

ISO/IEC 23090-5:2021 (E)

Information technology — Coded representation of immersive media — Part 5: Visual volumetric video-based coding (V3C) and video-based point cloud compression (V-PCC)

Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms and definitions
4	Abbreviated terms
5	Conventions
5.1	General
5.2	Arithmetic operators
5.3	Logical operators
5.4	Relational operators
5.5	Bit-wise operators
5.6	Assignment operators
5.7	Other operators
5.8	Mathematical functions
5.9	Order of operation precedence
5.10	Variables, syntax elements and tables
5.11	Text description of logical operations
5.12	Processes
6	Overall V3C characteristics, decoding operations and post-decoding processes
6.1	V3C characteristics
6.2	V3C bitstream characteristics, decoding operations and post-decoding processes
7	Bitstream format, partitioning and scanning processes
7.1	General
7.2	V3C bitstream formats
7.3	NAL bitstream formats
7.4	Partitioning of atlas frames into tiles
7.5	Tile partition scanning process
8	Syntax and semantics
8.1	Method of specifying syntax in tabular form
8.2	Specification of syntax functions and descriptors
8.3	Syntax in tabular form
8.3.1	General
8.3.2	V3C unit syntax
8.3.2.1	General V3C unit syntax
8.3.2.2	V3C unit header syntax
8.3.2.3	V3C unit payload syntax
8.3.2.4	Atlas sub-bitstream syntax
8.3.3	Byte alignment syntax
8.3.4	V3C parameter set syntax
8.3.4.1	General V3C parameter set syntax
8.3.4.2	Profile, tier and level syntax
8.3.4.3	Occupancy information syntax

- 8.3.4.4 Geometry information syntax
- 8.3.4.5 Attribute information syntax
- 8.3.4.6 Profile toolset constraints information syntax
- 8.3.5 NAL unit syntax
 - 8.3.5.1 General NAL unit syntax
 - 8.3.5.2 NAL unit header syntax
- 8.3.6 Raw byte sequence payloads, trailing bits and byte alignment syntax
 - 8.3.6.1 Atlas sequence parameter set RBSP syntax
 - 8.3.6.1.1 General atlas sequence parameter set RBSP syntax
 - 8.3.6.1.2 Point local reconstruction information syntax
 - 8.3.6.2 Atlas frame parameter set RBSP syntax
 - 8.3.6.2.1 General atlas frame parameter set RBSP syntax
 - 8.3.6.2.2 Atlas frame tile information syntax
 - 8.3.6.3 Atlas adaptation parameter set RBSP syntax
 - 8.3.6.4 Supplemental enhancement information RBSP syntax
 - 8.3.6.5 Access unit delimiter RBSP syntax
 - 8.3.6.6 End of sequence RBSP syntax
 - 8.3.6.7 End of bitstream RBSP syntax
 - 8.3.6.8 Filler data RBSP syntax
 - 8.3.6.9 Atlas tile layer RBSP syntax
 - 8.3.6.10 RBSP trailing bit syntax
 - 8.3.6.11 Atlas tile header syntax
 - 8.3.6.12 Reference list structure syntax
- 8.3.7 Atlas tile data unit syntax
 - 8.3.7.1 General atlas tile data unit syntax
 - 8.3.7.2 Patch information data syntax
 - 8.3.7.3 Patch data unit syntax
 - 8.3.7.4 Skip patch data unit syntax
 - 8.3.7.5 Merge patch data unit syntax
 - 8.3.7.6 Inter patch data unit syntax
 - 8.3.7.7 RAW patch data unit syntax
 - 8.3.7.8 EOM patch data unit syntax
 - 8.3.7.9 Point local reconstruction data syntax
- 8.3.8 Supplemental enhancement information message syntax
- 8.4 Semantics
 - 8.4.1 General
 - 8.4.2 V3C unit semantics
 - 8.4.2.1 General V3C unit semantics
 - 8.4.2.2 V3C unit header semantics
 - 8.4.2.3 V3C unit payload semantics
 - 8.4.2.4 Atlas sub-bitstream semantics
 - 8.4.2.5 Order of V3C units and association to coded information
 - 8.4.2.5.1 General
 - 8.4.2.5.2 Order of VPSs and their activation
 - 8.4.2.5.3 Order of V3C units and association to CVSs
 - 8.4.3 Byte alignment semantics
 - 8.4.4 V3C parameter set semantics
 - 8.4.4.1 General V3C parameter set semantics
 - 8.4.4.2 Profile, tier and level semantics
 - 8.4.4.3 Occupancy information semantics
 - 8.4.4.4 Geometry information semantics
 - 8.4.4.5 Attribute information semantics
 - 8.4.4.6 Profile toolset constraints information semantics
 - 8.4.5 NAL unit semantics
 - 8.4.5.1 General NAL unit semantics
 - 8.4.5.2 NAL unit header semantics
 - 8.4.5.3 Order of NAL units and atlas frames and association to coded atlas frames, access units and coded atlas sequences
 - 8.4.5.3.1 General
 - 8.4.5.3.2 Order of AAPS, ASPs and AFPS RBSPs and their activation
 - 8.4.5.3.3 Order of access units (AUs) and association to CASs
 - 8.4.5.3.4 Order of NAL units and coded atlas frames and their association to access units
 - 8.4.5.3.5 Order of ACL NAL units and association to coded atlas frames
 - 8.4.6 Raw byte sequence payloads, trailing bits and byte alignment semantics

- 8.4.6.1 Atlas sequence parameter set RBSP semantics
- 8.4.6.1.1 General atlas sequence parameter set RBSP semantics
- 8.4.6.1.2 Point local reconstruction information semantics
- 8.4.6.2 Atlas frame parameter set RBSP semantics
- 8.4.6.2.1 General atlas frame parameter set RBSP semantics
- 8.4.6.2.2 Atlas frame tile information syntax
- 8.4.6.3 Atlas adaptation parameter set RBSP semantics
- 8.4.6.4 Supplemental enhancement information RBSP semantics
- 8.4.6.5 Access unit delimiter RBSP semantics
- 8.4.6.6 End of sequence RBSP semantics
- 8.4.6.7 End of bitstream RBSP semantics
- 8.4.6.8 Filler data RBSP semantics
- 8.4.6.9 Atlas tile layer RBSP semantics
- 8.4.6.10 RBSP trailing bit semantics
- 8.4.6.11 Atlas tile header semantics
- 8.4.6.12 Reference list structure semantics
- 8.4.7 Atlas tile data unit semantics
- 8.4.7.1 General atlas tile data unit semantics
- 8.4.7.2 Patch information data semantics
- 8.4.7.3 Patch data unit semantics
- 8.4.7.4 Skip patch data unit semantics
- 8.4.7.5 Merge patch data unit semantics
- 8.4.7.6 Inter patch data unit semantics
- 8.4.7.7 RAW patch data unit semantics
- 8.4.7.8 EOM patch data unit semantics
- 8.4.7.9 Point local reconstruction data semantics
- 8.4.8 Supplemental enhancement information message semantics

9 Decoding process

- 9.1 General decoding process
- 9.2 Atlas data decoding process
- 9.2.1 General atlas data decoding process
- 9.2.2 Decoding process for a coded atlas frame
- 9.2.3 Atlas NAL unit decoding process
- 9.2.4 Atlas tile header decoding process
- 9.2.4.1 Atlas frame order count derivation process
- 9.2.4.2 Decoding process for generating unavailable reference atlas frames
- 9.2.4.2.1 General
- 9.2.4.2.2 Generation of one unavailable atlas frame
- 9.2.4.3 Reference atlas frame list construction process
- 9.2.4.4 Reference atlas frame marking process
- 9.2.5 Decoding process for patch data units
- 9.2.5.1 General decoding process for patch data units
- 9.2.5.2 Decoding process for patch data units coded in intra mode
- 9.2.5.3 Decoding process for patch data units coded in skip prediction mode
- 9.2.5.4 Decoding process for patch data units coded in merge prediction mode
- 9.2.5.5 Decoding process for patch data units coded in inter prediction mode
- 9.2.5.5.1 General decoding process for patch data units coded in inter prediction mode
- 9.2.5.5.2 Derivation of inter reference patch parameters
- 9.2.5.5.2.1 General derivation of inter reference patch parameters
- 9.2.5.5.2.2 Reference patches in projected mode
- 9.2.5.5.2.3 Reference patches in RAW mode
- 9.2.5.5.2.4 Reference patches in EOM mode
- 9.2.5.6 Decoding process for patch data units coded in RAW mode
- 9.2.5.7 Decoding process for patch data units coded in EOM mode
- 9.2.6 Decoding process of the block to patch map
- 9.2.7 Conversion of tile level patch information to atlas level patch information
- 9.2.7.1 General
- 9.2.7.2 Conversion of tile level blockToPatch information to atlas level blockToPatch information
- 9.2.7.3 Conversion of tile level patch information to atlas level patch information
- 9.2.7.3.1 General
- 9.2.7.3.2 Process of copying common patch parameters from a tile to an atlas representation

9.2.7.3.3	Process of copying application specific patch parameters from a tile to an atlas representation
9.3	Occupancy video decoding process
9.4	Geometry video decoding process
9.5	Attribute video decoding process
9.6	Sub-bitstream extraction process
9.6.1	General
9.6.2	V3C unit extraction
9.6.3	NAL unit extraction process
10	Pre-reconstruction process
11	Reconstruction process
12	Post-reconstruction process
13	Adaptation process
14	Parsing process
14.1	General
14.2	Parsing process for 0-th order Exp-Golomb codes
14.2.1	General
14.2.2	Mapping process for signed Exp-Golomb codes
Annex A (normative) Profiles, tiers and levels	
A.1	Overview of profiles, tiers and levels
A.2	Profile, tier and level structure
A.3	CodecGroup profile components
A.4	Toolset profile components
A.5	Reconstruction profile components
A.6	Tiers and levels
A.6.1	General tier and level limits
A.6.2	Profile specific level limits for the V3C dynamic profiles
Annex B (normative) Post-decoding conversion to nominal video formats	
B.1	General
B.2	Nominal format conversion
B.2.1	General
B.2.2	Occupancy nominal format conversion
B.2.3	Geometry nominal format conversion
B.2.4	Auxiliary geometry nominal format conversion
B.2.5	Attribute nominal format conversion
B.2.6	Auxiliary attribute nominal format conversion
B.3	Conversion operations
B.3.1	Map Extraction
B.3.2	Bit depth conversion
B.3.3	Resolution conversion
B.3.4	Output composition time conversion
B.3.4.1	Output order conversion
B.3.4.2	Atlas composition time alignment
B.3.5	Attribute dimension packing
B.3.5.1	Attribute dimension packing process
B.3.5.2	Attribute dimension packing process for an auxiliary attribute
B.3.6	Chroma up-sampling
B.3.7	Geometry map synthesis process
B.3.8	Attribute map synthesis process
B.3.9	Occupancy thresholding process
Annex C (normative) V3C sample stream format	
C.1	General
C.2	Sample stream V3C unit syntax and semantics
C.2.1	Sample stream V3C header syntax
C.2.2	Sample stream V3C unit syntax
C.2.3	Sample stream V3C header semantics

C.2.4 Sample stream V3C unit semantics

Annex D (normative) NAL sample stream format

- D.1 General**
- D.2 Sample stream NAL unit syntax and semantics**
 - D.2.1 Sample stream NAL header syntax**
 - D.2.2 Sample stream NAL unit syntax**
 - D.2.3 Sample stream NAL header semantics**
 - D.2.4 Sample stream NAL unit semantics**

Annex E (normative) Atlas hypothetical reference decoder

- E.1 General**
- E.2 Operation of coded atlas frame buffer**
 - E.2.1 General**
 - E.2.2 Timing of decoding unit arrival**
 - E.2.3 Timing of decoding unit removal and decoding of decoding unit**
- E.3 Operation of the decoded atlas frame buffer**
 - E.3.1 General**
 - E.3.2 Removal of atlas frames from the DAB before decoding of the current atlas frame**
 - E.3.3 Atlas frame output**
 - E.3.4 Current decoded atlas frame marking and storage**
 - E.3.5 Removal of atlas frames from the DAB after decoding of the current atlas frame**
- E.4 Bitstream conformance**
- E.5 Decoder conformance**
 - E.5.1 General**
 - E.5.2 Operation of the output order DAB**
 - E.5.2.1 General**
 - E.5.2.2 Output and removal of atlas frames from the DAB**
 - E.5.2.3 Additional bumping**
 - E.5.2.4 "Bumping" process**

Annex F (normative) Supplemental enhancement information

- F.1 General**
- F.2 SEI payload syntax**
 - F.2.1 General SEI message syntax**
 - F.2.2 Filler payload SEI message syntax**
 - F.2.3 User data registered by Recommendation ITU-T T.35 SEI message syntax**
 - F.2.4 User data unregistered SEI message syntax**
 - F.2.5 Recovery point SEI message syntax**
 - F.2.6 No reconstruction SEI message syntax**
 - F.2.7 Reserved SEI message syntax**
 - F.2.8 SEI manifest SEI message syntax**
 - F.2.9 SEI prefix indication SEI message syntax**
 - F.2.10 Active sub-bitstreams SEI message syntax**
 - F.2.11 Component codec mapping SEI message syntax**
 - F.2.12 Volumetric annotation SEI message family syntax**
 - F.2.12.1 Scene object information SEI message syntax**
 - F.2.12.2 Object label information SEI message syntax**
 - F.2.12.3 Patch information SEI message syntax**
 - F.2.12.4 Volumetric rectangle information SEI message syntax**
 - F.2.12.5 Atlas object association SEI message syntax**
 - F.2.13 Buffering period SEI message syntax**
 - F.2.14 Atlas frame timing SEI message syntax**
 - F.2.15 Viewport SEI messages family syntax**
 - F.2.15.1 Viewport camera parameters SEI messages syntax**
 - F.2.15.2 Viewport position SEI messages syntax**
 - F.2.16 Decoded atlas information hash SEI message syntax**
 - F.2.16.1 Decoded high level hash unit syntax**
 - F.2.16.2 Decoded atlas hash unit syntax**
 - F.2.16.3 Decoded atlas b2p hash unit syntax**
 - F.2.16.4 Decoded atlas tile hash unit syntax**
 - F.2.16.5 Decoded atlas tile b2p hash unit syntax**
 - F.2.17 Time code SEI message syntax**
- F.3 SEI payload semantics**

- F.3.1 General SEI payload semantics
 - F.3.2 Filler payload SEI message semantics
 - F.3.3 User data registered by Recommendation ITU-T T.35 SEI message semantics
 - F.3.4 User data unregistered SEI message semantics
 - F.3.5 Recovery point SEI message semantics
 - F.3.6 No reconstruction SEI message semantics
 - F.3.7 Reserved SEI message semantics
 - F.3.8 SEI manifest SEI message semantics
 - F.3.9 SEI prefix indication SEI message semantics
 - F.3.10 Active sub-bitstreams SEI message semantics
 - F.3.11 Component codec mapping SEI message semantics
 - F.3.12 Volumetric annotation SEI messages family syntax
 - F.3.12.1 Scene object information SEI message semantics
 - F.3.12.1.1 General
 - F.3.12.1.2 Object initialization
 - F.3.12.2 Object label information SEI message semantics
 - F.3.12.2.1 General
 - F.3.12.2.2 Label initialization
 - F.3.12.3 Patch information SEI message semantics
 - F.3.12.3.1 General
 - F.3.12.3.2 Tile and patch initialization
 - F.3.12.4 Volumetric rectangle information SEI message semantics
 - F.3.12.4.1 General
 - F.3.12.4.2 Rectangle initialization
 - F.3.12.5 Atlas object association SEI message semantics
- F.3.13 Buffering period SEI message semantics
- F.3.14 Atlas frame timing SEI message semantics
- F.3.15 Viewport SEI messages family semantics
 - F.3.15.1 Viewport camera parameters SEI message semantics
 - F.3.15.2 Viewport position SEI message semantics
- F.3.16 Decoded atlas information hash SEI message semantics
 - F.3.16.1 General
 - F.3.16.2 Strings of bytes arrangement for hash calculation
 - F.3.16.2.1 General
 - F.3.16.2.2 High-level atlas information string of bytes
 - F.3.16.2.2.1 Common ASPS level string of bytes
 - F.3.16.2.2.2 Application-based ASPS level string of bytes
 - F.3.16.2.2.3 Common AFPS level string of bytes
 - F.3.16.2.2.4 Application-based AFPS level string of bytes
 - F.3.16.2.3 Atlas information string of bytes
 - F.3.16.2.3.1 Common atlas patch string of bytes
 - F.3.16.2.3.2 Application-based atlas patch string of bytes
 - F.3.16.2.4 Tile information string of bytes
 - F.3.16.2.4.1 Common tile patch string of bytes
 - F.3.16.2.4.2 Application based tile patch string of bytes
 - F.3.16.2.5 Atlas block to patch string of bytes
 - F.3.16.2.6 Tile block to patch string of bytes
- F.3.17 Time code SEI message semantics

Annex G (normative) Volumetric usability information

- G.1 General
- G.2 VUI syntax
 - G.2.1 VUI parameters syntax
 - G.2.2 HRD parameters syntax
 - G.2.3 Sub-layer HRD parameters syntax
 - G.2.4 Maximum coded video resolution syntax
 - G.2.5 Coordinate system parameters syntax
- G.3 VUI semantics
 - G.3.1 VUI parameters semantics
 - G.3.2 HRD parameters semantics
 - G.3.3 HRD sub-layer parameters semantics
 - G.3.4 Maximum coded video resolution semantics
 - G.3.5 Coordinate system parameters semantics

Annex H (normative) Video-based point cloud coding

- H.1 General
- H.2 Overall V-PCC characteristics, decoding operations and post-decoding processes
- H.2.1 V3C characteristics
- H.2.2 V3C bitstream characteristics, decoding operations and post-decoding processes
- H.3 Bitstream format, partitioning and scanning process
- H.4 Syntax and semantics
 - H.4.1 Method of specifying syntax in tabular form
 - H.4.2 Specification of syntax functions and descriptors
 - H.4.3 Syntax in tabular form
 - H.4.3.1 General
 - H.4.3.2 V3C unit syntax
 - H.4.3.3 Byte alignment syntax
 - H.4.3.4 V3C parameter set syntax
 - H.4.3.5 NAL unit syntax
 - H.4.3.6 Raw byte sequence payloads, trailing bits and byte alignment syntax
 - H.4.3.6.1 Atlas sequence parameter set RBSP syntax
 - H.4.3.6.1.1 General atlas sequence parameter set RBSP syntax
 - H.4.3.6.1.2 Point local reconstruction information syntax
 - H.4.3.6.1.3 ASPS V-PCC extension syntax
 - H.4.3.6.2 Atlas frame parameter set RBSP syntax
 - H.4.3.6.3 Atlas adaptation parameter set RBSP syntax
 - H.4.3.6.3.1 General atlas adaptation parameter set RBSP syntax
 - H.4.3.6.3.2 AAPS V-PCC extension syntax
 - H.4.3.6.3.3 Atlas camera parameters syntax
 - H.4.3.6.4 Supplemental enhancement information RBSP syntax
 - H.4.3.6.5 Access unit delimiter RBSP syntax
 - H.4.3.6.6 End of sequence RBSP syntax
 - H.4.3.6.7 End of bitstream RBSP syntax
 - H.4.3.6.8 Filler data RBSP syntax
 - H.4.3.6.9 Atlas tile layer RBSP syntax
 - H.4.3.6.10 RBSP trailing bit syntax
 - H.4.3.6.11 Atlas tile header syntax
 - H.4.3.6.12 Reference list structure syntax
 - H.4.3.7 Atlas tile data unit syntax
 - H.4.3.8 Supplemental enhancement information message syntax
 - H.4.4 Semantics
 - H.4.4.1 General
 - H.4.4.2 V3C unit semantics
 - H.4.4.3 Byte alignment semantics
 - H.4.4.4 V3C parameter set semantics
 - H.4.4.5 NAL unit semantics
 - H.4.4.6 Raw byte sequence payloads, trailing bits and byte alignment semantics
 - H.4.4.6.1 Atlas sequence parameter set RBSP semantics
 - H.4.4.6.1.1 General atlas sequence parameter set RBSP semantics
 - H.4.4.6.1.2 Point local reconstruction information syntax
 - H.4.4.6.1.3 ASPS V-PCC extension semantics
 - H.4.4.6.2 Atlas frame parameter set RBSP semantics
 - H.4.4.6.3 Atlas adaptation parameter set RBSP semantics
 - H.4.4.6.3.1 General atlas adaptation parameter set RBSP semantics
 - H.4.4.6.3.2 AAPS V-PCC extension semantics
 - H.4.4.6.3.3 Atlas camera parameters semantics
 - H.4.4.6.4 Supplemental enhancement information RBSP semantics
 - H.4.4.6.5 Access unit delimiter RBSP semantics
 - H.4.4.6.6 End of sequence RBSP semantics
 - H.4.4.6.7 End of bitstream RBSP semantics
 - H.4.4.6.8 Filler data RBSP semantics
 - H.4.4.6.9 Atlas tile layer RBSP semantics
 - H.4.4.6.10 RBSP trailing bit semantics
 - H.4.4.6.11 Atlas tile header semantics
 - H.4.4.6.12 Reference list structure semantics
 - H.4.4.7 Atlas tile data unit semantics
 - H.4.4.8 Supplemental enhancement information message semantics

H.5	Decoding process
H.5.1	General decoding process
H.5.2	Atlas data decoding process
H.5.2.1	General atlas data decoding process
H.5.2.2	Decoding process for a coded atlas frame
H.5.2.3	Atlas NAL unit decoding process
H.5.2.4	Atlas tile header decoding process
H.5.2.5	Decoding process for patch data units
H.5.2.5.1	General decoding process for patch data units
H.5.2.5.2	Decoding process for patch data units coded in intra mode
H.5.2.5.3	Decoding process for patch data units coded in skip prediction mode
H.5.2.5.4	Decoding process for patch data units coded in merge prediction mode
H.5.2.5.5	Decoding process for patch data units coded in inter prediction mode
H.5.2.5.5.1	General
H.5.2.5.5.2	Derivation of inter reference patch parameters
H.5.2.5.6	Decoding process for patch data units coded in RAW mode
H.5.2.5.7	Decoding process for patch data units coded in EOM mode
H.5.2.6	Decoding process of the block to patch map
H.5.2.7	Conversion of tile level information to atlas level information
H.5.2.7.1	General
H.5.2.7.2	Conversion of tile level blockToPatch information to atlas level blockToPatch information
H.5.2.7.3	Conversion of tile level patch information to atlas level patch information
H.5.2.7.3.1	General
H.5.2.7.3.2	Process of copying common patch parameters from a tile to an atlas representation
H.5.2.7.3.3	Process of copying application specific patch parameters from a tile to an atlas representation
H.5.3	Occupancy video decoding process
H.5.4	Geometry video decoding process
H.5.5	Attribute video decoding process
H.5.6	Sub-bitstream extraction process
H.6	Pre-reconstruction process
H.6.1	General
H.6.2	Occupancy synthesis process
H.6.2.1	General
H.6.2.2	Patch border filtering (PBF)
H.6.2.2.1	General
H.6.2.2.2	Bounding box and border point determination
H.6.2.2.3	Neighbouring patches determination
H.6.2.2.4	Neighbouring depth determination
H.6.2.2.5	Occupancy filtering
H.6.2.2.6	Conversion from a 3D point position to atlas coordinates and depth
H.6.2.2.7	Occupancy pruning
H.7	Reconstruction process
H.7.1	General
H.7.2	Reconstruction of points for projected patches
H.7.2.1	Common reconstruction process of points for projected patches
H.7.2.2	Process to check for duplicated points across maps
H.7.2.3	Reconstruction of points for projected patches when asps_pixel_deinterleaving_enabled_flag is equal to 1
H.7.2.4	Reconstruction of points for projected patches when asps_plr_enabled_flag is equal to 1
H.7.3	Reconstruction for EOM patches
H.7.4	Reconstruction of RAW patches
H.7.5	Conversion from atlas coordinates to 3D coordinates
H.7.6	Conversion of 3D coordinates for projection planes at 45 degrees
H.8	Post-reconstruction process
H.8.1	General
H.8.2	Geometry smoothing process
H.8.3	Attribute smoothing process
H.8.4	Identification of the geometry and attribute center grids
H.8.4.1	Identification of the geometry center grid
H.8.4.2	Identification of the attribute center grid
H.8.4.3	Generation of an 1D index lookup table

- H.8.5 Identification of boundary points
- H.8.6 Identification of $2 \times 2 \times 2$ cells corresponding to a reconstructed point position
- H.8.7 Trilinear filtering
 - H.8.7.1 Trilinear filtering for geometry smoothing
 - H.8.7.2 Trilinear filtering for attribute smoothing
- H.8.8 Attribute transfer
 - H.8.8.1 General
 - H.8.8.2 Process for attribute transfer
 - H.8.8.3 Process to compute the distance between two arrays
 - H.8.8.4 Point neighbour search process
- H.9 Adaptation process
- H.10 Parsing process
- H.11 Profiles, tiers and levels
 - H.11.1 Overview of profiles, tiers and levels
 - H.11.2 Profile, tier and level structure
 - H.11.3 CodecGroup profile components
 - H.11.4 Toolset profile components
 - H.11.4.1 V-PCC Basic, V-PCC Basic Still, V-PCC Extended and V-PCC Extended Still toolset profile components
 - H.11.5 Reconstruction profile components
 - H.11.5.1 General
 - H.11.5.2 V-PCC reconstruction decoder conformance
- H.11.6 Tier and levels
- H.12 Post-decoding conversion to nominal video formats
- H.13 V3C sample stream format
- H.14 NAL sample stream format
- H.15 Atlas hypothetical reference decoder
- H.16 Supplemental enhancement information
 - H.16.1 General
 - H.16.2 SEI payload syntax
 - H.16.2.1 General SEI message syntax
 - H.16.2.2 Filler payload SEI message syntax
 - H.16.2.3 User data registered by Recommendation ITU-T T.35 SEI message syntax
 - H.16.2.4 User data unregistered SEI message syntax
 - H.16.2.5 Recovery point SEI message syntax
 - H.16.2.6 No reconstruction SEI message syntax
 - H.16.2.7 Reserved SEI message syntax
 - H.16.2.8 SEI manifest SEI message syntax
 - H.16.2.9 SEI prefix indication SEI message syntax
 - H.16.2.10 Active sub-bitstreams SEI message syntax
 - H.16.2.11 Component codec mapping SEI message syntax
 - H.16.2.12 Volumetric annotation SEI message family syntax
 - H.16.2.13 Buffering period SEI message syntax
 - H.16.2.14 Atlas frame timing SEI message syntax
 - H.16.2.15 Viewport SEI messages family syntax
 - H.16.2.16 Decoded atlas information hash SEI message syntax
 - H.16.2.17 Attribute transformation parameters SEI message syntax
 - H.16.2.18 Occupancy synthesis SEI message syntax
 - H.16.2.19 Geometry smoothing SEI message syntax
 - H.16.2.20 Attribute smoothing SEI message syntax
 - H.16.3 SEI payload semantics
 - H.16.3.1 General SEI payload semantics
 - H.16.3.2 Filler payload SEI message semantics
 - H.16.3.3 User data registered by Recommendation ITU-T T.35 SEI message semantics
 - H.16.3.4 User data unregistered SEI message semantics
 - H.16.3.5 Recovery point SEI message semantics
 - H.16.3.6 No reconstruction SEI message semantics
 - H.16.3.7 Reserved SEI message semantics
 - H.16.3.8 SEI manifest SEI message semantics
 - H.16.3.9 SEI prefix indication SEI message semantics
 - H.16.3.10 Active sub-bitstreams SEI message semantics
 - H.16.3.11 Component codec mapping SEI message semantics
 - H.16.3.12 Volumetric annotation SEI messages family syntax
 - H.16.3.13 Buffering period SEI message semantics

H.16.3.14 Atlas frame timing SEI message semantics
H.16.3.15 Viewport SEI messages family semantics
H.16.3.16 Decoded atlas information hash SEI message semantics
H.16.3.16.1 General
H.16.3.16.2 Strings of bytes arrangement for hash calculation
H.16.3.16.2.1 General
H.16.3.16.2.2 High-level atlas information string of bytes
H.16.3.16.2.3 Atlas information string of bytes
H.16.3.16.2.4 Tile information string of bytes
H.16.3.16.2.5 Atlas block to patch string of bytes
H.16.3.16.2.6 Tile block to patch string of bytes
H.16.3.17 Time code SEI message semantics
H.16.3.18 Attribute transformation parameters SEI message semantics
H.16.3.19 Occupancy synthesis SEI message semantics
H.16.3.20 Geometry smoothing SEI message semantics
H.16.3.21 Attribute smoothing SEI message semantics
H.17 Volumetric usability information

Page count: 331