ISO/IEC 13818-1:2023-12 (E)

Information technology - Generic coding of moving pictures and associated audio information - Part 1: Systems

Contents

Page

SECTION 1 – GENERAL 1
1.1 Scope 1
1.2 Normative references 1
SECTION 2 – TECHNICAL ELEMENTS 4
2.1 Definitions 4
2.2 Symbols and abbreviations 12
2.3 Method of describing bit stream syntax 14
2.4 Transport stream bitstream requirements 15
2.5 Program stream bitstream requirements 63
2.6 Program and program element descriptors 77
2.7 Restrictions on the multiplexed stream semantics 166
2.8 Compatibility with ISO/IEC 11172 170
2.9 Registration of copyright identifiers 170
2.10 Registration of private data format 171
2.11 Carriage of ISO/IEC 14496 data 171
2.12 Carriage of metadata 183
2.13 Carriage of ISO 15938 data 192
2.14 Carriage of Rec. ITU-T H.264 | ISO/IEC 14496-10 video 192
2.15 Carriage of ISO/IEC 14496-17 text streams 208
2.16 Carriage of auxiliary video streams 210
2.17 Carriage of HEVC 210
2.18 Carriage of green access units 224
2.19 Carriage of ISO/IEC 23008-3 MPEG-H 3D audio data 226
2.20 Carriage of Quality Access Units in MPEG-2 sections 228
2.21 Carriage of sample variants 229
2.22 Carriage of Media Orchestration Access Units 230
2.23 Carriage of VVC 230
2.24 Carriage of EVC 235
2.25 Carriage of LCEVC 238
Annex A CRC decoder model 240
A.1 CRC decoder model 240
Annex B Digital storage medium command and control (DSM-CC) 241
B.1 Introduction 241
B.2 General elements 242
B.3 Technical elements 244
Annex C Program-specific information 250
C.1 Explanation of program-specific information in transport streams 250
C.2 Introduction 250
C.3 Functional mechanism 250
C.4 The mapping of sections into transport stream packets 251
C.5 Repetition rates and random access 251
C.6 What is a program? 252
C.7 Allocation of program_number 252
C.8 Usage of PSI in a typical system 252
C.9 The relationships of PSI structures 253
C.10 Bandwidth utilization and signal acquisition time 255
Annex D Systems timing model and application implications of this Recommendation | International Standard 258
D.1 Introduction 258

Annex E Data transmission applications 267
E.1 General considerations 267
E.2 Suggestion 267
Annex F Graphics of syntax for this Recommendation | International Standard 268
F.1 Introduction 268
Annex G General information 272
G.1 General information 272
Annex H Private data 273
H.1 Private data 273
Annex I Systems conformance and real-time interface 274
I.1 Systems conformance and real-time interface 274
Annex J Interfacing jitter-inducing networks to MPEG-2 decoders 275
J.1 Introduction 275
J.2 Network compliance models 275
J.3 Network specification for jitter smoothing 276
J.4 Example decoder implementations 277
Annex K Splicing transport streams 278
K.1 Introduction 278
K.2 The different types of splicing point 278
K.3 Decoder behaviour on splices 279
Annex L Registration procedure (see 2.9) 281
L.1 Procedure for the request of a Registered Identifier (RID) 281
L.2 Responsibilities of the Registration Authority 281
L.3 Responsibilities of parties requesting an RID 281
L.4 Appeal procedure for denied applications 281
Annex M Registration application form (see 2.9) 283
M.1 Contact information of organization requesting a Registered Identifier (RID) 283
M.2 Statement of an intention to apply the assigned RID 283
M.3 Date of intended implementation of the RID 283
M.4 Authorized representative 283
M.5 For official use only of the Registration Authority 283
Annex N Registration Authority Diagram of administration structure (see 2.9) 284
Annex O Registration procedure (see 2.10) 285
O.1 Procedure for the request of an RID 285
O.2 Responsibilities of the Registration Authority 285
O.3 Contact information for the Registration Authority 285
O.4 Responsibilities of parties requesting an RID 285
O.5 Appeal procedure for denied applications 285
Annex P Registration application form 287
P.1 Contact information of organization requesting an RID 287
P.2 Request for a specific RID 287
P.3 Short description of RID that is in use and date system that was implemented 287
P.4 Statement of an intention to apply the assigned RID 287
P.5 Date of intended implementation of the RID 287
P.6 Authorized representative 287
P.7 For official use of the Registration Authority 287
Annex Q T-STD and P-STD buffer models for ISO/IEC 13818-7 ADTS 288
Q.1 Introduction 288
Q.2 Leak rate from transport buffer 288
Q.3 Buffer size 288
Q.4 Conclusion 289
Annex R Carriage of ISO/IEC 14496 scenes in Rec. ITU-T H.222.0 | ISO/IEC 13818-1 291
R.1 Content access procedure for ISO/IEC 14496 program components within a program stream 291
R.2 Content access procedure for ISO/IEC 14496 program components within a transport stream 292
Annex S Carriage of JPEG 2000 part 1 video over MPEG-2 transport streams 296
S.1 Introduction 296

S.2 J2K video access unit, J2K video elementary stream, J2K video sequence and J2K still picture 296
S.3 Optional J2K block mode for high resolution support 296
S.4 Optional J2K stripe mode for Ultra-Low Latency 297
S.5 Elementary stream header (elsm) and mapping to PES packets 297
S.6 J2K transport constraints 300
S.7 Interpretation of flags in adaptation and PES headers for J2K video elementary streams 301
S.8 T-STD extension for J2K video elementary streams 301
Annex T MIME type for MPEG-2 transport streams 304
T.1 Introduction 304
T.2 MIME type and subtype 304
T.3 Security considerations 305
T.4 Parameters 305
Annex U Carriage of timeline and external media information over MPEG-2 transport streams 307
U.1 Introduction 307
U.2 TEMI access unit and TEMI elementary stream 308
U.3 AF descriptors 309
Annex V Transport of HEVC tiles 318
V.1 Introduction 318
V.2 HEVC tile substream identification example 319
V.3 Subregion layout example 319
Annex W Carriage of JPEG XS part 1 video over MPEG-2 Transport Streams 321
W.1 Introduction 321
W.2 JPEG XS video access unit, JPEG XS video elementary stream, JPEG XS video sequence and JPEG XS still picture 321
W.3 Elementary stream header (jxes) and mapping to PES packets 321
W.4 JPEG XS transport constraints 322
W.5 Interpretation of flags in adaptation field and PES packet for JPEG XS video elementary streams 323
W.6 T-STD extension for JPEG XS video elementary streams 323
Bibliography 326

Table 2-1 – Transport stream ... 26
Table 2-2 – Transport packet of this Recommendation | International Standard ... 26
Table 2-3 – PID table ... 27
Table 2-4 – Scrambling control values ... 27
Table 2-5 – Adaptation field control values ... 28
Table 2-6 – Transport stream adaptation field ... 28
Table 2-7 – Splice parameters Table 1 Simple Profile Main Level, Main Profile Main Level, SNR Profile Main Level (both layers), Spatial Profile High-1440 Level (base layer), High Profile Main Level (middle + base layers), Multi-view Profile Main Level (base layer) Video ... 35
Table 2-8 – Splice parameters Table 2 Main Profile Low Level, SNR Profile Low Level (both layers), High Profile Main Level (base layer), Multi-view Profile Low Level (base layer) Video ... 35
Table 2-9 – Splice parameters Table 3 Main Profile High-1440 Level, Spatial Profile High-1440 Level (all layers), High Profile High-1440 Level (middle + base layers), Multi-view Profile High-1440 Level (base layer) Video ... 36
Table 2-10 – Splice parameters Table 4 Main Profile High Level, High Profile High-1440 Level (all layers), High Profile High Level (middle + base layers), Multi-view Profile High Level (base layer) Video ... 36
Table 2-11 – Splice parameters Table 5 SNR Profile Low Level (base layer) Video ... 36
Table 2-12 – Splice parameters Table 6 SNR Profile Main Level (base layer) Video ... 36
Table 2-13 – Splice parameters Table 7 Spatial Profile High-1440 Level (middle + base layers) Video ... 37
Table 2-14 – Splice parameters Table 8 High Profile Main Level (all layers), High Profile High-1440 Level (base layer) Video ... 37
Table 2-15 – Splice parameters Table 9 High Profile High Level (base layer), Multi-view Profile Main Level (both layers) Video ... 37
Table 2-16 – Splice parameters Table 10 High Profile High Level (all layers), Multi-view Profile High-1440 Level (both layers) Video ... 38
Table 2-17 – Splice parameters Table 11 4:2:2 Profile Main Level Video ... 38
Table 2-18 – Splice parameters Table 12 Multi-view Profile Low Level (both layers) Video ... 38
Table 2-19 – Splice parameters Table 13 Multi-view Profile High Level (both layers) Video ... 38
Table 2-20 – Splice parameters Table 14 4:2:2 Profile High Level Video ... 39
Table 2-21 – PES packet ... 39
Table 2-22 – Stream_id assignments ... 42
Table 2-23 – PES scrambling control values ... 43
Table 2-24 – Trick mode control values ... 48
Table 2-25 – Field_id field control values ... 49
Table 2-26 – Coefficient selection values ... 49
Table 2-27 – Stream_id_extension assignments ... 51
Table 2-28 – Program-specific information ... 52
Table 2-29 – Program-specific information pointer ... 54
Table 2-30 – Program association section ... 54
Table 2-31 – table_id assignment values ... 55
Table 2-32 – Conditional access section ... 56
Table 2-33 – Transport stream program map section ... 57
Table 2-34 – Stream type assignments ... 58
Table 2-35 – Private section ... 61
Table 2-36 – The transport stream description table ... 62
Table 2-37 – Program stream ... 68
Table 2-38 – Program stream pack ... 68
Table 2-39 – Program stream pack header ... 69
Table 2-40 – Program stream system header ... 70
Table 2-41 – Program stream map ... 73
Table 2-42 – Program stream directory packet ... 75
Table 2-43 – Intra_coded indicator ... 76
Table 2-44 – Coding_parameters indicator ... 77
Table 2-45 – Program and program element descriptors ... 77
Table 2-46 – Video stream descriptor ... 79

Table 2-47 – Frame rate code 79
Table 2-48 – Audio stream descriptor 80
Table 2-49 – Hierarchy descriptor 80
Table 2-50 – Hierarchy_type field values 82
Table 2-51 – Registration descriptor 82
Table 2-52 – Data stream alignment descriptor 83
Table 2-53 – Video stream alignment values 83
Table 2-54 – AVC video stream alignment values 84
Table 2-55 – HEVC video stream alignment values 84
Table 2-56 – Audio stream alignment values 84
Table 2-57 – VVC video stream alignment values 85
Table 2-58 – EVC video stream alignment values 85
Table 2-59 – Target background grid descriptor 86
Table 2-60 – Video window descriptor 86
Table 2-61 – Conditional access descriptor 87
Table 2-62 – ISO 639 language descriptor 87
Table 2-63 – Audio type values 88
Table 2-64 – System clock descriptor 89
Table 2-65 – Multiplex buffer utilization descriptor 89
Table 2-66 – Copyright descriptor 90
Table 2-67 – Maximum bitrate descriptor 90
Table 2-68 – Private data indicator descriptor 91
Table 2-69 – Smoothing buffer descriptor 91
Table 2-70 – STD descriptor 92
Table 2-71 – IBP descriptor 92
Table 2-72 – MPEG-4 video descriptor 93
Table 2-73 – MPEG-4 audio descriptor 93
Table 2-75 – IOD descriptor 96
Table 2-76 – SL descriptor 96
Table 2-77 – FMC descriptor 97
Table 2-78 – External_ES_ID descriptor 97
Table 2-79 – Muxcode descriptor 98
Table 2-80 – M4MuxBufferSize descriptor 98
Table 2-81 – MultiplexBuffer descriptor 99
Table 2-82 – M4MuxTiming descriptor 99
Table 2-83 – Content labelling descriptor 100
Table 2-84 – Metadata_application_format 100
Table 2-85 – Content_time_base_indicator values 101
Table 2-86 – Metadata pointer descriptor 102
Table 2-87 – Metadata format values 102
Table 2-88 – MPEG_carriage_flags 103
Table 2-89 – Metadata descriptor 104
Table 2-90 – decoder_config_flags 105
Table 2-91 – Metadata STD descriptor 106
Table 2-92 – AVC video descriptor 106
Table 2-93 – AVC timing and HRD descriptor 108
Table 2-94 – MPEG-2 AAC_audio_descriptor 109
Table 2-95 – MPEG-2_AAC_additional_information field values 110
Table 2-96 – MPEG-4 text descriptor 110
Table 2-97 – MPEG-4 audio extension descriptor 110
Table 2-98 – Auxiliary video stream descriptor 111
Table 2-99 – SVC extension descriptor 112
Table 2-100 – MVC extension descriptor 113
Table 2-101 – J2K video descriptor 114

Table 2-102 – Example frame rates based on DEN_frame_rate and NUM_frame_rate values 116
Table 2-103 – MVC operation point descriptor 118
Table 2-104 – MPEG2_stereoscopic_video_format_descriptor syntax 119
Table 2-105 – Stereoscopic_program_info_descriptor syntax 119
Table 2-106 – Stereoscopic_service_type values 120
Table 2-107 – Stereoscopic_video_info_descriptor syntax 120
Table 2-108 – Upsampling factor values 121
Table 2-109 – Extension descriptor 121
Table 2-110 – Extension descriptor tag values 124
Table 2-111 – Transport_profile_descriptor syntax 125
Table 2-112 – Transport_profile values 125
Table 2-113 – HEVC video descriptor 126
Table 2-114 – Semantics of HDR_WGC_idc 128
Table 2-115 – HEVC timing and HRD descriptor 128
Table 2-116 – Adaptation field extension descriptor 129
Table 2-117 – HEVC operation point descriptor 130
Table 2-118 – HEVC hierarchy extension descriptor 132
Table 2-119 – Semantics of extension dimension bits 132
Table 2-120 – Green extension descriptor 133
Table 2-121 – MPEG-H 3D audio descriptor 134
Table 2-122 – MPEG-H 3D audio config descriptor 134
Table 2-123 – MPEG-H 3D audio scene descriptor 135
Table 2-124 – MPEG-H 3D audio text label descriptor 138
Table 2-125 – MPEG-H 3D audio multi-stream descriptor 140
Table 2-126 – MPEG-H 3D audio DRC and Loudness descriptor() 141
Table 2-127 – MPEG-H 3D audio command descriptor 143
Table 2-128 – Quality extension descriptor 144
Table 2-129 – Virtual segmentation descriptor 145
Table 2-130 – HEVC tile substream descriptor 146
Table 2-131 — HEVC subregion descriptor 147
Table 2-132 – JPEG XS video descriptor 149
Table 2-133 – VVC video descriptor 151
Table 2-134 – Semantics of HDR_WGC_idc 152
Table 2-135 – SDR widely used video property combinations 153
Table 2-136 – WCG widely used video property combinations 153
Table 2-137 – HDR/WCG widely used video property combinations 153
Table 2-138 – No Indication 154
Table 2-139 – VVC timing and HRD descriptor 154
Table 2-140 – EVC video descriptor 156
Table 2-141 – EVC timing and HRD descriptor 157
Table 2-142 – LCEVC video descriptor 158
Table 2-143 – LCEVC linkage descriptor 159
Table 2-144 – Media service kind descriptor 160
Table 2-145 – media_description_flag 160
Table 2-146 – Media type indicator 160
Table 2-147 – ID_length_code 161
Table 2-148 – ID_type 161
Table 2-149 – configuration type values 161
Table 2-150 – lang_len_indicator 162
Table 2-151 – Media service type values 162
Table 2-152 – Carriage of individual ISO/IEC 14496 streams in Rec. ITU-T H.222.0 | ISO/IEC 13818-1 172
Table 2-153 – Section syntax for transport of ISO/IEC 14496 stream 177
Table 2-154 – ISO/IEC defined options for carriage of an ISO/IEC 14496 scene and associated streams in Rec. ITU-T H.222.0 | ISO/IEC 13818-1 180
Table 2-155 – Metadata Access Unit Wrapper 187

Table 2-156 – Metadata AU cell 187
Table 2-157 – Cell fragment indication 187
Table 2-158 – Section syntax for transport of metadata 188
Table 2-159 – Section fragment indication 189
Table 2-160 – View and dependency representation delimiter NAL unit 198
Table 2-161 – Implied hierarchy_layer_index if no hierarchy descriptors are used 218
Table 2-162 – Green access unit section syntax 225
Table 2-163 – Green access unit 225
Table 2-164 – Quality Access Unit 228
Table B.1 – DSM-CC syntax 245
Table B.2 – Command_id assigned values 245
Table B.3 – DSM-CC control 246
Table B.4 – Select mode assigned values 247
Table B.5 – DSM-CC Acknowledgement 248
Table B.6 – Time code 249
Table C.1 – Composite_descriptor 255
Table C.2 – Sub-descriptor 255
Table C.3 – Program association table bandwidth usage (bit/s) Number of programs per transport stream 256
Table C.4 – Program map table bandwidth usage (bit/s) Number of programs per transport stream 256
Table D.1 – Re-multiplexing strategy 263
Table E.1 – PES packet header example 267
Table S.1 – J2K Access unit elementary stream header 298
Table S.2 – Operating levels and maximum buffer size for JPEG 2000 broadcast profiles (from Table A.49 in Rec. ITU-T T.800 (2015) | ISO/IEC 15444-1:2016) 303
Table T.1 – 'codecs' parameter values for some specific stream_type values 305
Table U.1 – Variable field length notation example 307
Table U.1*bis* – Table U.1 in equivalent full notation 308
Table U.2 – TEMI access unit 308
Table U.3 – AF descriptor tags 309
Table U.4 – TEMI location descriptor 310
Table U.5 – TEMI URL scheme types 310
Table U.6 – TEMI service types 311
Table U.7 – TEMI base URL descriptor 311
Table U.8 – TEMI timeline descriptor 312
Table U.9 – TEMI MPEG-H_3dAudio_extStreamID descriptor 314
Table U.10 – Boundary descriptor 315
Table U.11 – sequence_number_length_code interpretation 315
Table U.12 – Labelling Descriptor 316
Table U.13 – label_length_code interpretation 316
Table U.14 – label_type values 317
Table U.15 – HEVC tile substream af_descriptor 317
Table W.1 – JPEG XS Access unit elementary stream header (jxes header) 321

Figure Intro. 1 – Simplified overview of the scope of this Recommendation | International Standard xiv
Figure Intro. 2 – Prototypical transport demultiplexing and decoding example xvi
Figure Intro. 3 – Prototypical transport multiplexing example xvi
Figure Intro. 4 – Prototypical transport stream to program stream conversion xvi
Figure Intro. 5 – Prototypical decoder for program streams xvii
Figure 2-1 – Transport stream system target decoder notation 16
Figure 2-2 – Program stream system target decoder notation 63
Figure 2-3 – Target background grid descriptor display area 85
Figure 2-4 – Media Service Kind Descriptor semantics at program level 165
Figure 2-5 – Media Program Kind Descriptor semantics at elementary stream level 165
Figure 2-6 – T-STD model extensions for individual ISO/IEC 14496 elementary streams 172
Figure 2-7 – T-STD model for ISO/IEC 14496 content 178
Figure 2-8 – P-STD model for ISO/IEC 14496 Systems stream 181
Figure 2-9 – Timing model for delivery of content and metadata 184
Figure 2-10 – Delivery of metadata in PES packets 185
Figure 2-11 – Metadata signalling and referencing 191
Figure 2-12 – Metadata decoding in the STD 191
Figure 2-13 – T-STD model extensions for Rec. ITU-T H.264 | ISO/IEC 14496-10 video 195
Figure 2-14 – P-STD model extensions for Rec. ITU-T H.264 | ISO/IEC 14496-10 video 197
Figure 2-15 – T-STD model extensions for Rec. ITU-T H.264 | ISO/IEC 14496-10 Video with scalable video sub-bitstreams 198
Figure 2-16 – P-STD model extensions for Rec. ITU-T H.264 | ISO/IEC 14496-10 Video with scalable video sub-bitstreams 201
Figure 2-17 – T-STD model extensions for Rec. ITU-T H.264 | ISO/IEC 14496-10 Video with MVC video sub-bitstreams 203
Figure 2-18 – P-STD model extensions for Rec. ITU-T H.264 | ISO/IEC 14496-10 Video with MVC video sub-bitstreams 207
Figure 2-19 – T-STD model extensions for ISO/IEC 14496-17 text streams 209
Figure 2-20 – T-STD model extensions for single layer HEVC 212
Figure 2-21 – T-STD model extensions for layered transport of HEVC temporal video subsets 214
Figure 2-22 – T-STD model extensions for bitstream-partition-specific CPB operation 216
Figure 2-23 – T-STD model extensions for transport of HEVC tiles through individual ESs 220
Figure 2-24 – T-STD model extensions for transport of HEVC tiles in a common ES using AF descriptors 222
Figure 2-25 – T-STD model extension for transport of HEVC tiles in a common ES ignoring AF descriptors 224
Figure 2-26 – T-STD model extension for green access units 226
Figure 2-27 – Transport stream system target decoder for multiple audio elementary streams 228
Figure 2-28 – Quality Access Unit decoder processing model 229
Figure 2-29 – T-STD model extensions for single layer VVC 231
Figure 2-30 – T-STD model extensions for layered transport of VVC temporal video subsets 233
Figure 2-31 – T-STD model extensions for single layer EVC 236
Figure A.1 – 32-bit CRC decoder model 240
Figure B.1 – Configuration of DSM-CC application 243
Figure B.2 – BSM-CC bitstream decoded as a stand-alone bitstream 243
Figure B.3 – DSM-CC bitstream decoded as part of the system bitstream 244
Figure C.1 – Program and network mapping relationships 253
Figure D.1 – Constant delay model 258
Figure D.2 – STC recovery using PLL 262
Figure F.1 – Transport stream syntax diagram 268
Figure F.2 – PES packet syntax diagram 269
Figure F.3 – Program association section diagram 269
Figure F.4 – Conditional access section diagram 269
Figure F.5 – TS program map section diagram 270
Figure F.6 – Private section diagram 270
Figure F.7 – Program stream diagram 271

Figure F.8 – Program stream map diagram 271
Figure J.1 – Sending system streams over a jitter-inducing network 276
Figure J.2 – Jitter-smoothing using network-layer timestamps 276
Figure J.3 – Integrated dejittering and MPEG-2 decoding 277
Figure R.1 – Example of ISO/IEC 14496 content in a program stream 292
Figure R.2 – Example of ISO/IEC 14496 content in a transport stream 293
Figure R.3 – Usage of MPEG-4 in a transport stream with BIFS scene referring to native PES 294
Figure R.4 – Usage of MPEG-4 in a transport stream with an ODUpdate_descriptor carrying an image ObjectDescriptor in the PMT 295
Figure S.1 – Structure and order of JPEG 2000 access units 300
Figure S.2 – T-STD model extensions for J2K Video 301
Figure U.1 – Stream partitioning into 2 and 5 second segments 315
Figure V.1 – Illustration of HEVC tiled encoding of panoramic content beyond UHD 318
Figure V.2 – Example of HEVC tile substream identification 319
Figure V.3 – Example of subregion layout for a 3 x 3 RoI 319
Figure W.1 – Structure and order of JPEG XS access units 322
Figure W.2 – T-STD model extensions for JPEG XS Video 324