ISO/IEC 12113:2022-07 (E)

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

Contents

Page

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