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| **Title** | **Potential Improvement of ISO/IEC CD 23090-26 Conformance and reference software for carriage of geometry-based point cloud compression data** |
| **Source** | **WG 03, MPEG Systems** |
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Scope

This document specifies the reference software and conformance suite for carriage of G-PCC data as specified in ISO/IEC 23090-18. The information provided describes the reference software modules and the features that it supports. It includes the status of the development of the reference software for ISOBMFF encapsulation of carriage of G-PCC data. It also provides a description of how the reference software can be utilized. Finally, it also provides a description of conformance test vectors.

[Ed.(SO): since ISO/IEC 23090-18 includes both of ISOBMFF encapsulation and streaming over DASH or MMT, we need to clearly describe the scope of the reference software]

Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO/IEC 23090-18:2023, Information technology — Coded representation of immersive media — Part 18: Carriage of geometry-based point cloud compression data

ISO/IEC 14496-12:2021, Information technology — Coding of audio-visual objects — Part 12: ISO base media file format

ISO/IEC 23008-12:2022, Information technology — High efficiency coding and media delivery in heterogeneous environments — Part 12: Image file format

Terms and definitions

For the purposes of this document, the terms and definitions given in ISO/IEC FDIS 23090-18 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

* ISO Online browsing platform: available at <https://www.iso.org/obp>
* IEC Electropedia: available at <http://www.electropedia.org>

Abbreviated terms

For the purposes of this International Standard, the following abbreviations apply:

|  |  |
| --- | --- |
| DASH | dynamic adaptive streaming over HTTP (specified in ISO/IEC 23009-1) |
| G-PCC | Geometry-based point cloud compression (specified in ISO/IEC 23090-9) |
| ISOBMFF | ISO base media file format (specified in ISO/IEC 14496-12) |

Reference software for ISO/IEC 23090-18

General

The source code for ISO/IEC 23090-18 reference software is available on MPEG’s GitLab server and is accessible to MPEG members via the following URL:

<http://mpegx.int-evry.fr/software/MPEG/Systems/PCC-SYS/23090-18-conformance>

All merge requests should be submitted to the repository on MPEG’s GitLab server after following the contribution guidelines from CONTRIBUTING.md file.

Overview

The G-PCC carriage reference software utilizes in the architecture the reference software for the ISOBMFF [libisomediafile](https://github.com/MPEGGroup/isobmff) [1][2], the reference software for G-PCC mpeg-pcc-tmc13 [3] and other miscellaneous supporting libraries. Figure 1 shows the simplified overview of the architecture for the reference software implementation. Boxes with a gray colored background are in the scope of the reference software implementation.

Diagram

Description automatically generated

Figure 1: Architecture overview

The reference software implementation consists of the G-PCC carriage library *libGPCCCarriage*, and the command line application with the name *GPCCCarriageApp*. While the library implements an API to parse and write data structures as defined in ISO/IEC 23090‑18, the command line application uses this API together with other helping libraries to implement actual multiplexing and demultiplexing functionality.

Feature support list

Table 1 summarizes a list of features specified in ISO/IEC 23090-18 and indicates which features are currently supported by the reference software.

Table 1: G-PCC Reference Software Feature Support List

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Feature** | **4CCs** | **Version** | **Status** |
| Common | GPCCConfigurationBox | gpcC | 0 | OK |
| GPCCComponentInfoBox | ginf | 0 | OK |
| TileInventoryInfoEntry | gtii | 0 | TBD |
| Single track | GPCCSampleEntry (single track) | gpe1 gpeg | 0 | OK |
| Multiplexer | N/A |  | TBD |
| Demultiplexer | N/A |  | TBD |
| Sub-samples | N/A |  | TBD |
| Multi track | GPCCSampleEntry (multiple tracks) | gpc1 gpcg | 0 | In pull request |
| Multiplexer | N/A |  | TBD |
| Demultiplexer | N/A |  | TBD |
| Sub-samples | N/A |  | TBD |
| track reference | gpca |  | TBD |
| Multi track with Tile tracks | GPCCSampleEntry (Tile-base track) | gpeb gpcb | 0 | TBD |
| GPCCTileSampleEntry | gpt1 | 0 | TBD |
| GPCCTileConfigurationBox | gptC |  | TBD |
| Multiplexer (tile base track and tile track) | N/A |  | TBD |
| Demultiplexer (tile base track and tile track) | N/A |  | TBD |
| Sub-samples (tile base track and tile track) | N/A |  | TBD |
| Track reference | gpbt |  | TBD |
| Non-timed | GPCCItemData | gpe1 gpc1 gpeb | 0 | TBD |
| GPCConfigurationProperty | gpcC | 0 | TBD |
| GPCCComponentInformationProperty | ginf | 0 | TBD |
| GPCCSpatialRegionInfoProperty | gpsr | 0 | TBD |
| GPCCTileItem | gpt1 | 0 | TBD |
| GPCCTileInfoProperty | gpti | 0 | TBD |
| Sub-sample item property | ??? |  | TBD |
| Entity group | ViewportAssociationBox | vpta |  | TBD |
| Partial access | Vector3 | N/A |  | OK |
| GPCCBoundingBoxStruct | N/A |  | OK |
| TileInfoStruct | N/A |  | TBD |
| GPCCSpatialRegionStruct | N/A |  | In pull request |
| GPCCSpatialRegionInfoBox | gpsr | 0 | In pull request |
| DynamicGPCCSpatialRegionSampleEntry | gpdr | 0 | In pull request |
| Static partial access multiplexer | N/A |  | TBD |
| Static partial access demultiplexer | N/A |  | TBD |
| Dynamic partial access multiplexer | N/A |  | TBD |
| Dynamic partial access demultiplexer | N/A |  | TBD |
| Viewport metadata | ExtCameraInfoStruct | N/A |  | OK |
| IntCameraInfoStruct | N/A |  | OK |
| ViewportInfoStruct | N/A |  | OK |
| GPCCViewportInfoConfigurationBox | gvpC | 0 | OK |
| DynamicGPCCViewportSampleEntry | gpdv | 0 | TBD |
| Static viewport multiplexer | N/A |  | TBD |
| Static viewport demultiplexer | N/A |  | TBD |
| Dynamic viewport multiplexer | N/A |  | TBD |
| Dynamic viewport demultiplexer | N/A |  | TBD |

GPCC carriage library API

General

This section contains documentation for the public exported API of the reference software. You are advised to use only the functions documented here. All function prototypes can be found in GPCCCarriage.h.

GPCCCreateBox

MP4Err GPCCCreateBox(u32 type, MP4AtomPtr \*pOut)

Create a GPCC Box of a given type. If type FOURCC is not recognized it will create an UnknownBox with the provided type.

Parameters

type FOURCC of the box

pOut output Box (if Box type is not supported return an unknown Box)

GPCCParseBox

MP4Err GPCCParseBox(MP4Handle inputHandle, MP4AtomPtr \*pOut)

Parse a handle with raw data into a GPCC Box

Parameters

inputHandle handle with raw data of the box

pOut output Box (if data is not recognized return an unknown Box)

GPCCParseUnknownBox

MP4Err GPCCParseUnknownBox(MP4AtomPtr inBox, MP4AtomPtr \*outBox)

Parse an unknown Box into a GPCC Box

Parameters

inBox input UnknownBox which can be obtained from the libisomedia API

pOut output Box (if data is not recognized return an unknown Box)

GPCCNewBitstreamSampleEntry

MP4Err GPCCNewBitstreamSampleEntry(MP4Track theTrack,  
 MP4VolumetricVisualSampleEntryAtomPtr \*sampleEntryPtr,  
 u32 inBandFlag,   
 u32 dataRefIdx)

Create a new GPCC bitstream track sample entry (single track)

Parameters

theTrack track to put the sample entry to

sampleEntryPtr output sample entry box

inBandFlag 0 - out of band 'gpe1', 1 - in band 'gpeg'

dataRefIdx sample entry data reference index

GPCCAddGPCCParameterSet

MP4Err GPCCAddGPCCParameterSet(  
 MP4VolumetricVisualSampleEntryAtomPtr sampleEntryPtr,  
 MP4Handle gpccParameterSetH,  
 u32 payloadType)

Add GPCC Parameter sets to Volumetric Visual SampleEntry

Parameters

sampleEntryPtr Volumetric Visual SampleEntry to add parameter sets to

gpccParameterSetH data to add

payloadType type of setup unit (TLV payload type)

GPCCGetGPCCParameterSet

MP4Err GPCCGetGPCCParameterSet(  
 MP4VolumetricVisualSampleEntryAtomPtr sampleEntryPtr,  
 MP4Handle ps,  
 u32 payloadType,  
 u32 index)

Get GPCC Parameter sets from SampleEntry

Parameters

sampleEntryPtr Volumetric Visual SampleEntry to get setup unit from

ps [out] handle which is holding the setup unit.

payloadType type of setup unit (TLV payload type)

index the index of the parameter set

Usage of GPCCCarriageApp

[Ed: Waiting on proponents of the technologies to provide implementation.]

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Each source code module in this document contains copyright disclaimer, which shall not be removed from the source code module.

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Conformance for ISO/IEC 23090-18

This clause describes the status of the conformance files.

[Ed:Waiting on proponents of the technologies to provide conformance files.]

Bibliography

[1] ISO/IEC 14496-32, Information technology — Coding of audio-visual objects — Part 32: File format reference software and conformance

[2] ISOBMFF reference software available at https://github.com/MPEGGroup/isobmff

[3] G-PCC Test Model 13 available at <https://mpeg.expert/software/MPEG/PCC/TM/mpeg-pcc-tmc13>

[4] ISO/IEC 23090-22, Information technology — Coded representation of immersive media — Part 22: Conformance for G-PCC