International Standard

ISO/IEC 23090-18

Information technology — Coded representation of immersive media —

Part 18: Carriage of geometry-based point cloud compression data

AMENDMENT 1: Support for temporal scalability

Technologies de l'information — Représentation codée de média immersifs —

Partie 18: Transport des données de compression des nuages de points basée sur la géométrie

AMENDEMENT 1: Prise en charge de l'échelonnabilité temporelle

First edition
2024-01

AMENDMENT 1
2024-09

Reference number
ISO/IEC 23090-18:2024/Amd. 1:2024(en)

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

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This document was prepared by Joint Technical Committee ISO/IEC JTC 1, *Information technology*, Subcommittee SC 29, *Coding of audio, picture, multimedia and hypermedia information*.

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Information technology — Coded representation of immersive media —

Part 18: Carriage of geometry-based point cloud compression data

AMENDMENT 1: Support for temporal scalability

Clause 3

Add the following terms:

3.12
temporal level track
volumetric visual track which carries a subset of point cloud frames in the G-PCC bitstream that constitute a temporal sub-sequence of the actual G-PCC bitstream

3.13
temporal level tile track
volumetric visual track which carries one or more G-PCC tiles of a subset of point cloud frames in the G-PCC bitstream that constitute a temporal sub-sequence of the actual G-PCC bitstream

7.2.1.2

Replace the content of the subclause with the following:

```
aligned(8) class GPCCDecoderConfigurationRecord {
   unsigned int(8)      configurationVersion = 1;
   unsigned int(2)      reserved = 0;
   unsigned int(1)      simple_profile_compliant;
   unsigned int(1)      dense_profile_compliant;
   unsigned int(1)      predictive_profile_compliant;
   unsigned int(1)      main_profile_compliant;
   unsigned int(18)     reserved_profile_18bits
   unsigned int(8)      level_idc;
   unsigned int(7)      num_setup_unit_arrays;
   unsigned int(1)      array_completeness;
   for (i=0; i<num_setup_unit_arrays; i++) {
      unsigned int(8)      setup_unit_type;
      unsigned int(8)      num_setup_units;
      for (j=0; j<num_setup_units; j++) {
         tlv_encapsulation   setup_unit;   //as defined in ISO/IEC 23090-9, Annex B
      }
   }
   // additional fields
}
```

7.2.1.3

Replace

— `numOfSetupUnits` specifies the number of following `setupUnit` present in the decoder configuration record.

— `setupUnit` contains one data unit carrying one of SPS, GPS, and APS as defined in ISO/IEC 23090-9.

with

— num_setup_unit_arrays indicates the number of arrays of setup units of the given type(s).

— array_completeness when equal to 1 indicates all parameter sets of all types are in the following array and none are in the stream; when equal to 0 indicates that parameter set(s) of one or more types may be in the stream; the default and permitted values are constrained by the sample entry type. When the sample entry type of the track is 'gpe1' or 'gpc1', the value of array_completeness shall be equal to 1.

— setup_unit_type indicates the type of G-PCC setup units as defined in Annex B of ISO/IEC 23090-9.

— num_setup_units specifies the number of following setup_unit present in the decoder configuration record.

— setup_unit contains one data unit carrying one of SPS, GPS, and APS as defined in ISO/IEC 23090-9.

7.2.5, 7.26 and 7.2.7

Add the following subclauses after 7.2.4.

7.2.5 G-PCC parameter set sample group

7.2.5.1 Definition

Group Types: 'gpsg'

Container: Sample Group Description Box ('sgpd')

Mandatory: No

Quantity: Zero or more

A G-PCC parameter set sample group entry contains the parameter set information for samples that mapped to it from SampleToGroupBox. Multiple SampleToGroupBox with grouping_type equal to 'gpsg' but with a different grouping_type_parameter may be present. When multiple instances of the SampleToGroupBox with grouping_type equal to 'gpsg' are present, the version of all the SampleToGroupBox boxes shall be set to 1.

A G-PCC parameter set sample group may be present in G-PCC tracks with track type 'gpcg', 'gpeg', 'gpcb' and 'gpeb'. A G-PCC parameter set sample group shall not be present in G-PCC tracks with track type 'gpc1', 'gpe1' and 'gpt1'.

A SampleToGroupBox with grouping_type equal to 'gpsg' with a particular grouping_type_parameter provides the mapping between samples with G-PCC parameter set sample group entries that contains all parameter sets of that particular type.

NOTE When a particular G-PCC parameter set sample group entry is referred to / mapped to a sample in a SampleToGroupBox with grouping_type equal to 'gpsg' with a particular grouping_type_parameter, the G-PCC parameter set sample group entry contains all the parameter sets of that particular type for decoding the sample while it can also contain other parameter sets as well.

Within a SampleToGroupBox with grouping_type equal to 'gpsg' with a particular grouping_type_parameter, a sample shall be mapped to group_description_index value 0 when one of the following case is satisfied:

— The sample contains parameter set of that particular type.

— The sample does not contain the parameter set of that type but other parameter sets are present in the sample entry.

For tracks with types 'gpeg', 'gpcb' and 'gpeb', if only one SampleToGroupBox with grouping_type equal to 'gpsg' is present in the track then grouping_type_parameter shall be set to zero. When a sample is mapped to a G-PCC parameter set sample group entry in a SampleToGroupBox with grouping_type equal to

'gpsg' and grouping_type_parameter equal to zero, the G-PCC parameter set sample group entry contains the information to all the required parameter sets for the sample.

Annex L describes how the file player supports the random access.

7.2.5.2 Syntax

```
aligned(8) class GPCCParameterSetInfoEntry()
      extends VolumetricVisualSampleGroupEntry ('gpsg') {
      unsigned int(1) gpcc_unit_offset_flag;
      unsigned int(7) num_parameter_sets_minus1;
      for(int i = 0; i <= num_parameter_sets_minus1; i++) {
            unsigned int(4) parameter_set_type;
            unsigned int(4) parameter_set_id;
            unsigned int(16)sample_offset;
            if(gpcc_unit_offset_flag)
                  unsigned int(8) gpcc_unit_offset;
      }
}
```

7.2.5.3 Semantics

gpcc_unit_offset_flag indicates whether the gpcc_unit offset information is present in the sample description entry or not.

num_parameter_sets_minus1 plus one indicates the number of parameter sets described in the sample description entry.

parameter_set_type indicates the type of the i-th parameter set as indicated in Table B.1 of ISO/IEC 23090-9. parameter_set_id indicates the identifier of parameter set carried in the indicated sample. In case of geometry parameter set, this value is equal to gps_geom_parameter_set_id present in the GPS. In case of attribute parameter set, this field value is equal to aps_attr_parameter_set_id present in the APS. In case of sequence parameter set, this field value is equal to sps_seq_parameter_set_id present in the SPS.

sample_offset specifies the sample offset from the immediately preceding sync sample where the indicated parameter set is contained. The value of sample_offset shall be equal to or greater than 0.

NOTE When sample_offset is equal to 0, the sample that contains the parameter set is the immediately preceding sync sample.

gpcc_unit_offset specifies that the i-th parameter set is the (gpcc_unit_offset + 1)-th GPCC unit in the sample that contains the parameter set. The value of gpcc_unit_offset shall be equal to or greater than 0.

NOTE When gpcc_unit_offset is equal to 0, the parameter set is the 1st GPCC unit in the sample that contains the parameter set.

7.2.6 Sub-frame timing sample group

7.2.6.1 Definition

This sample group provides sub-frame timing information which indicates a time offset to the composition time of the G-PCC sample containing the sub-frame. When the track containing this sample group has no CompositionOffsetBox, the composition time of the G-PCC sample corresponds to the decoding time of this sample. The composition times for G-PCC sub-frames contained in a G-PCC sample is derived after the composition time of the containing G-PCC sample is resolved.

— When the difference between sub-frame time offsets is constant (constant_time_offset_delta equals 1) for a group of G-PCC samples, the time offset of the i-th G-PCC sub-frame in a sample is equal to subframe_time_offset_delta * *i* and the composition timestamp of the i-th G-PCC sub-frame in a sample is computed as CTS[i] = CT + subframe_time_offset_delta * i, where CT is the composition time of the sample containing the G-PCC sub-frame and i is varying from 0 to subframe_count – 1, included.

— When the difference between sub-frame time offsets is not constant (`constant_time_offset_delta` equals 0) for a group of G-PCC samples, the time offset of the i-th G-PCC sub-frame in a sample is equal to `subframe_time_offset[i]` and the composition timestamp of the i-th G-PCC sub-frame in a sample is computed as `CTS[i] = CT + subframe_time_offset[i]`, where `CT` is the composition time of the sample containing the sub-frame and `i` is varying from 0 to `subframe_count - 1`, included.

The loop on `subframe_time_offset[i]` is implicitly ordered in the order of sub-frames present in the samples mapped to this entry with increasing frame index or frame number attribute values.

When a G-PCC bitstream contains sub-frames, i.e. frame number or frame index attribute, the following constraints are applied:

— For single track encapsulation, when the G-PCC bitstream is carried using G-PCC tracks with `'gpe1'` or `'gpeg'` sample entry type, the subframe timing sample group may be present in the G-PCC track.

— For multi-track encapsulation, when the G-PCC bitstream is carried in multiple G-PCC tracks with `'gpc1'` or `'gpcg'` sample entry type, the subframe timing sample group may be present only in the G-PCC attribute track carrying the frame number or frame index attribute data units. The subframe timing sample group shall not be present in G-PCC geometry track or G-PCC attribute track which does not carry the frame number or frame index attribute data units.

— For encapsulation with G-PCC tile tracks, the sub-frame timing sample group may be present only in the G-PCC tile track (`'gpt1'`) carrying all components or in G-PCC attribute tile track carrying the frame number or frame index attribute data units. The subframe timing sample group shall not be present in a tile base track. The subframe timing sample group shall not be present in the following G-PCC tile tracks:

  — G-PCC tile track carrying all components which are not comprised of the frame number or frame index attribute data units;

  — G-PCC geometry tile track;

  — G-PCC attribute tile track which are not comprised of frame number or frame index attribute data units.

— The sub-frame timing sample group may be present in temporal level tracks or temporal level tile tracks with the same constraints as for single track or multi-track encapsulations described in this clause.

NOTE The sub-frame timing sample group, when present, allows file readers to access to precise timing information (e.g. corresponding to a capture time by a 3D sensor). When the G-PCC bitstream contains the frame number attribute data units potentially leading to sub-frame reordering across samples, the subframe timing sample group can be present in the appropriate G-PCC tracks to help file readers in reordering the sub-frames.

7.2.6.2 Syntax

```
aligned(8) class SubFrameTimingGroupEntry()
      extends VolumetricVisualSampleGroupEntry ('sfcf') {
      unsigned int (1)  constant_time_offset_delta;
      unsigned int (7)  reserved = 0;
      unsigned int(32)  subframe_count;
      if (constant_time_offset_delta == 1) {
            unsigned int(32) subframe_time_offset_delta;
      }
      else {
            for (int i=0; i < subframe_count; i++) {
                  signed int(32) subframe_time_offset[i];
            }
      }
}
```

7.2.6.3 Semantics

`constant_time_offset_delta` indicates whether all G-PCC sub-frames contained in the G-PCC samples mapped to this entry have a constant time offset delta with the previous G-PCC sub-frame in the increasing order of their frame index or frame number attribute values. Value 1 indicates that the time offset delta is constant.

`subframe_count` is an unsigned integer that counts the number of G-PCC sub-frames in the G-PCC samples mapped to this entry. The value 0 is reserved.

`subframe_time_offset_delta` is an unsigned integer that gives the difference, in the timescale of the media, between composition timestamps of two successive G-PCC sub-frames present in a G-PCC sample mapped to this entry.

`subframe_time_offset[i]` is a signed integer that indicates the time offset of the i-th G-PCC sub-frame present in the G-PCC samples mapped to this entry, in the timescale of the media. This time offset is relative to the composition timestamp of the sample containing the sub-frame.

7.2.7 TLV sample group

7.2.7.1 Definition

Group Types: `'tlvs'`

Container: Sample Group Description Box (`'sgpd'`)

Mandatory: No

Quantity: Zero or more

The use of `'tlvs'` for the `grouping_type` in sample grouping indicates the number of slices and the number of TLVs per slice of the samples associated with this sample group. When a `SampleGroupDescriptionBox` with `grouping_type` equal to `'tlvs'` is present, an accompanying `SampleToGroupBox` with the same grouping type may be present (when default sample grouping cannot apply). The `grouping_type_parameter` in this `SampleToGroupBox` is undefined.

The `'tlvs'` sample group may be present in `'gpc1'` or `'gpcg'` or `'gpt1'` geometry tracks referenced by a `'gpcb'` tile base track. The `'tlvs'` sample group shall not be present in `'gpc1'` or `'gpcg'` attribute tracks, `'gpe1'`, `'gpeg'`, `'gpeb'`, `'gpcb'`, or `'gpt1'` track carrying DUs of all components.

Annex M describes how a G-PCC frame is reconstructed from multiple tracks. The reconstruction process is applied to the following cases containing more than one slice:

— one geometry track and its associated attribute tracks;

— each set of geometry tile track and its associated attribute tile tracks;

— when temporal scalability is in use:

  — each set of geometry temporal level track and its associated attribute temporal level tracks;

  — each set of geometry temporal tile track and its associated attribute temporal tile tracks.

7.2.7.2 Syntax

```
aligned(8) class GPCC_TLVToSliceGroupEntry() extends
VolumetricVisualSampleGroupEntry ('tlvs')
{
      unsigned int nb_referenced_tracks;
      unsigned int (16) num_slices;
      for (int I = 0; i < num_slices; i++){
       unsigned int (8) num_tlvs[1 + nb_referenced_tracks]
      }
}
```

7.2.7.3 Semantics

`nb_referenced_tracks` is equal to the number of tracks referenced by the `'gpca'` track references from the geometry track containing this sample group to attribute tracks.

`num_slices` indicates the number of slices present in the samples associated with this sample group.

`num_tlvs` is an array of integers providing the number of consecutive TLV units of the geometry track containing this sample group and the referenced tracks of a given slice in the samples associated with this sample group.-The array is ordered starting by the number of TLV units for the geometry track containing this sample group, followed by the number of TLV units for each attribute track referenced by the `'gpca'` track reference, in the order of tracks within the track reference.

7.6

Add the following subclause after 7.5.

7.6 Sync sample box

Sync`SampleBox` may be present in the following tracks:

— Track with sample entry type `'gpeg'`

— Track with sample entry type `'gpcg'`

— Track with sample entry type `'gpeb'` or`'gpcb'`

NOTE `SyncSampleBox` is not present in track with sample entry type `'gpe1'` and in track with sample entry type `'gpc1'` since all samples have intra coded frame and all parameter sets are carried in the sample entry.

NOTE `SyncSampleBox` is not present in the tile base track when all parameter sets that are needed to decode any samples in the associated tile tracks are carried in the tile base track sample entry.

A sync sample with sample entry type '`gpcg`' and '`gpcg`' shall satisfy all the following conditions:

— It shall be independently decodable.

— None of the samples that come after the sync sample (in decoding order) have any decoding dependency on any sample prior to the sync sample.

— All samples that come after the sync sample (in decoding order) and until the next sync samples are successfully decodable.

— The parameter set(s) required to decode the sample shall be included either in the sample itself or in the sample entry.

When it is present in the track with sample entry type '`gpcg`', `SyncSampleBox` shall be present in the geometry track and the associated attribute tracks. The sync samples in the geometry track and its associated attribute tracks that are indicated in `SyncSampleBox` shall be aligned.

When it is present in the track with sample entry type '`gpeb`' or '`gpcb`', the following applies:

a) If the sample is a sync sample, all parameter sets needed for decoding the associated G-PCC tile track samples shall be included either in the sample entry or in the sample itself.

b) Otherwise (the sample is not a sync sample), all parameter sets needed for decoding the associated G-PCC tile track samples shall be included either in the sample entry or in any of the samples since the previous sync sample to the sample itself, inclusive.

When both `SyncSampleBox` and G-PCC parameter sets sample group are not present in a track with sample entry type '`gpeg`', `gpcg`', '`gpeb`' or'`gpcb`', the method to perform random access playback is not specified.

When temporal scalability is supported and the G-PCC bitstream is stored in multiple temporal level tracks, `SyncSampleBox` may be present in all the tracks.

9.2.3.1

Replace the last paragraph with:

Static viewport information is signalled in `GPCCViewportInfoConfigutationBox` present in the sample entry of one of G-PCC bitstream track, G-PCC geometry track, or G-PCC tile base track. `GPCCViewportInfoConfigutationBox` shall not be present in any G-PCC attribute tracks and G-PCC tile tracks.

When `GPCCViewportInfoConfigutationBox` present in the sample entry of one of G-PCC bitstream track, G-PCC geometry track, or G-PCC tile base track, both of `dynamic_int_camera_flag` and `dynamic_ext_camera_flag` shall be set to 0.

9.2.4.2

Add the following:

Both of `dynamic_int_camera_flag` and `dynamic_ext_camera_flag` in `GPCCViewportInfoConfigutationBox` shall not be set to 0.

9.2.4.3.3

Replace the content of the subclause with:

— `num_viewports` indicate the number of viewports signalled in the sample.

— `viewport_id` is an identifier that is used to identify the viewport.

— When `viewport_cancel_flag` is equals to 1, it indicates that the viewport with the `viewport_id` is cancelled. When `viewport_cancel_flag` is equals to 0, it indicates that either camera extrinsic information structure or camera intrinsic information structure shall be present in the current sample.

— When `camera_ext_flag` is equal to 1, it indicates that the extrinsic camera information structure of this viewport is present in the current sample. It shall be equal to 0 when `dynamic_ext_camera_flag` in the sample entry is equal to 0.

— When `camera_int_flag` equal to 1 indicates that the intrinsic camera information structure of this viewport is present in the current sample. It shall be equal to 0 when `dynamic_int_camera_flag` in the sample entry is equal to 0.

Clause 12

Add the following new clause after Clause 11.

12 Temporal scalability support

12.1 General

A G-PCC temporal level is a subset of the point cloud frames that constitute a temporal sub-sequence of the actual G-PCC bitstream. Each point cloud frame may be associated with a particular temporal level. Each temporal level is identified by a unique temporal level identifier with the first temporal level having the id 0.

A G-PCC bitstream may be carried/stored in one or more temporal level tracks. Necessary information to describe the temporal level tracks and the mapping between a sample and its temporal level may be available in the file. A G-PCC sample belonging to a certain temporal level shall not have any decoding dependency