**INTERNATIONAL ORGANISATION FOR STANDARDISATION**

**ORGANISATION INTERNATIONALE DE NORMALISATION**

**ISO/IEC JTC 1/SC 29/WG 04**

**MPEG VIDEO CODING**

**ISO/IEC JTC 1/SC 29/WG 04 m57960**

**October 2021, Online**

**Title: InterDigital MIV conformance bitstreams**

**Source: Franck Thudor (InterDigital), Renaud Doré (InterDigital), Bertrand Chupeau (InterDigital)**

**Abstract**

As specified in [N0117], some conformance bitstreams should be made available to help newcomers to implement MIV decoders that meet the normative requirements specified in ISO/IEC 23090-12. The present contribution gives some conformance bitstreams (CB06, CB09, CB14, CB19). For each, the features exercised by the bitstream are listed, TMIV version and parameters for their creation are presented, and output logs are given.

# Introduction

Table 1 summarizes the conformance bitstreams that are presented in this contribution. This table is an excerpt of the full list presented in [m57442]. To generate such conformance bitstreams, the procedure presented in [N0117] is followed. Hence, for each proposed bitstream there will be an attached file containing:

* a *.bit* bitstream,
* a *.txt* file with some explanations on the bitstream,
* a *.dec* output log,
* a *.hls* human readable parsed metadata,
* and a *.csv* bitrate report.

|  |  |  |
| --- | --- | --- |
| Conformance bitstream ID | Features tested | Proponent (contact person) |
| CB06 | Constant depth patches (in all atlases, enabled in one atlas and disabled in another atlas) | InterDigital |
| CB09 | Ancillary atlas | InterDigital |
| CB14 | Pruning graph (with different graph than in the CTC, no pruning graph) | InterDigital |
| CB19 | Restricted (indexed) geometry (MPI) | InterDigital |

Table 1 : conformance bitstreams studied in this document

TMIV version which is selected for creating the conformance bitstreams is

* branch=main,
* commit=[3e6a2ae9](http://mpegx.int-evry.fr/software/MPEG/MIV/RS/TM1/-/commit/3e6a2ae9dd7f16134704d746d81e89cc18ba683c) (on 2021, Sept 13th), i.e. the commit that corrected the “patch parameters list hash fails” [issue](http://mpegx.int-evry.fr/software/MPEG/MIV/RS/TM1/-/issues/594), 6 commits after v10.1 tag has been released.

If additional code modification is needed to construct a specific bitstream, this will be explained in the bitstream section.

When applicable, images of atlas or rendered views will show the effect of parameters. It is also mentioned when a bitstream is renderable.

# CB06 : constant depth patches

## Objective

Propose some reference bitstreams with/without constant depth patches in atlases. Three bitstreams are provided:

* CB06\_none : no constant depth patches
* CB06\_only\_one: one atlas contains constant depth patches
* CB06\_both: two atlases contain constant depth patches

List of features of ISO/IEC 23090-12 that are specifically exercised by those bitstreams:

* asme\_patch\_constant\_depth\_flag (true or false)

## Parameters

Each bitstream contains 2 texture atlases, 2 geometry atlases and associated metadata for TMIV decoding and rendering. Parameters used for the generation are:

* Sequence C (Hijack), modified with only 3 input views at encoder side
* Using configuration files in *config/ctc/miv\_anchor* with modification (\*\*)
* Number of frames = 3
* Intraperiod = 2
* TMIV 10.1 (commit 3e6a2ae9) (\*)
* VVenC 0.3.1.0 (comes with TMIV)
* Visual Studio 16.4.4

(\*) To get the bitstream with no constant depth patches, apply the provided patch “*none.patch*”. To get the bitstream with only one atlas with constant depth patch, apply the provided patch “*onlyOne.patch*” to TMIV code. To get the bitstream with both atlases with constant depth patch, apply the provided patch “*both.patch*” to TMIV code.

(\*\*) Modifications were brought to have a first atlas containing only the basic view v0, and a second atlas containing patches from pruned views v1 and v2. These modifications are part of each softwaree patch.

The same list of commands is run for CB06\_none, CB06\_ only\_one and CB06\_both.

Each generated bitstream is called TMIV\_A3\_C\_QP3.bit and is renderable. Size of the bitstream is:

* CB06\_none : 137 657 bytes
* CB06\_only\_one : 137 657 bytes
* CB06\_both : 137 657 bytes

## Commands

### TMIV encoding

..\msvc\bin\Encoder.exe -c .\config\ctc\miv\_anchor\A\_1\_TMIV\_encode.json -p configDirectory .\config\ -p inputDirectory E:\MPEG\_3DoFplus\_Content\ -p outputDirectory ..\..\OUTPUT\msvc\ -s C -n 3 -f 0 -p intraPeriod 2 -p depthLowQualityFlag false -p maxLumaPictureSize 8388608

### Video encoding

..\msvc\bin\vvencFFapp.exe -c .\config\ctc\miv\_anchor\A\_2\_VVenC\_encode\_tex.cfg -i ..\..\OUTPUT\msvc\A3\C\TMIV\_A3\_C\_tex\_c00\_4096x2048\_yuv420p10le.yuv -b ..\..\OUTPUT\msvc\A3\C\QP3\TMIV\_A3\_C\_QP3\_tex\_c00.bit -s 4096x2048 -q 38 -f 3 -fr 30

..\msvc\bin\vvencFFapp.exe -c .\config\ctc\miv\_anchor\A\_2\_VVenC\_encode\_tex.cfg -i ..\..\OUTPUT\msvc\A3\C\TMIV\_A3\_C\_tex\_c01\_4096x2048\_yuv420p10le.yuv -b ..\..\OUTPUT\msvc\A3\C\QP3\TMIV\_A3\_C\_QP3\_tex\_c01.bit -s 4096x2048 -q 38 -f 3 -fr 30

..\msvc\bin\vvencFFapp.exe -c .\config\ctc\miv\_anchor\A\_2\_VVenC\_encode\_geo.cfg -i ..\..\OUTPUT\msvc\A3\C\TMIV\_A3\_C\_geo\_c00\_2048x1024\_yuv420p10le.yuv -b ..\..\OUTPUT\msvc\A3\C\QP3\TMIV\_A3\_C\_QP3\_geo\_c00.bit -s 2048x1024 -q 16 -f 3 -fr 30

..\msvc\bin\vvencFFapp.exe -c .\config\ctc\miv\_anchor\A\_2\_VVenC\_encode\_geo.cfg -i ..\..\OUTPUT\msvc\A3\C\TMIV\_A3\_C\_geo\_c01\_2048x1024\_yuv420p10le.yuv -b ..\..\OUTPUT\msvc\A3\C\QP3\TMIV\_A3\_C\_QP3\_geo\_c01.bit -s 2048x1024 -q 16 -f 3 -fr 30

### TMIV multiplexing

..\msvc\bin\Multiplexer.exe -c .\config\ctc\miv\_anchor\A\_3\_TMIV\_mux.json -p configDirectory .\config\ -p inputDirectory ..\..\OUTPUT\msvc\ -p outputDirectory ..\..\OUTPUT\msvc\ -s C -n 3 -r QP3

### TMIV parsing

..\msvc\bin\Parser.exe -b ..\..\OUTPUT\msvc\A3\C\QP3\TMIV\_A3\_C\_QP3.bit -o ..\..\OUTPUT\msvc\A3\C\QP3\TMIV\_A3\_C\_QP3.hls

### TMIV bitrate reporting

..\msvc\bin\BitrateReport.exe -b ..\..\OUTPUT\msvc\A3\C\QP3\TMIV\_A3\_C\_QP3.bit > ..\..\OUTPUT\msvc\A3\C\QP3\TMIV\_A3\_C\_QP3.csv

### TMIV decoding

..\msvc\bin\Decoder.exe -c .\config\ctc\miv\_anchor\A\_4\_TMIV\_decode.json -p configDirectory .\config\ -p inputDirectory ..\..\OUTPUT\msvc\ -p outputDirectory ..\..\OUTPUT\msvc\ -n 3 -N 3 -s C -r QP3 -v v3 -p outputLogPath ..\..\OUTPUT\msvc\A3\C\QP3\TMIV\_A3\_C\_QP3.dec

## Output log

Here is the resulting output log for each bitstream (see [N0117] for definition of fields).

CB06\_none:

0 0 4096 2048 9cc96c86 7ee8cdcd ef2a1b2d facd35a7

0 1 4096 2048 02630ddf 2f70a6a2 d4493c4f facd35a7

1 0 4096 2048 d6338971 7ee8cdcd ef2a1b2d facd35a7

1 1 4096 2048 57e968c3 2f70a6a2 d4493c4f facd35a7

2 0 4096 2048 1431ac48 7ee8cdcd ef2a1b2d 3e380462

2 1 4096 2048 18bf35a4 1f49eefc de049d66 3e380462

CB06\_only\_one:

0 0 4096 2048 9cc96c86 7ee8cdcd ef2a1b2d facd35a7

0 1 4096 2048 02630ddf 2f70a6a2 d4493c4f facd35a7

1 0 4096 2048 d6338971 7ee8cdcd ef2a1b2d facd35a7

1 1 4096 2048 57e968c3 2f70a6a2 d4493c4f facd35a7

2 0 4096 2048 1431ac48 7ee8cdcd ef2a1b2d 3e380462

2 1 4096 2048 18bf35a4 1f49eefc de049d66 3e380462

CB06\_both:

0 0 4096 2048 9cc96c86 7ee8cdcd ef2a1b2d facd35a7

0 1 4096 2048 02630ddf 2f70a6a2 d4493c4f facd35a7

1 0 4096 2048 d6338971 7ee8cdcd ef2a1b2d facd35a7

1 1 4096 2048 57e968c3 2f70a6a2 d4493c4f facd35a7

2 0 4096 2048 1431ac48 7ee8cdcd ef2a1b2d 3e380462

2 1 4096 2048 18bf35a4 1f49eefc de049d66 3e380462

The following images illustrate the effect of the constant depth patches at decoder side. It should be noted that the constant depth information has not been written in accordance with the scene at encoder side (default value for each constant depth patch), hence reprojection of these patches are not correct.

A group of people in a room

Description automatically generated with medium confidence

A group of people in a room

Description automatically generated with medium confidence

A group of people walking in a room

Description automatically generated with low confidence

Figure 1: v3 synthesized view for CB06\_none (top), CB06\_only\_one (middle) and CB06\_both (bottom).

# CB09 : ancillary atlas

## Objective

Propose a reference bitstream with ancillary atlas. For comparison purpose, two bitstreams are provided:

* CB09\_ori : without any ancillary atlas
* CB09\_ancillary: second atlas only is an ancillary atlas.

List of features of ISO/IEC 23090-12 that are specifically exercised by those bitstreams:

* asme\_ancillary\_atlas\_flag (true or false)

## Parameters

Each bitstream contains 2 texture atlases, 2 geometry atlases and associated metadata for TMIV decoding and rendering. Parameters used for the generation are:

* Sequence D (Painter)
* Using configuration files in *config/ctc/miv\_view\_anchor*
* Number of frames = 5
* Intraperiod = 2
* TMIV 10.1 (commit 3e6a2ae9) (\*)
* VVenC 0.3.1.0 (comes with TMIV)
* Visual Studio 16.4.4

(\*) To get the bitstream with modified ancillary atlas, apply the provided patch “*ancillary\_atlas.patch*” to TMIV code.

Each generated bitstream is TMIV\_V5\_D\_QP4.bit and is renderable. Size of each bitstream is:

* CB09\_ori: 255 045 bytes
* CB09\_modif: 255 045 bytes

## Commands

### TMIV encoding

..\msvc\bin\Encoder.exe -c .\config\ctc\miv\_view\_anchor\V\_1\_TMIV\_encode.json -p configDirectory .\config\ -p inputDirectory E:\MPEG\_3DoFplus\_Content\ -p outputDirectory ..\..\OUTPUT\msvc\ -s D -n 5 -f 50 -p intraPeriod 2

### Video encoding

..\msvc\bin\vvencFFapp.exe -c .\config\ctc\miv\_view\_anchor\V\_2\_VVenC\_encode\_tex.cfg -i ..\..\OUTPUT\msvc\V5\D\TMIV\_V5\_D\_tex\_c00\_2048x4352\_yuv420p10le.yuv -b ..\..\OUTPUT\msvc\V5\D\QP4\TMIV\_V5\_D\_QP4\_tex\_c00.bit -s 2048x4352 -q 42 -f 5 -fr 30

..\msvc\bin\vvencFFapp.exe -c .\config\ctc\miv\_view\_anchor\V\_2\_VVenC\_encode\_tex.cfg -i ..\..\OUTPUT\msvc\V5\D\TMIV\_V5\_D\_tex\_c01\_2048x4352\_yuv420p10le.yuv -b ..\..\OUTPUT\msvc\V5\D\QP4\TMIV\_V5\_D\_QP4\_tex\_c01.bit -s 2048x4352 -q 42 -f 5 -fr 30

..\msvc\bin\vvencFFapp.exe -c .\config\ctc\miv\_view\_anchor\V\_2\_VVenC\_encode\_geo.cfg -i ..\..\OUTPUT\msvc\V5\D\TMIV\_V5\_D\_geo\_c00\_1024x2176\_yuv420p10le.yuv -b ..\..\OUTPUT\msvc\V5\D\QP4\TMIV\_V5\_D\_QP4\_geo\_c00.bit -s 1024x2176 -q 19 -f 5 -fr 30

..\msvc\bin\vvencFFapp.exe -c .\config\ctc\miv\_view\_anchor\V\_2\_VVenC\_encode\_geo.cfg -i ..\..\OUTPUT\msvc\V5\D\TMIV\_V5\_D\_geo\_c01\_1024x2176\_yuv420p10le.yuv -b ..\..\OUTPUT\msvc\V5\D\QP4\TMIV\_V5\_D\_QP4\_geo\_c01.bit -s 1024x2176 -q 19 -f 5 -fr 30

### TMIV multiplexing

..\msvc\bin\Multiplexer.exe -c .\config\ctc\miv\_view\_anchor\V\_3\_TMIV\_mux.json -p configDirectory .\config\ -p inputDirectory ..\..\OUTPUT\msvc\ -p outputDirectory ..\..\OUTPUT\msvc\ -s D -n 5 -r QP4

### TMIV parsing

..\msvc\bin\Parser.exe -b ..\..\OUTPUT\msvc\V5\D\QP4\TMIV\_V5\_D\_QP4.bit -o ..\..\OUTPUT\msvc\V5\D\QP4\TMIV\_V5\_D\_QP4.hls

### TMIV bitrate reporting

..\msvc\bin\BitrateReport.exe -b ..\..\OUTPUT\msvc\V5\D\QP4\TMIV\_V5\_D\_QP4.bit > ..\..\OUTPUT\msvc\V5\D\QP4\TMIV\_V5\_D\_QP4.csv

### TMIV decoding

..\msvc\bin\Decoder.exe -c .\config\ctc\miv\_view\_anchor\V\_4\_TMIV\_decode.json -p configDirectory .\config\ -p inputDirectory ..\..\OUTPUT\msvc\ -p outputDirectory ..\..\OUTPUT\msvc\ -n 5 -N 5 -s D -r QP4 -v v5 -p outputLogPath ..\..\OUTPUT\msvc\V5\D\QP4\TMIV\_V5\_D\_QP4.dec

## Output log

Here is the resulting output log for each bitstream (see [N0117] for definition of fields).

CB09\_ori:

0 0 2048 4352 1f149171 dd774f37 a70e141c f6f7270f

0 1 2048 4352 2739d99c dd774f37 5d2a3786 f6f7270f

1 0 2048 4352 47143756 dd774f37 a70e141c f6f7270f

1 1 2048 4352 e8fa9b53 dd774f37 5d2a3786 f6f7270f

2 0 2048 4352 588f56c1 dd774f37 a70e141c c01fd6e7

2 1 2048 4352 7a8c4909 dd774f37 5d2a3786 c01fd6e7

3 0 2048 4352 5f62b209 dd774f37 a70e141c c01fd6e7

3 1 2048 4352 36d7ea39 dd774f37 5d2a3786 c01fd6e7

4 0 2048 4352 2050c472 dd774f37 a70e141c 557b311d

4 1 2048 4352 12114106 dd774f37 5d2a3786 557b311d

CB09\_ancillary:

0 0 2048 4352 1f149171 dd774f37 a70e141c f6f7270f

0 1 2048 4352 2739d99c dd774f37 5d2a3786 f6f7270f

1 0 2048 4352 47143756 dd774f37 a70e141c f6f7270f

1 1 2048 4352 e8fa9b53 dd774f37 5d2a3786 f6f7270f

2 0 2048 4352 588f56c1 dd774f37 a70e141c c01fd6e7

2 1 2048 4352 7a8c4909 dd774f37 5d2a3786 c01fd6e7

3 0 2048 4352 5f62b209 dd774f37 a70e141c c01fd6e7

3 1 2048 4352 36d7ea39 dd774f37 5d2a3786 c01fd6e7

4 0 2048 4352 2050c472 dd774f37 a70e141c 557b311d

4 1 2048 4352 12114106 dd774f37 5d2a3786 557b311d

# CB14 : pruning graph

## Objective

Propose some reference bitstreams with different pruning graph. Three bitstreams are provided:

* CB14\_ori : original pruning graph
* CB14\_modif : modified pruning graph
* CB14\_no : no pruning graph

List of features of ISO/IEC 23090-12 that are specifically exercised by those bitstreams:

* mvp\_pruning\_graph\_params\_present\_flag (true or false)
* pp\_parent\_idx (different values)

## Parameters

Each bitstream contains 2 texture atlases, 2 geometry atlases and associated metadata for TMIV decoding and rendering. Parameters used for the generation are:

* Sequence E (Frog) downscaled
* Using the .json file in *config/test/sequences*
* Using configuration files in *config/ctc/miv\_anchor*
* Running the script *scripts/test/integration\_test.py* to get the list of commands (\*)
* Number of frames = 3
* Intraperiod = 2
* TMIV 10.1 (commit 3e6a2ae9) (\*\*)
* VVenC 0.3.1.0 (comes with TMIV)
* Visual Studio 16.4.4

(\*) The same list of commands is run for CB14\_ori, CB14\_modif and CB14\_no (cf. section 4.3).

(\*\*) To get the bitstream with modified pruning graph, apply the provided patch “*modified\_pruning\_graph.patch*” to TMIV code. To get bitstream with no pruning graph, apply the provided patch “*no\_pruning\_graph.patch*” to TMIV code.

Each generated bitstream is called TMIV\_A3\_E\_QP3.bit and is renderable. Size of the bitstream is:

* CB14\_ori : 68 668 bytes
* CB14\_modif: 67 180 bytes
* CB14\_no : 92 941 bytes

## Commands

To generate the bitstream and to get the log output at decoder, *integration\_test.py* script is run:

python.exe .\scripts\test\integration\_test.py ..\msvc\ .\ E:\DATA\_DOWNSCALED\ ..\..\OUTPUT\msvc\integration\_test\

The commands below are a direct recopy of the commands that are launched when running this script:

{0} = C:\dev\TMIV\_10.1\_hash\_corrected\TM1\msvc

{1} = C:\dev\TMIV\_10.1\_hash\_corrected\TM1\src

{2} = E:\DATA\_DOWNSCALED

{3} = C:\dev\TMIV\_10.1\_hash\_corrected\OUTPUT\msvc\integration\_test

+ {0}/bin/Encoder -c {1}/config/ctc/miv\_anchor/A\_1\_TMIV\_encode.json -p configDirectory {1}/config -p inputDirectory {2} -p outputDirectory {3} -n 3 -s E -p intraPeriod 2 -p inputSequenceConfigPathFmt test/sequences/T{{1}}.json -p maxLumaPictureSize 1048576 -f 0

+ {0}/bin/vvencFFapp -c {1}/config/ctc/miv\_anchor/A\_2\_VVenC\_encode\_geo.cfg -i {3}/A3/E/TMIV\_A3\_E\_geo\_c01\_512x512\_yuv420p10le.yuv -b {3}/A3/E/QP3/TMIV\_A3\_E\_QP3\_geo\_c01.bit -s 512x512 -q 20 -f 3 -fr 30

+ {0}/bin/vvencFFapp -c {1}/config/ctc/miv\_anchor/A\_2\_VVenC\_encode\_geo.cfg -i {3}/A3/E/TMIV\_A3\_E\_geo\_c00\_512x512\_yuv420p10le.yuv -b {3}/A3/E/QP3/TMIV\_A3\_E\_QP3\_geo\_c00.bit -s 512x512 -q 20 -f 3 -fr 30

+ {0}/bin/vvencFFapp -c {1}/config/ctc/miv\_anchor/A\_2\_VVenC\_encode\_tex.cfg -i {3}/A3/E/TMIV\_A3\_E\_tex\_c01\_1024x1024\_yuv420p10le.yuv -b {3}/A3/E/QP3/TMIV\_A3\_E\_QP3\_tex\_c01.bit -s 1024x1024 -q 43 -f 3 -fr 30

+ {0}/bin/vvencFFapp -c {1}/config/ctc/miv\_anchor/A\_2\_VVenC\_encode\_tex.cfg -i {3}/A3/E/TMIV\_A3\_E\_tex\_c00\_1024x1024\_yuv420p10le.yuv -b {3}/A3/E/QP3/TMIV\_A3\_E\_QP3\_tex\_c00.bit -s 1024x1024 -q 43 -f 3 -fr 30

+ {0}/bin/Multiplexer -c {1}/config/test/miv\_anchor/A\_3\_TMIV\_mux.json -p inputDirectory {3} -p outputDirectory {3} -n 3 -s E -r QP3

+ {0}/bin/Decoder -c {1}/config/ctc/miv\_anchor/A\_4\_TMIV\_decode.json -p configDirectory {1}/config -p inputDirectory {3} -p outputDirectory {3} -n 3 -N 3 -s E -r QP3 -v v11 -p outputLogPath {3}/A3/E/QP3/TMIV\_A3\_E\_QP3.dec -p inputViewportParamsPathFmt test/sequences/T{{1}}.json

+ {0}/bin/BitrateReport -b {3}/A3/E/QP3/TMIV\_A3\_E\_QP3.bit

+ {0}/bin/Parser -b {3}/A3/E/QP3/TMIV\_A3\_E\_QP3.bit -o {3}/A3/E/QP3/TMIV\_A3\_E\_QP3.hls

## Output log

Here is the resulting output log for each bitstream (see [N0117] for definition of fields).

CB14\_ori:

0 0 1024 1024 ce3b7b34 b4d473f8 8ebb64f8 ec1b6ee1

0 1 1024 1024 bfef949b 0ba8e5c2 edd2704c ec1b6ee1

1 0 1024 1024 6ca97658 b4d473f8 8ebb64f8 ec1b6ee1

1 1 1024 1024 291c30ab 0ba8e5c2 edd2704c ec1b6ee1

2 0 1024 1024 c4596187 2764970a cd7b7e75 88cf6fe7

2 1 1024 1024 35c34d35 0ba8e5c2 619379cc 88cf6fe7

CB14\_modif:

0 0 1024 1024 22ace1fe 08391dd4 6f7879ce ec1b6ee1

0 1 1024 1024 aa6847cd 0ba8e5c2 caa2a579 ec1b6ee1

1 0 1024 1024 f689bdcc 08391dd4 6f7879ce ec1b6ee1

1 1 1024 1024 a8690bed 0ba8e5c2 caa2a579 ec1b6ee1

2 0 1024 1024 1d91013d 731bf0a9 19099679 88cf6fe7

2 1 1024 1024 988ce287 0ba8e5c2 619379cc 88cf6fe7

CB14\_no

0 0 1024 1024 aae76dde ba6ad18a 22a1b053 ec1b6ee1

0 1 1024 1024 ae893586 93409167 090369bc ec1b6ee1

1 0 1024 1024 7c33c878 ba6ad18a 22a1b053 ec1b6ee1

1 1 1024 1024 dacea907 93409167 090369bc ec1b6ee1

2 0 1024 1024 ed4b39bb ba6ad18a 6ab45093 88cf6fe7

2 1 1024 1024 0ca554f7 93409167 d550f89b 88cf6fe7

The pruning graph for CB14\_ori bitstream is

( v10 v12 v13 ) <- v9 <- v11

( v6 v8 ) <- v5 <- v7 <- s0

( v1 v2 v4 ) <- v3

the pruning graph for CB14\_modif bitstream is

( v1 v2 v4 v6 v8 v10 v12 v13 ) <- v3 <- v11 <- v5 <- v9 <- v7 <- s0

and there is no pruning graph for CB14\_no. Hence, patches are different, atlases are different (cf. Figure 1) and reconstructed views will also be slightly different.

A collage of a person

Description automatically generated with medium confidence A collage of a person

Description automatically generated with medium confidence A collage of a person

Description automatically generated with medium confidence

Figure 1: texture atlas c00 for CB14\_ori (left), CB14\_modif (middle) and CB14\_no (right).

# CB19 : Restricted (indexed) geometry (=MPI)

## Objective

Propose a reference bitstream for MPI, with transparency and texture, but no geometry, and with constant depth patches.

List of features of ISO/IEC 23090-12 that are specifically exercised by this bitstream:

* ptc\_restricted\_geometry\_flag (=true)
* asme\_patch\_constant\_depth\_flag (=true)
* ai\_attribute\_type\_id (=ATTR\_TRANSPARENCY and ATTR\_TEXTURE)
* ai\_attribute\_count (=2)

It should be noted that the profile name “**MIV Extended Restricted Geometry**” from table A.1 of ISO/IEC 23090-12 corresponds to a *ptl\_profile\_toolset\_idc* set to 65 (i.e. the same value as for the profile name “**MIV Extended**”) and a *ptc\_restricted\_geometry\_flag* set to true.

## Parameters

This bitstream contains 1 (one) texture atlas, 1 (one) transparency atlas and associated metadata for TMIV decoding and rendering. Parameters used for this reference bitstream:

* Sequence M (MPI\_FAN)
* Number of frames = 8
* Intraperiod = 3
* Using configuration files in *config/test/miv\_mpi*
* TMIV 10.1 (commit 3e6a2ae9)
* HM16.16 (comes with TMIV)
* Visual Studio 16.4.4

Generated bitstream is TMIV\_M8\_M\_QP3.bit (2 490 266 bytes). This bitstream is renderable.

## Commands

### TMIV encoding

..\msvc\bin\MpiEncoder.exe -c .\config\test\miv\_mpi\M\_1\_TMIV\_encode.json -p configDirectory .\config\ -p inputDirectory E:\MPEG\_3DoFplus\_Content\ -p outputDirectory ..\..\OUTPUT\msvc\ -p startFrame 0 -n 8 -s M -p intraPeriod 3

### Video encoding the texture component

..\msvc\bin\TAppEncoder.exe -c .\config\test\miv\_mpi\M\_2\_HM\_encode\_tex.cfg -i ..\..\OUTPUT\msvc\M8\M\TMIV\_M8\_M\_tex\_c00\_4096x4096\_yuv420p10le.yuv -b C:\dev\TMIV\_10.1\OUTPUT\msvc\M8\M\QP3\TMIV\_M8\_M\_QP3\_tex\_c00.bit -wdt 4096 -hgt 4096 -q 32 -f 8 -fr 30

### Video encoding the transparency component

..\msvc\bin\TAppEncoder.exe -c .\config\test\miv\_mpi\M\_2\_HM\_encode\_tra.cfg -i ..\..\OUTPUT\msvc\M8\M\TMIV\_M8\_M\_tra\_c00\_4096x4096\_yuv420p10le.yuv -b C:\dev\TMIV\_10.1\OUTPUT\msvc\M8\M\QP3\TMIV\_M8\_M\_QP3\_tra\_c00.bit -wdt 4096 -hgt 4096 -q 45 -f 8 -fr 30

### TMIV multiplexing

..\msvc\bin\Multiplexer.exe -c .\config\test\miv\_mpi\M\_3\_TMIV\_mux.json -p configDirectory .\config\ -p inputDirectory ..\..\OUTPUT\msvc\ -p outputDirectory ..\..\OUTPUT\msvc\ -n 8 -s M -j 1 -r QP3

### TMIV decoding

..\msvc\bin\Decoder.exe -c .\config\test\miv\_mpi\M\_4\_TMIV\_decode.json -p configDirectory .\config\ -p inputDirectory ..\..\OUTPUT\msvc\ -p outputDirectory ..\..\OUTPUT\msvc\ -n 8 -N 8 -s M -j 1 -r QP3 -P p01 -p outputLogPath ..\..\OUTPUT\msvc\M8\M\QP3\TMIV\_M8\_M\_QP3.dec

## Output log

Here is the resulting output log (see [N0117] for definition of fields).

0 0 4096 4096 74eadabf 3e28fddf f7ebd3e1 b8826179

1 0 4096 4096 4aff652d 3e28fddf f7ebd3e1 b8826179

2 0 4096 4096 06608e9f 3e28fddf f7ebd3e1 b8826179

3 0 4096 4096 b6df15b1 198517b9 a5ca27c0 b8826179

4 0 4096 4096 384d3874 198517b9 a5ca27c0 b8826179

5 0 4096 4096 73cf9a44 198517b9 a5ca27c0 b8826179

6 0 4096 4096 0c3d478d 02a57b41 58a896d0 b8826179

7 0 4096 4096 0f31ac1f 02a57b41 58a896d0 b8826179

# Discussion

When generating the bitstreams, some unexpected results appeared regarding the conformance and the implementation of the reference decoder.

* Hashing function

Metadata are different between CB06\_none, CB06\_only\_one and CB06\_both, this can be seen by comparing .hls files and the rendered views. But the output logs are identical because **asme** is not hashed : is it what is intended ? If not, 23090-23 must be modified with supplementary hashing functions.

Metadata are different between CB09\_ori and CB09\_ancillary, this can be seen by comparing .hls files. But the output logs are identical because **asme** is not hashed : is it what is intended ? If not, 23090-23 must be modified with supplementary hashing functions.

* Decoder

The ancillary flag is not tested at decoder side in the reference decoder. Hence the synthesized views are identical between CB09\_ori and CB09\_ancillary. This is not in line with the hypothetical renderer behavior from the [N0111]. Should the reference software behave like the hypothetical one in spec ? If yes, then the software TMIV decoder must be corrected.

* V3c parameter set

Reading the field “ptc\_restricted\_geometry\_flag” in V3cParameterSet.hpp is not constrained by the value of field “ptl\_profile\_toolset\_idc”. From table A-1 from [N0111], it seems that “ptc\_restricted\_geometry\_flag” value should not be read when ptl\_profile\_toolset\_idc=64. If this understanding is correct, the TMIV software should be corrected.

# Recommendation

We recommend discussing the points listed in the discussion section.

We recommend using the conformance bitstreams presented in this document for assessing the conformance of a MIV decoder with respect to the normative requirements specified in ISO/IEC 23090-12.

# References

[m57442] B. Kroon, “Creating MIV conformance bitstreams – v4”*,* ISO/IEC JTC1/SC29/WG04 MPEG/m57442, July 2021, Online.

[N0117] “Information technology — Coded Representation of Immersive Media — Part 23: Conformance and Reference Software for MPEG Immersive Video”*,* ISO/IEC 23090-23:2021(E), ISO/IEC JTC 1/SC 29/WG 04, July 2021, Online.

[N0111] “Information technology — Coded Representation of Immersive Media — Part 12: MPEG Immersive video”*,* ISO/IEC 23090-12:2021(E), ISO/IEC JTC 1/SC 29/WG 04, July 2021, Online.