.17.7. glTF.bufferViews	95
5.17.8. glTF.cameras	95
5.17.9. glTF.images	95
5.17.10. glTF.materials	95
5.17.11. glTF.meshes	95
5.17.12. glTF.nodes	96
5.17.13. glTF.samplers	96
5.17.14. glTF.scene	96
5.17.15. glTF.scenes	96
5.17.16. glTF.skins	96
5.17.17. glTF.textures	96
5.17.18. glTF.extensions	96
5.17.19. glTF.extras	97

5.18. Image	97
5.18.1. image.uri	98
5.18.2. image.mimeType	98
5.18.3. image.bufferView	98
5.18.4. image.name	98
5.18.5. image.extensions	98
5.18.6. image.extras	99
5.19. Material	99
5.19.1. material.name	100
5.19.2. material.extensions	100
5.19.3. material.extras	100
5.19.4. material.pbrMetallicRoughness	100
5.19.5. material.normalTexture	100
5.19.6. material.occlusionTexture	101
5.19.7. material.emissiveTexture	101
5.19.8. material.emissiveFactor	101
5.19.9. material.alphaMode	101
5.19.10. material.alphaCutoff	102
5.19.11. material.doubleSided	102
5.20. Material Normal Texture Info	102
5.20.1. material.normalTextureInfo.index	103
5.20.2. material.normalTextureInfo.texCoord	103
5.20.3. material.normalTextureInfo.scale	103
5.20.4. material.normalTextureInfo.extensions	103
5.20.5. material.normalTextureInfo.extras	104
5.21. Material Occlusion Texture Info	104
5.21.1. material.occlusionTextureInfo.index	104
5.21.2. material.occlusionTextureInfo.texCoord	104
5.21.3. material.occlusionTextureInfo.strength	105
5.21.4. material.occlusionTextureInfo.extensions	105
5.21.5. material.occlusionTextureInfo.extras	105
5.22. Material PBR Metallic Roughness	105
5.22.1. material.pbrMetallicRoughness.baseColorFactor	106
5.22.2. material.pbrMetallicRoughness.baseColorTexture	106
5.22.3. material.pbrMetallicRoughness.metallicFactor	106
5.22.4. material.pbrMetallicRoughness.roughnessFactor	107
5.22.5. material.pbrMetallicRoughness.metallicRoughnessTexture	107
5.22.6. material.pbrMetallicRoughness.extensions	107
5.22.7. material.pbrMetallicRoughness.extras	107
5.23. Mesh	108
5.23.1. mesh.primitives	108

5.23.2. mesh.weights	108
5.23.3. mesh.name	108
5.23.4. mesh.extensions	109
5.23.5. mesh.extras	109
5.24. Mesh Primitive	109
5.24.1. mesh.primitive.attributes	110
5.24.2. mesh.primitive.indices	110
5.24.3. mesh.primitive.material	110
5.24.4. mesh.primitive.mode	110
5.24.5. mesh.primitive.targets	111
5.24.6. mesh.primitive.extensions	111
5.24.7. mesh.primitive.extras	111
5.25. Node	111
5.25.1. node.camera	113
5.25.2. node.children	113
5.25.3. node.skin	113
5.25.4. node.matrix	113
5.25.5. node.mesh	114
5.25.6. node.rotation	114
5.25.7. node.scale	114
5.25.8. node.translation	114
5.25.9. node.weights	114
5.25.10. node.name	114
5.25.11. node.extensions	115
5.25.12. node.extras	115
5.26. Sampler	115
5.26.1. sampler.magFilter	115
5.26.2. sampler.minFilter	116
5.26.3. sampler.wrapS	116
5.26.4. sampler.wrapT	116
5.26.5. sampler.name	117
5.26.6. sampler.extensions	117
5.26.7. sampler.extras	117
5.27. Scene	117
5.27.1. scene.nodes	118
5.27.2. scene.name	118
5.27.3. scene.extensions	118
5.27.4. scene.extras	118
5.28. Skin	118
5.28.1. skin.inverseBindMatrices	119
5.28.2. skin.skeleton	119

5.28.3. skin.joints	119
5.28.4. skin.name	120
5.28.5. skin.extensions	120
5.28.6. skin.extras	120
5.29. Texture	120
5.29.1. texture.sampler	121
5.29.2. texture.source	121
5.29.3. texture.name	121
5.29.4. texture.extensions	122
5.29.5. texture.extras	122
5.30. Texture Info	122
5.30.1. textureInfo.index	122
5.30.2. textureInfo.texCoord	123
5.30.3. textureInfo.extensions	123
5.30.4. textureInfo.extras	123
6. Acknowledgments (Informative)	124
6.1. Editors	124
6.2. Khronos 3D Formats Working Group and Alumni	124
6.3. Special Thanks	124
Appendix A: JSON Schema Reference (Informative)	126
A.1. JSON Schema for Accessor	126
A.2. JSON Schema for Accessor Sparse	130
A.3. JSON Schema for Accessor Sparse Indices	131
A.4. JSON Schema for Accessor Sparse Values	133
A.5. JSON Schema for Animation	134
A.6. JSON Schema for Animation Channel	135
A.7. JSON Schema for Animation Channel Target	136
A.8. JSON Schema for Animation Sampler	137
A.9. JSON Schema for Asset	139
A.10. JSON Schema for Buffer	140
A.11. JSON Schema for Buffer View	141
A.12. JSON Schema for Camera	143
A.13. JSON Schema for Camera Orthographic	145
A.14. JSON Schema for Camera Perspective	146
A.15. JSON Schema for Extension	147
A.16. JSON Schema for Extras	148
A.17. JSON Schema for glTF	149
A.18. JSON Schema for glTF Child of Root Property	153
A.19. JSON Schema for glTF Id	154
A.20. JSON Schema for glTF Property	155
A.21. JSON Schema for Image	156

A.22. JSON Schema for Material	158
A.23. JSON Schema for Material Normal Texture Info	161
A.24. JSON Schema for Material Occlusion Texture Info	162
A.25. JSON Schema for Material PBR Metallic Roughness	163
A.26. JSON Schema for Mesh	165
A.27. JSON Schema for Mesh Primitive	166
A.28. JSON Schema for Node	169
A.29. JSON Schema for Sampler	172
A.30. JSON Schema for Scene	175
A.31. JSON Schema for Skin	176
A.32. JSON Schema for Texture	177
A.33. JSON Schema for Texture Info	178
Appendix B: BRDF Implementation	179
B.1. General	179
B.2. Material Structure	179
B.2.1. Metals	179
B.2.2. Dielectrics	180
B.2.3. Microfacet Surfaces	181
B.2.4. Complete Model	182
B.3. Sample Implementation (Informative)	183
B.3.1. Overview	183
B.3.2. Specular BRDF	183
B.3.3. Diffuse BRDF	184
B.3.4. Fresnel	184
B.3.5. Metal BRDF and Dielectric BRDF	185
B.3.6. Discussion	185
B.3.6.1. Masking-Shadowing Term and Multiple Scattering	185
B.3.6.2. Schlick's Fresnel Approximation	185
B.3.6.3. Coupling Diffuse and Specular Reflection	186
B.4. References	187
Appendix C: Animation Sampler Interpolation Modes	188
C.1. Overview	188
C.2. Step Interpolation	188
C.3. Linear Interpolation	188
C.4. Spherical Linear Interpolation	188
C.5. Cubic Spline Interpolation	189

Chapter 1. Foreword

Copyright 2013-2021 The Khronos Group Inc.

This specification is protected by copyright laws and contains material proprietary to Khronos. Except as described by these terms, it or any components may not be reproduced, republished, distributed, transmitted, displayed, broadcast, or otherwise exploited in any manner without the express prior written permission of Khronos.

This specification has been created under the Khronos Intellectual Property Rights Policy, which is Attachment A of the Khronos Group Membership Agreement available at https://www.khronos.org/files/member_agreement.pdf. Khronos grants a conditional copyright license to use and reproduce the unmodified specification for any purpose, without fee or royalty, EXCEPT no licenses to any patent, trademark or other intellectual property rights are granted under these terms. Parties desiring to implement the specification and make use of Khronos trademarks in relation to that implementation, and receive reciprocal patent license protection under the Khronos IP Policy must become Adopters under the process defined by Khronos for this specification; see <https://www.khronos.org/conformance/adopters/file-format-adopter-program>.

Some parts of this Specification are non-normative through being explicitly identified as purely informative, and do not define requirements necessary for compliance and so are outside the Scope of this Specification.

Where this Specification includes normative references to external documents, only the specifically identified sections and functionality of those external documents are in Scope. Requirements defined by external documents not created by Khronos may contain contributions from non-members of Khronos not covered by the Khronos Intellectual Property Rights Policy.

Khronos makes no, and expressly disclaims any, representations or warranties, express or implied, regarding this specification, including, without limitation: merchantability, fitness for a particular purpose, non-infringement of any intellectual property, correctness, accuracy, completeness, timeliness, and reliability. Under no circumstances will Khronos, or any of its Promoters, Contributors or Members, or their respective partners, officers, directors, employees, agents or representatives be liable for any damages, whether direct, indirect, special or consequential damages for lost revenues, lost profits, or otherwise, arising from or in connection with these materials.

Khronos® and Vulkan® are registered trademarks, and ANARI™, WebGL™, glTF™, NNEF™, OpenVX™, SPIR™, SPIR-V™, SYCL™, OpenVG™ and 3D Commerce™ are trademarks of The Khronos Group Inc. OpenXR™ is a trademark owned by The Khronos Group Inc. and is registered as a trademark in China, the European Union, Japan and the United Kingdom. OpenCL™ is a trademark of Apple Inc. and OpenGL® is a registered trademark and the OpenGL ES™ and OpenGL SC™ logos are trademarks of Hewlett Packard Enterprise used under license by Khronos. ASTC is a trademark of ARM Holdings PLC. All other product names, trademarks, and/or company names are used solely for identification and belong to their respective owners.

Chapter 2. Introduction

2.1. General

This document, referred to as the “glTF Specification” or just the “Specification” hereafter, describes the glTF file format.

glTF is an API-neutral runtime asset delivery format. glTF bridges the gap between 3D content creation tools and modern graphics applications by providing an efficient, extensible, interoperable format for the transmission and loading of 3D content.

2.2. Document Conventions

The glTF Specification is intended for use by both implementers of the asset exporters or converters (e.g., digital content creation tools) and application developers seeking to import or load glTF assets, forming a basis for interoperability between these parties.

Specification text can address either party; typically, the intended audience can be inferred from context, though some sections are defined to address only one of these parties.

Any requirements, prohibitions, recommendations, or options defined by [normative terminology](#) are imposed only on the audience of that text.

2.2.1. Normative Terminology and References

The key words **MUST**, **MUST NOT**, **REQUIRED**, **SHALL**, **SHALL NOT**, **SHOULD**, **SHOULD NOT**, **RECOMMENDED**, **MAY**, and **OPTIONAL** in this document are to be interpreted as described in [BCP 14](#).

These key words are highlighted in the specification for clarity.

References to external documents are considered normative if the Specification uses any of the normative terms defined in this section to refer to them or their requirements, either as a whole or in part.

2.2.2. Informative Language

Some language in the specification is purely informative, intended to give background or suggestions to implementers or developers.

If an entire chapter or section contains only informative language, its title is suffixed with “(Informative)”. If not designated as informative, all chapters, sections, and appendices in this document are normative.

All Notes, Implementation notes, and Examples are purely informative.