ETSI TS 126 116 V13.1.0 (2018-01)

TECHNICAL SPECIFICATION

**Universal Mobile Telecommunications System (UMTS);
LTE;
Television (TV) over 3GPP services;
Video profiles
(3GPP TS 26.116 version 13.1.0 Release 13)**

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Sous-Préfecture de Grasse (06) N° 7803/88

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Contents

Foreword

This Technical Specification has been produced by the 3rd Generation Partnership Project (3GPP).

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Introduction

Linear TV services can be made available on 3GPP services based on MBMS and PSS user services (over RTP or 3GP-DASH).

- 3GP-DASH aims at offering the best quality of experience as possible by adapting to the UE capabilities and dynamically to the network conditions. Linear TV and on-demand services are already identified as major use cases for 3GP-DASH delivery format.

- (e)MBMS user services offer the possibility to offload the network when the same content is consumed simultaneously by many UEs. This typically happens when a large audience accesses the same content concurrently, such as a popular football match, the Olympic Games, a political debate, breaking news, etc. For this reason, the access to live broadcast TV services is a major use case for eMBMS.

For traditional linear TV distribution, TV services accessed through Satellite, Digital Terrestrial TV (DTT), cable or IPTV obey to requirements on the video profiles to ensure a consistent quality of experience while accessing different channels within a TV bouquet.

On-demand video services, via streaming or downloading, generally obey to the same requirements.

In previous releases, 3GPP specifications were missing detailed definitions of consistent video distribution formats (such as spatial and temporal resolutions, aspect ratios, random access points, etc.) for which operators can provide such guarantees in terms of quality of experience. The purpose of the present document is to specify those distribution formats.

1 Scope

The present document specifies requirements and guidelines on video source formats (frame rate, resolution, aspect ratio, colorimetry, bit depth…) and encoding parameters (codec format, random access point period, SEI messages…) for different types of TV services, including linear TV, catch-up TV or on-demand services. A limited set of Operation Points (e.g. SDTV, HDTV…) are defined to provide confidence to content providers/broadcasters on the quality of experience offered by 3GPP services when used for TV-like distribution. Operation Points define format and encoding restrictions, but may also be viewed as compatibility points for UEs.

In particular, the Operation Points defined in the present document may serve as the primary tested configurations for TV centric video distribution. The initial set of Operation Points are defined based on the analysis and findings in the technical report TR 26.949 [2].

In addition, in the context of DASH operations, not only the main distribution format are defined, but also a subset of spatial and temporal resolutions. In order to minimize testing for seamless switching experience, suitable lower resolutions of distribution formats are defined. Furthermore, to compensate congestion situations, a minimum service quality is defined in order to provide service continuity.

2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non-specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1]   3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2]   3GPP TR 26.949: "Video formats for 3GPP services".

[3]   Recommendation ITU-R BT.709-6 (06/2015): "Parameter values for the HDTV standards for production and international programme exchange".

[4]   Recommendation ITU-R BT.2020-2 (10/2015): "Parameter values for ultra-high definition television systems for production and international programme exchange".

[5]   Recommendation ITU-T H.264 (04/2017): "Advanced video coding for generic audiovisual services" | ISO/IEC 14496-10:2014: "Information technology – Coding of audio-visual objects – Part 10: Advanced Video Coding".

[6]   Recommendation ITU-T H.265 (12/2016): "High efficiency video coding" | ISO/IEC 23008-2:2015: "High Efficiency Coding and Media Delivery in Heterogeneous Environments – Part 2: High Efficiency Video Coding".

[7]   3GPP TS 26.244: "Transparent end-to-end packet switched streaming service (PSS); 3GPP file format (3GP)".

[8]   3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".

[9]   ISO/IEC 14496-15: 2017: "Information technology - Coding of audio-visual objects - Part 15: Carriage of network abstraction layer (NAL) unit structured video in ISO base media file format".

[10]   ISO/IEC 23001-8:2016, "Information technology -- MPEG systems technologies -- Part 8: Coding-independent code points".

3 Definitions and abbreviations

3.1 Definitions

For the purposes of the present document, the terms and definitions given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

Bitstream: A media bitstream that conforms to a video encoding format and certain Operation Point.

Operation Point: A collection of discrete combinations of different content formats including spatial and temporal resolutions, colour mapping, transfer functions, etc. and the encoding format.

Pillarbox: The pillarbox effect occurs in widescreen video displays when black bars (mattes or masking) are placed on the sides of the image. It becomes necessary when film or video that was not originally designed for widescreen is shown on a widescreen display, or a narrower widescreen image is displayed within a wider aspect ratio.

Receiver: A receiver that can decode and render any bitstream that is conforming to a certain Operation Point.

3.2 Abbreviations

For the purposes of the present document, the abbreviations given in 3GPP TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in 3GPP TR 21.905 [1].

AVC	Advanced Video Coding
DASH	Dynamic Adaptive Streaming over HTTP
FFS	For Further Study
HD	High Definition
HDR	High Dynamic Range
HRD	Hypothetical Reference Decoder
HEVC	High Efficiency Video Coding
MBMS	Multicast Broadcast Multimedia Service
MPD	Media Presentation Description
NAL	Network Abstraction Layer
PPS	Picture Parameter Set
PSS	Packet Switch Streaming
RAP	Random Access Point
SDR	Standard Dynamic Range
SEI	Supplemental Enhancement Information
SPS	Sequence Parameter Set
TV	Television
UHD	Ultra High Definition
VCL	Video Coding Layer
VUI	Video Usability Information

4 Video profiles Operation Points

4.1 Introduction

The video profile Operation Points defined in this clause are primarily defined in order to apply to the content format being delivered to 3GPP UE PSS/DASH and MBMS clients over the 3GPP system. Parameters for video encoder/decoder, content format and transport are defined.

The following Operation Points are defined in the present document: H.264/AVC 720p HD, H.264/AVC Full HD, H.265/HEVC 720p HD, H.265/HEVC Full HD, and H.265/HEVC UHD.

Clause 4.2 specifies general requirements applicable to all Operation Points. Clause 4.3 specifies general requirements applicable to the video codecs. Then for each Operation Point, Bitstream and Receiver requirements are detailed in clause 4.4 for H.264/AVC and clause 4.5 for H.265/HEVC.

4.2 General requirements on video profile Operation Points

The following requirements apply to video profile Operation Points:

- 16:9 picture aspect ratio shall be used. 3GPP UEs with display aspect ratio different from 16:9 and supporting the TV services over 3GPP are, by default, assumed to display the video in letter-box or pillarbox modes, depending on the screen size and orientation.

- Y'CbCr (non-constant luminance) as the Chroma Format should be used.

- 4:2:0 chroma sub-sampling shall be used.

- The following spatial resolutions should be used for:

  - Operation Points (for video intended to be viewed in full-screen mode): 3840 × 2160, 1920 × 1080 and 1280 × 720.

  - Distribution formats: 3840 × 2160, 3200 × 1800, 2560 × 1440, 1920 × 1080, 1600 × 900, 1280 × 720, 960 × 540, 854 × 480, 640 × 360, 426 × 240.

NOTE 1: Distribution formats within an Operation Point do not exceed the native resolution of the Operation Point, but they may be subsampled in order to optimize distribution or adapt to the viewing conditions.

- The following frame rates should be used depending on the Operation Point: 24; 25; 30; 50 and 60Hz. The following fractional frame rates may be used: 24/1.001, 30/1.001, 60/1.001 (Hz). Frame rates are not associated to any particular spatial resolution.

- The following colour space formats may be used depending on the Operation Point: ITU-R BT.709 [3] and ITU-R BT.2020 [4]. If no signal is provided for the colour space, BT.709 [3] should be assumed as default colour space. Receiving devices should support BT.2020 [4] signaling and provide an appropriate mapping of the signal to the supported colour space of the device. Colour spaces are not associated to any particular spatial resolution.

NOTE 2: Although ITU-R BT.2020 is originally only recommended for 2160p/4320p resolution, this 3GPP specification recommends that BT.2020 be supported irrespective of the resolution to keep the colour space consistent across resolutions.

- The Random Access Point period shall be less than or equal to 5 seconds, should be less than or equal to 2 seconds and may be less than or equal to 0.5 second for H.264/AVC [5] and 1 second for H.265/HEVC [6] for specific service requirements such as fast channel change or fast access to the bitstream.

- Bit depth: Either 8 or 10 bits shall be used depending on the Operation Point.

Table 4.1 provides an overview of the Operation Points defined in the present document.

Table 4.1: TV over 3GPP services Video Profile Operation Points

Operation Point name	Resolution format	Picture aspect ratio	Scan	Max. frame rate	Chroma format	Chroma sub-sampling	Bit depth	Colour space format
H.264/AVC 720p HD	1280 × 720	16:9	Progressive	30	Y'CbCr	4:2:0	8	BT.709 [3]
H.265/HEVC 720p HD	1280 × 720	16:9	Progressive	30	Y'CbCr	4:2:0	8	BT.709 [3]
H.264/AVC Full HD	1920 × 1080	16:9	Progressive	60	Y'CbCr	4:2:0	8	BT.709 [3]; BT.2020 [4]
H.265/HEVC Full HD	1920 × 1080	16:9	Progressive	60	Y'CbCr	4:2:0	8; 10	BT.709 [3]; BT.2020 [4]
H.265/HEVC UHD	3840 × 2160	16:9	Progressive	60	Y'CbCr	4:2:0	10	BT.2020 [4]

Operation Points are defined including the video codec format.

4.3 General Video codec requirements

The following video codecs and associated Profiles and Levels should be used:

- H.264/AVC Progressive High Profile Level 3.1 [5] for 720p HD services

- H.264/AVC Progressive High Profile Level 4.2 [5] for Full HD services

- H.265/HEVC Main Profile Main Tier Level 3.1 [6] for 720p HD services

- H.265/HEVC Main-10 Profile Main Tier Level 4.1 [6] for Full HD services

- H.265/HEVC Main-10 Profile Main Tier Profile Level 5.1 [6] for UHD services

The Table 4.2 presents the mapping of the operation points with the codec type, profile and level.

Table 4.2: Video codec parameters

Operation Point name	Resolution Format	Codec type, profile and level
H.264/AVC 720p HD	1280 × 720	AVC/H.264 Progressive High Profile Level 3.1
HEVC/H.265 720p HD	1280 × 720	HEVC/H.265 Main Profile Main Tier Level 3.1
H.264/AVC Full HD	1920 × 1080	AVC/H.264 Progressive High Profile Level 4.2
HEVC/H.265 Full HD	1920 × 1080	HEVC/H.265 Main-10 Profile Main Tier Level 4.1
HEVC/H.265 UHD	3840 × 2160	HEVC/H.265 Main-10 Profile Main Tier Level 5.1

4.4 H.264/AVC Operation Points

4.4.1 Common requirements and recommendations

4.4.1.1 General

The video Bitstream and Receiver shall conform to Recommendation ITU-T H.264 / ISO/IEC 14496-10 [5] with the restrictions described in this clause. H.264/AVC Bitstreams and Receivers shall support some parts of the "Video

Usability Information (VUI)" syntax elements as specified in Recommendation ITU-T H.264 / ISO/IEC 14496-10 [5], annex E, which values are defined in this clause.

4.4.1.2 Random access point

4.4.1.2.1 Definition

An H.264/AVC random access point (RAP) is defined as an access unit in an H.264/AVC Bitstream at which a Receiver can begin decoding the video successfully. This access unit shall include an AU delimiter NAL unit, only one Sequence Parameter Set (that is active) including the VUI and the Picture Parameter Set (PPS) that is required for decoding the associated picture. The access unit shall contain an IDR picture or an I picture.

4.4.1.2.2 Random access point period

RAPs shall be present in the Bitstream at least once every 5 seconds. It is recommended that RAPs occur in the video Bitstream on average at least every 2 seconds. The time interval between successive RAPs is measured as the difference between their respective decoding time values.

4.4.1.3 Sequence parameter set

The following restrictions apply to the active Sequence Parameter Set (SPS):

- gaps_in_frame_num_value_allowed_flag value shall be set to 0.

- The Video Usability Information shall be present in the active Sequence Parameter Set. The vui_parameter_present_flag shall be set to 1.

- The source video format shall be progressive. frame_mbs_only_flag shall be set to 1 for every picture of the Bitstream.

4.4.1.4 Video usability information

The aspect ratio information shall be present, i.e.

- The `aspect_ratio_present_flag` value shall be set to 1.

- The `aspect_ratio_idc` value shall be set to 1 indicating a square pixel format.

The colour parameter information shall be present, i.e.

- video_signal_type_present_flag value and colour_description_present_flag value shall be set to 1.

- The values of colour_primaries, transfer_characteristics and matrix_coefficients are defined in clause 4.4.2.4 for H.264/AVC 720p HD and in clause 4.4.3.4 for H.264/AVC Full HD Operation Points.

The timing information may be present.

- If the timing information is present, i.e. the value of `timing_info_present_flag` is set to 1, then the values of `num_units_in_tick` and `time_scale` shall be set according to the frame rates allowed in clause 4.4.2.5 for H.264/AVC 720p HD and in clause 4.4.3.5 for H.264/AVC Full HD Operation Points. The timing information present in the video Bitstream should be consistent with the timing information signalled at the system level.

  NOTE: In 3GPP PSS and MBMS User services, the Receiver observes the timing at the system level, and ignores the timing information in the video Bitstream.

- The frame rate shall not change between two RAPs. `fixed_frame_rate_flag` value shall be set to 1.

There are no requirements on output timing conformance for H.264/AVC decoding (Annex C of [5]). The Hypothetical Reference Decoder (HRD) parameters, if present, should be ignored by the Receiver.

4.4.2 H.264/AVC 720p HD Operation Point

4.4.2.1 Introduction

The following restrictions apply for the **H.264/AVC 720p HD** Operation Point. The general requirements and recommendations for Bitstreams and Receivers for H.264/AVC Operation Points in clause 4.4.1 shall apply.

NOTE: This format is within the capabilities of H.264/AVC video codecs of 3GPP video services up to Release 13.

4.4.2.2 Profile and level

A Bitstream conforming to the H.264/AVC 720p HD Operation Point shall comply with the following restrictions:

- The `profile_idc` shall be set to 100 indicating the High profile.

- The constrain_set0_flag, constrain_set1_flag, constrain_set2_flag and constrain_set3_flag shall all be set to 0.

- The value of `level_idc` shall not be greater than 31 (corresponding to the level 3.1) and should indicate the lowest level to which the Bitstream conforms.

4.4.2.3 Spatial resolutions

The spatial resolution of the distribution format shall be one of the following:

- 1280×720,

- 960×540,

- 854×480,

- 640×360,

- 426×240.

4.4.2.4 Colour information

A Bitstream conforming to the H.264/AVC 720p HD Operation Point shall use Recommendation ITU-R BT.709 [3] colorimetry.

The `colour_primaries` value, the `transfer_characteristics` value and the `matrix_coefficients` value in the Video Usability Information shall all be set to 1.

A Receiver conforming to the H.264/AVC 720p HD Operation Point shall be capable of decoding Bitstreams that use Recommendation ITU-R BT.709 [3] colorimetry.

4.4.2.5 Frame rates

A Bitstream conforming to the H.264/AVC 720p HD Operation Point shall have one of the following frame rates: 24; 25; 30; 24/1.001; 30/1.001 Hz.

The frame rate may be indicated in the VUI by setting `time_scale` and `num_units_in_tick`.

4.4.2.6 Receiver compatibility

Receivers conforming to the **H.264/AVC 720p** Operation Point shall support decoding and displaying **H.264/AVC 720p HD** Bitstreams.

Receivers conforming to the **H.264/AVC 720p** Operation Point are only required to support Bitstreams with the maximum VCL Bit Rate constrained to be 14 Mbps with cpbBrVclFactor and cpbBrNalFactor being fixed to be 1000 and 1200, respectively.

4.4.3 H.264/AVC Full HD Operation Point

4.4.3.1 Introduction

The following restrictions apply for the **H.264/AVC Full HD** Operation Point. The general requirements and recommendations for Bitstreams and Receivers for H.264/AVC Operation Points in clause 4.4.1 shall apply.

4.4.3.2 Profile and level

A Bitstream conforming to the H.264/AVC Full HD Operation Point shall comply with the following restrictions:

- The `profile_idc` shall be set to 100 indicating the High profile.

- The constrain_set0_flag, constrain_set1_flag, constrain_set2_flag and constrain_set3_flag shall all be set to 0.

- The value of `level_idc` shall not be greater than 42 (corresponding to the level 4.2)) and should indicate the lowest level to which the Bitstream conforms.

4.4.3.3 Spatial resolutions

The spatial resolution of the distribution format shall be one of the following:

- 1920 x 1080,

- 1600×900,

- 1280×720,

- 960×540,

- 854×480,

- 640×360,

- 426×240.

4.4.3.4 Colour information

A Bitstream conforming to the H.264/AVC Full HD Operation Point shall use Recommendation ITU-R BT.709 [3] colorimetry.

The `colour_primaries` value, the `transfer_characteristics` value and the `matrix_coefficients` value in the Video Usability Information shall all be set to 1.

A Receiver conforming to the H.264/AVC Full HD Operation Point shall be capable of decoding Bitstreams that use Recommendation ITU-R BT.709 [3] colorimetry.

4.4.3.5 Frame rates

A Bitstream conforming to the H.264/AVC Full HD Operation Point shall have one of the following frame rates: 24; 25; 30; 50; 60; 24/1.001; 30/1.001; 60/1.001 Hz.

The frame rate may be indicated in the VUI by setting `time_scale` and `num_units_in_tick`.

4.4.3.6 Receiver compatibility

Receivers conforming to the **H.264/AVC Full HD** Operation Point shall support decoding and displaying **H.264/AVC 720p HD** and **H.264/AVC Full HD** Bitstreams.

4.5 H.265/HEVC Operation Points

4.5.1 Common requirements and recommendations

4.5.1.1 General

The video Bitstream and Receiver shall conform to Recommendation ITU-T H.265 / ISO/IEC 23008-2 [6] with the restrictions described in this clause. H.265/HEVC Bitstreams and Receivers shall support some parts of the "Video usability information (VUI)" syntax elements as specified in Recommendation ITU-T H.265 / ISO/IEC 23008-2 [6], annex E. which values are defined in this clause.

4.5.1.2 Random access point

4.5.1.2.1 Definition

An H.265/HEVC random access point (RAP) is defined as an access unit in an H.265/HEVC Bitstream at which a Receiver can begin decoding the video bitstream successfully. This access unit shall include an AU delimiter NAL unit, only one Video Parameter Set (that is active), only one Sequence Parameter Set (that is active) including the VUI and the Picture Parameter Set that is required for decoding the associated picture. The access unit shall contain an IRAP picture or an I picture, as defined in Recommendation ITU-T H.265 / ISO/IEC 23008-2 [6].

4.5.1.2.2 Random access point period

RAPs shall be present in the Bitstream at least once every 5 seconds. It is recommended that RAPs occur in the video Bitstream on average at least every 2 seconds. The time interval between successive RAPs is measured as the difference between their respective decoding time values.

4.5.1.3 Video parameter set

H.265/HEVC Receivers should ignore the content of all Video Parameter Sets (VPS) NAL units as defined in Recommendation ITU-T H.265 / ISO/IEC 23008-2 [6].

NOTE: The content of VPS may be used in future Operation Points.

4.5.1.4 Sequence parameter set

The following restrictions apply to the active Sequence Parameter Set (SPS):

- The Video Usability Information (VUI) shall be present in the active Sequence Parameter Set. The `vui_parameters_present_flag` shall be set to 1.

- The chroma sub-sampling shall be 4:2:0, `chroma_format_idc` value shall be set to 1.

- The source video format shall be progressive, i.e.

  - The `general_progressive_source_flag` shall be set to 1,

  - The `general_interlaced_source_flag` shall be set to 0,

  - The `general_frame_only_constraint_flag` shall be set to 1.

- Only 2D contents are required to be supported, i.e.

  - The `general_non_packed_constraint_flag` shall be set to 1.

Receivers conforming to any of the H.265/HEVC Operation Points shall only support Bitstreams with the restrictions on the SPS defined above.

4.5.1.5 Video usability information

The aspect ratio information shall be present, i.e.

- The `aspect_ratio_info_present_flag` value shall be set to 1.

- The `aspect_ratio_idc` value shall be set to 1 indicating a square pixel format.

The colour parameter information shall be present, i.e.

- video_signal_type_present_flag value and colour_description_present_flag value shall be set to 1.

- The values of colour_primaries, transfer_characteristics and matrix_coeffs are defined in clause 4.5.2.5 for H.265/HEVC 720p HD, in clause 4.5.3.5 for H.265/HEVC Full HD and in clause 4.5.4.5 for H.265/HEVC UHD Operation Points.

The timing information may be present.

- If the timing information is present, i.e. the value of `vui_timing_info_present_flag` is set to 1, then the values of `vui_num_units_in_tick` and `vui_time_scale` shall be set according to the frame rates allowed in clause 4.5.2.6 for H.265/HEVC 720p HD, in clause 4.5.3.6 for H.265/HEVC Full HD and in clause 4.5.4.6 for H.265/HEVC UHD Operation Points. The timing information present in the video Bitstream should be consistent with the timing information signalled at the system level.

- The frame rate shall not change between two RAPs. `fixed_frame_rate_flag` value, if present, shall be set to 1.

NOTE: In 3GPP PSS and MBMS User services, the Receiver observes the timing at the system level, and ignores the timing information in the video Bitstream.

There are no requirements on output timing conformance for H.265/HEVC decoding (Annex C of [6]). The Hypothetical Reference Decoder (HRD) parameters, if present, should be ignored by the Receiver.

4.5.2 H.265/HEVC 720p HD Operation Point

4.5.2.1 Introduction

The following restrictions apply for the **H.265/HEVC 720p HD** Operation Point. The general requirements and recommendations for Bitstreams and Receivers for H.265/HEVC Operation Points in clause 4.5.1 shall apply.

NOTE: This format is within the capabilities of H.265/HEVC video codecs as defined in 3GPP video services up to Release 13.

4.5.2.2 Profile, tier and level

A Bitstream conforming to the H.265/HEVC 720p HD Operation Point shall comply with the following restrictions:

- The `general_profile_idc` shall be set to 1 indicating the Main profile.

- The `general_tier_flag` shall be set to 0 indicating the Main tier.

- The value of `level_idc` shall not be greater than 93 (corresponding to the Level 3.1) and should indicate the lowest level to which the Bitstream conforms.

4.5.2.3 Bit depth

Bitstreams conforming to the H.265/HEVC 720p HD Operation Point shall be encoded with 8 bit precision.

- `bit_depth_luma_minus8` = 0

- `bit_depth_chroma_minus8` = `bit_depth_luma_minus8`

Receivers conforming to the H.265/HEVC 720p HD Operation Point shall support 8 bit precision.

4.5.2.4 Spatial resolutions

The spatial resolution of the distribution format shall be one of the following:

- 1280×720,

- 960×540,

- 854×480,

- 640×360,

- 426×240.

4.5.2.5 Colour information

A Bitstream conforming to the H.265/HEVC 720p HD Operation Point shall use Recommendation ITU-R BT.709 [3] colorimetry.

The `colour_primaries` value, the `transfer_characteristics` value and the `matrix_coeffs` value in the Video Usability Information shall all be set to 1.

A Receiver conforming to the H.265/HEVC 720p HD Operation Point shall be capable of decoding Bitstreams that use Recommendation ITU-R BT.709 [3] colorimetry.

4.5.2.6 Frame rates

A Bitstream conforming to the H.265/HEVC 720p HD Operation Point shall have one of the following frame rates: 24; 25; 30; 24/1.001; 30/1.001 Hz.

The frame rate may be indicated in the VUI by setting `vui_time_scale` and `vui_num_units_in_tick`.

4.5.2.7 Receiver compatibility

Receivers conforming to the **H.265/HEVC 720p** Operation Point shall support decoding and displaying **H.265/HEVC 720p HD** Bitstreams.

4.5.3 H.265/HEVC Full HD Operation Point

4.5.3.1 Introduction

The following restrictions apply for the **H.265/HEVC Full HD** Operation Point. The general requirements and recommendations for Bitstreams and Receivers for H.265/HEVC Operation Points in clause 4.5.1 shall apply.

4.5.3.2 Profile, tier and level

A Bitstream conforming to the H.265/HEVC Full HD Operation Point shall comply with the following restrictions:

- The `general_profile_idc` shall be set to 2 indicating the Main10 profile.

- The `general_tier_flag` shall be set to 0 indicating the Main tier.

- The value of `level_idc` shall not be greater than 123 (corresponding to the Level 4.1) and should indicate the lowest level to which the Bitstream conforms.

4.5.3.3 Bit depth

Bitstreams conforming to the H.265/HEVC Full HD Operation Point shall be encoded with either 8 or 10 bit precision.

- `bit_depth_luma_minus8` = 0 or 2 (8 or 10 bits respectively)

- `bit_depth_chroma_minus8` = `bit_depth_luma_minus8`

Receivers conforming to the H.265/HEVC Full HD Operation Point shall support 8 bit and10 bit precision.

4.5.3.4 Spatial resolution

The spatial resolution of the distribution format shall be one of the following:

- 1920×1080,

- 1600×900,

- 1280×720,

- 960×540,

- 854×480,

- 640×360,

- 426×240.

4.5.3.5 Colour information

A Bitstream conforming to the H.265/HEVC Full HD Operation Point shall use either Recommendation ITU-R BT.709 [3] colorimetry or Recommendation ITU-R BT.2020 [4] colorimetry in non-constant luminance.

- BT.709 [3] shall be signalled by setting `colour_primaries` to the value 1, `transfer_characteristics` to the value 1 and `matrix_coeffs` to the value 1.

- BT.2020 [4] shall be signalled by setting `colour_primaries` to the value 9, `transfer_characteristics` to the value 14 and `matrix_coeffs` to the value 9.

A Receiver conforming to the H.265/HEVC Full HD Operation Point shall be capable of decoding Bitstreams that use Recommendation ITU-R BT.709 [3] and ITU-R BT.2020 [4] colorimetry. Such a Receiver should support ITU-R BT.2020 [4] signalling and provide an appropriate mapping of the signal to the supported colour space of the device.

NOTE: Colour spaces are not associated to any particular spatial resolution.

4.5.3.6 Frame rates

A Bitstream conforming to the H.265/HEVC Full HD Operation Point shall have one of the following frame rates: 24; 25; 30; 50; 60; 24/1.001; 30/1.001; 60/1.001 Hz.

The frame rate may be indicated in the VUI by setting `vui_time_scale` and `vui_num_units_in_tick`.

4.5.3.7 Receiver compatibility

Receivers conforming to the **H.265/HEVC Full HD** Operation Point shall support decoding and displaying **H.265/HEVC 720p HD** and **H.265/HEVC Full HD** Bitstreams.

NOTE: The requirement infers that the Receivers conforming to the **H.265/HEVC Full HD** support Main and Main10 Profile.

4.5.4 H.265/HEVC UHD Operation Point

4.5.4.1 Introduction

The following restrictions apply for the **H.265/HEVC UHD** Operation Point. The general requirements and recommendations for Bitstreams and Receivers for H.265/HEVC Operation Points in clause 4.5.1 shall apply.

4.5.4.2 Profile, tier and level

A Bitstream conforming to the H.265/HEVC UHD Operation Point shall comply with the following restrictions:

- The `general_profile_idc` shall be set to 2 indicating the Main-10 profile.

- The `general_tier_flag` shall be set to 0 indicating the Main tier.

- The value of `level_idc` shall not be greater than 153 (corresponding to the Level 5.1) and should indicate the lowest level to which the Bitstream conforms.

4.5.4.3   Bit depth

A Bitstream conforming to the H.265/HEVC UHD Operation Point shall be encoded with 10 bits precision.

- `bit_depth_luma_minus8` = 2

- `bit_depth_chroma_minus8` = `bit_depth_luma_minus8`

Receivers conforming to the H.265/HEVC UHD Operation Point shall support 10 bits precision.

4.5.4.4   Spatial resolution

The spatial resolution of the distribution format shall be one of the following:

- 3840×2160,

- 3200×1800,

- 2560×1440,

- 1920×1080,

- 1600×900,

- 1280×720,

- 960×540,

- 854×480,

- 640×360,

- 426×240.

4.5.4.5   Colour information

A Bitstream conforming to the H.265/HEVC UHD Operation Point shall use Recommendation ITU-R BT.2020 [4] colorimetry in non-constant luminance.

- BT.2020 [4] shall be signalled by setting `colour_primaries` to the value 9, `transfer_characteristics` to the value 14 and `matrix_coeffs` to the value 9.

A Receiver conforming to the H.265/HEVC UHD Operation Point shall be capable of decoding Bitstreams that use ITU-R BT.2020 [4] colorimetry. Such a Receiver should support ITU-R BT.2020 [4] signalling and provide an appropriate mapping of the signal to the supported colour space of the device.

4.5.4.6   Frame rates

A Bitstream conforming to the H.265/HEVC UHD Operation Point shall have one of the following frame rates: 24; 25; 30; 50; 60; 24/1.001; 30/1.001; 60/1.001 Hz.

The frame rate may be indicated in the VUI by setting `vui_time_scale` and `vui_num_units_in_tick`.

4.5.4.7   Receiver compatibility

Receivers conforming to the **H.265/HEVC UHD** Operation Point shall support decoding and displaying **H.265/HEVC 720p HD**, **H.265/HEVC Full HD** and **H.265/HEVC UHD** Bitstreams.

NOTE: The requirement infers that the Receivers conforming to the **H.265/HEVC UHD** support Main and Main-10 Profile.

5 Mapping to 3GP-DASH delivery

5.1 General

5.1.1 MPD and 3GP-DASH format

The MPD shall conform to the 3GP-DASH format [8] with the constraints defined in clause 5.1.3. The MPD may signal the appropriate profiles parameter as defined below in the **MPD**@profiles attribute.

5.1.2 File Format Signalling

Representations used in the context of the specification shall conform to the 3GP File Format [7] and the 3GP-DASH Segment format [8] with the following further requirements:

- The '3gtv' ISO brand shall be set as a compatible_brand in the File Type Box ('ftyp').

- The value of the duration field in the Movie Header Box ('mvhd') shall be set to a value of '0'

- The Track Header Box ('tkhd') shall obey the following constraints:

    - The value of the duration field shall be set to '0'.

    - The width and height fields for a visual track shall specify the track's visual presentation size as fixed-point 16.16 values expressed in on a uniformly sampled grid (commonly called square pixels)

- The Media Header Box ('mdhd') shall obey the following constraints:

    - The value of the duration field shall be set to '0'.

- The Video Media Header ('vmhd') shall obey the following constraints:

    - The value of the version field shall be set to '0'.

    - The value of the graphicsmode field shall be set to '0'.

    - The value of the opcolor field shall be set to {'0', '0', '0'}.

- The Sample Description Box ('stsd') shall obey the following constraints:

    - A visual sample entry shall be used.

    - The box shall include a NAL Structured Video Parameter Set.

    - the maximum width and height values shall correspond to the maximum cropped horizontal and vertical sample counts indicated in any Sequence Parameter Set in the track.

    - It shall contain a Decoder Configuration Record which signals the Profile, Level, and other parameters in the video track.

- The entry_count field of the Sample-to-Chunk Box ('stsc') shall be set to '0'.

- Both the sample_size and sample_count fields of the Sample Size Box ('stsz') box shall be set to zero ('0'). The sample_count field of the Sample Size Box ('stz2') box shall be set to zero ('0'). The actual sample size information can be found in the Track Fragment Run Box ('trun') for the track.

NOTE: This is because the Movie Box ('moov') contains no media samples.

- The `entry_count` field of the Chunk Offset Box ('`stco`') shall be set to '0'.

- Movie Fragment Header Boxes ('`mfhd`') shall contain sequence_number values that are sequentially numbered starting with the number 1 and incrementing by +1, sequenced by movie fragment storage and presentation order.

- Any Segment Index Box ('`sidx`'), if present, shall obey the additional constraints:

  - the `timescale` field shall have the same value as the timescale field in the Media Header Box ('`mdhd`') within the same track; and

  - the `reference_ID` field shall be set to the `track_ID` of the ISO Media track as defined in the Track Header Box ('`tkhd`').

- For AVCSampleEntry ('`avc3`') and HEVCSampleEntry ('`hev1`') NAL Structured Video tracks, the '`first_sample_flags`' shall signal the picture type of the first sample in each movie fragment as specified below.

  - `sample_is_non_sync_sample=0`: If the first sample is a sync sample.

  - `sample_is_non_sync_sample=1`: If the first sample is not a sync sample.

  - `sample_depends_on=2`: If the first sample is an I frame.

- The Colour Information Box ('`colr`') should be present. If present, it shall signal the `colour_primaries`, `transfer_characteristics` and `matrix_coeffs` applicable to all the bitstreams associated with this sample entry.

- The sample timing shall obey the frame rate requirements for each Operation Point.

5.1.3   Adaptation Set Constraints

For a video Adaptation Set, the following constraints apply:

- The `@codecs` parameter shall be present on Adaptation Set level and shall signal the maximum required capability to decode any Representation in the Adaptation Set. The @codecs parameter should be signalled on the representation level if different from the one on Adaptation Set level.

- The `@profiles` parameter may be present to signal the constraints for the Adaptation Set.

- The attributes `@maxWidth` and `@maxHeight` shall be present. They are expected be used to signal the original source content format. This means that they may exceed the actual largest size of any coded Representation in one Adaptation Set. More details for each Operation Point are provided.

- The `@width` and `@height` shall be signalled for each Representation (possibly defaulted on Adaptation Set level) and shall match the values of the maximum width and height in the Sample Description box of the contained Representation.

- The Chroma Format may be signalled. If signalled:

  - An Essential or Supplemental Descriptor shall be used to signal the value by setting the `@schemeIdURI` attribute to `urn:mpeg:mpegB:cicp:MatrixCoefficients` as defined ISO/IEC 23001-8 [10] and the `@value` attribute according to Table 4 of ISO/IEC 23001-8 [10]. The values shall match the values set in the VUI.

  - The signalling shall be on Adaptation Set level.

- The Color Primaries and Transfer Function shall be signalled unless ITU-R BT.709 is used. If signalled:

  - An Essential or Supplemental Descriptor shall be used to signal the value by setting the `@schemeIdURI` attribute to `urn:mpeg:mpegB:cicp:ColourPrimaries` and `urn:mpeg:mpegB:cicp:TransferCharacteristics` as defined ISO/IEC 23001-8 [10] and the `@value` attribute according to Table 4 of ISO/IEC 23001-8 [10]. The values shall match the values set in the VUI.

- The signalling shall be on Adaptation Set level only, i.e. the value shall not be different for different Representations in one Adaptation Set.

- The maximum frame rate may be signalled on Adaptation Set using the `@maxFrameRate` attribute.

- The `@frameRate` shall be signalled for each Representation (possibly defaulted on Adaptation Set level). In one Adaptation Set, only frame rates shall be present from one of the following subsets:

  - 24 Hz with proposed signalling `@frameRate="24"`

  - 25 Hz, 50 Hz with proposed signalling `@frameRate="25"` or `@frameRate="50"`,

  - 30 Hz, 60 Hz with proposed signalling `@frameRate="30"` or `@frameRate="60"`,

  - 24/1.001 Hz with proposed signalling `@frameRate="24000/1001"`,

  - 30/1.001 Hz, 60/1.001 Hz with proposed signalling `@frameRate="30000/1001"` or `@frameRate="60000/1001"`.

- Random Access Points shall be signalled by `@startsWithSAP` set to 1, 2 or 3.

5.2 H.264/AVC 720p HD Operation Point

5.2.1 Operation Point Identifier

If all Representations in an Adaptation Set conforms to the elementary stream constraints for the **H.264/AVC 720p HD** Operation Point as defined in clause 4.4.2 and the Adaptation Set conforms to the MPD signalling according to clause 5.2.2 and 5.2.4, and the Representations conform to the file format constraints in clause 5.2.3, then the `@profiles` parameter in the Adaptation Set may signal conformance to this Operation Point by using `"urn:3GPP:video:op:h264-720p-HD"`.

5.2.2 MPD Signalling

The requirements as defined in clause 5.1.2 shall apply. In addition, the conditions in 5.2.3 shall apply.

5.2.3 File Format Signalling

The requirements as defined in clause 5.1.3 shall apply. In addition, the following shall apply.

The syntax and values for visual sample entry shall be set as follows:

- It shall conform to AVCSampleEntry (`'avc1'`) or AVCSampleEntry (`'avc3'`) as defined in ISO/IEC 14496-15 [9].

- If AVCSampleEntry (`'avc3'`) is used the following requirements apply:

  - If the sample is a Sync Sample, all parameter sets needed for decoding that sample SHALL be included in the sample itself.

  - If the sample is at the start of a Segment or a Subsegment, (i.e. a random access point position) that is not a Sync Sample, all parameter sets needed for decoding that sample shall occur in one of the samples between the starting point and that sample inclusive.

- The video track shall be encoded using the requirements and recommendations for H.264/AVC 720p HD Operation Point as defined in clause 4.4.2.

5.2.4 Adaptation Set Constraints

The requirements as defined in clause 5.1.3 shall apply. In addition, the following shall apply:

- `@maxWidth` shall be set to 1280 and `@maxHeight` shall be set to 720.

- The `@codecs` parameter shall be set to `avc1.64Y01F` or `avc3.64Y01F`,

- `@width` and `@height` for Representations shall be set to one of the following pairs: `(1280, 720)`,`(960, 540)`,`(854, 480)`,`(640, 360)`,or `(426, 240)`.

- `@frameRate` shall be set to one of the following values: `"24"`, `"25"`, `"30"`, `"24000/1001"`,or `"30000/1001"`.

5.3 H.264/AVC Full HD Operation Point

5.3.1 Operation Point Identifier

If all Representations in an Adaptation Set conforms to the elementary stream constraints for the **H.264/AVC Full HD** Operation Point as defined in clause 4.4.3 and the Adaptation Set conforms to the MPD signalling according to clause 5.3.2 and 5.3.4, and the Representations conform to the file format constraints in clause 5.3.3, then the `@profiles` parameter in the Adaptation Set may signal conformance to this Operation Point by using `"urn:3GPP:video:op:h264-Full-HD"`.

5.3.2 MPD Signalling

The requirements as defined in clause 5.1.2 shall apply. In addition, the conditions in 5.3.3 shall apply.

5.3.3 File Format Signalling

The requirements as defined in clause 5.2.3 shall apply. In addition, the video track shall be encoded using the requirements and recommendations for H.264/AVC Full HD Operation Point as defined in clause 4.4.3.

5.3.4 Adaptation Set Constraints

The requirements as defined in clause 5.1.3 shall apply. In addition, the following shall apply:

- `@maxWidth` and `@maxHeight` shall be set to one of the following pairs: `(1920,1080)`,`(1280,720)`

- The `@codecs` parameter shall be set to `avc1.64Y030` or `avc3.64Y030`,

- `@width` and `@height` for Representations shall be set to one of the following pairs: (1920, 1080), (1600, 900), (1280, 720), (960, 540), (854, 480), (640, 360), or (426, 240).

- If ITU-R BT.2020 is used, then the Colour Primaries, Transfer Characteristics and Matrix Coefficients shall be signalled as defined in clause 5.1.3.

5.4 H.265/HEVC 720p HD Operation Point

5.4.1 Operation Point Identifier

If all Representations in an Adaptation Set conforms to the elementary stream constraints for the **H.265/HEVC 720p HD** Operation Point as defined in clause 4.5.2 and the Adaptation Set conforms to the MPD signalling according to clause 5.4.2 and 5.4.4, and the Representations conform to the file format constraints in clause 5.4.3, then the `@profiles` parameter in the Adaptation Set may signal conformance to this Operation Point by using `"urn:3GPP:video:op:h265-720p-HD"`.

5.4.2 MPD Signalling

The requirements as defined in clause 5.1.2 shall apply. In addition, the conditions in 5.4.3 shall apply.

5.4.3   File Format Signalling

The requirements as defined in clause 5.1.3 shall apply. In addition, the following shall apply:

- It shall conform to HEVCSampleEntry ('hvc1') or HEVCSampleEntry ('hev1') as defined in ISO/IEC 14496-15 [9];

- If HEVCSampleEntry ('hev1') is used the following requirements apply:

    If the sample is a Sync Sample, all parameter sets needed for decoding that sample shall be included in the sample itself.

    - If the sample is at the start of a Segment or a Subsegment, (i.e. a random access point position) that is not a Sync Sample, all parameter sets needed for decoding that sample occur in one of the samples between the starting point and that sample inclusive.

- The video track shall be encoded using the requirements and recommendations for H.265/HEVC 720p HD Operation Point as defined in clause 4.5.2.

5.4.4   Adaptation Set Constraints

The requirements as defined in clause 5.1.3 shall apply. In addition, the following shall apply:

- `@maxWidth` shall be set to 1280 and `@maxHeight` shall be set to 720.

- The `@codecs` parameter shall be set to `hev1.1.2.L93.B0` or `hvc1.1.2.L93.B0`,

- `@width` and `@height` for Representations shall be set to one of the following pairs: `(1280, 720)`,`(960, 540)`,`(854, 480)`,`(640, 360)`,or `(426, 240)`.

- `@frameRate` shall be set to one of the following values: `"24"`, `"25"`, `"30"`, `"24000/1001"`, or `"30000/1001"`.

5.5   H.265/HEVC Full HD Operation Point

5.5.1   Operation Point Identifier

If all Representations in an Adaptation Set conforms to the elementary stream constraints for the **H.265/HEVC Full HD** Operation Point as defined in clause 4.5.3 and the Adaptation Set conforms to the MPD signalling according to clause 5.5.2 and 5.5.4, and the Representations conform to the file format constraints in clause 5.5.3, then the `@profiles` parameter in the Adaptation Set may signal conformance to this Operation Point by using `"urn:3GPP:video:op:h265-Full-HD"`.

5.5.2   MPD Signalling

The requirements as defined in clause 5.1.2 shall apply. In addition, the conditions in 5.5.3 shall apply.

5.5.3   File Format Signalling

The requirements as defined in clause 5.4.3 shall apply. In addition, the video track shall be encoded using the requirements and recommendations for H.265/HEVC Full HD Operation Point as defined in clause 4.5.3.

5.5.4   Adaptation Set Constraints

The requirements as defined in clause 5.1.3 shall apply. In addition, the following shall apply:

- `@maxWidth` and `@maxHeight` shall be set to one of the following pairs: `(1920, 1080)`,`(1280, 720)`.

- The `@codecs` parameter shall be set to hev1.2.4.L123.B0 or hvc1.2.4.L123.B0,

- `@width` and `@height` for Representations shall be set to one of the following pairs: (1920, 1080), (1600, 900), (1280, 720), (960, 540), (854, 480), (640, 360), or (426, 240).

- If ITU-R BT.2020 is used, then the Colour Primaries, Transfer Characteristics and Matrix Coefficients shall be signalled as defined in clause 5.1.3.

- `@frameRate` shall be set to one of the following values: "24", "25", "30", "50", "60", "24000/1001", "30000/1001" or "60000/1001".

5.6 H.265/HEVC UHD Operation Point

5.6.1 Operation Point Identifier

If all Representations in an Adaptation Set conforms to the elementary stream constraints for the **H.265/HEVC UHD** Operation Point as defined in clause 4.5.4 and the Adaptation Set conforms to the MPD signalling according to clause 5.6.2 and 5.6.4, and the Representations conform to the file format constraints in clause 5.6.3, then the `@profiles` parameter in the Adaptation Set may signal conformance to this Operation Point by using `"urn:3GPP:video:op:h265-UHD"`.

5.6.2 MPD Signalling

The requirements as defined in clause 5.1.2 shall apply. In addition, the conditions in 5.6.3 shall apply.

5.6.3 File Format Signalling

The requirements as defined in clause 5.4.3 shall apply. The video track shall be encoded using the requirements and recommendations for H.265/HEVC UHD Operation Point as defined in clause 4.5.4.

5.6.4 Adaptation Set Constraint

The requirements as defined in clause 5.1.3 shall apply. In addition, the following shall apply:

- `@maxWidth` and `@maxHeight` shall be set to one of the following pairs: (3840, 2160), (1920, 1080), (1280, 720).

- The `@codecs` parameter shall be set to hev1.2.4.L153.B0 or hvc1.2.4.L153.B0.

- `@width` and `@height` for Representations shall be set to one of the following pairs: (3840, 2160), (3200, 1800), (2560, 1440), (1920, 1080), (1600, 900), (1280, 720), (960, 540), (854, 480), (640, 360), or (426, 240). `@width` and `@height` shall not be greater than `@MaxWidth` and `@MaxHeight` respectively.

- `@frameRate` shall be set to one of the following values: "24", "25", "30", "50", "60", "24000/1001", "30000/1001" or "60000/1001".

- The Colour Primaries, Transfer Characteristics and Matrix Coefficients shall be signalled to indicate ITU-R BT.2020 as defined in clause 5.1.3.

Annex A (informative): Registration Information

A.1 3GPP Registered URIs

The clause documents the registered URIs in this specification following the process in
http://www.3gpp.org/specifications-groups/34-uniform-resource-name-urn-list

Table A-1 lists all registered URN values as well as

- a brief description of its functionality;

- a reference to the specification or other publicly available document (if any) containing the definition;

- the name and email address of the person making the application; and

- any supplementary information considered necessary to support the application.

Table A-1: 3GPP Registered URNs

URN	Description	Reference	Contact	Remarks
`urn:3GPP:video:op:h264-720p-HD`	DASH profile identifier for H.264/AVC 720p HD Operation Point	TS 26.116, clause 5.2.1	Thomas Stockhammer tsto@qti.qualcomm.com	none
`urn:3GPP:video:op:h264-Full-HD`	DASH profile identifier for H.264/AVC Full HD Operation Point	TS 26.116, clause 5.3.1	Thomas Stockhammer tsto@qti.qualcomm.com	none
`urn:3GPP:video:op:h265-720p-HD`	DASH profile identifier for H.265/HEVC 720p HD Operation Point	TS 26.116, clause 5.4.1	Thomas Stockhammer tsto@qti.qualcomm.com	none
`urn:3GPP:video:op:h265-Full-HD`	DASH profile identifier for H.265/HEVC Full HD Operation Point	TS 26.116, clause 5.5.1	Thomas Stockhammer tsto@qti.qualcomm.com	none
`urn:3GPP:video:op:h265-UHD`	DASH profile identifier for H.265/HEVC UHD Operation Point	TS 26.116, clause 5.6.1	Thomas Stockhammer tsto@qti.qualcomm.com	none

Annex B (informative):
Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
2016-03						Approved at TSG SA#71	13.0.0
2017-12	SA#78	SP-170821	0003	-	F	URN Registration for DASH profiles	13.1.0
2017-12	SA#78	SP-170821	0005	-	F	Corrections to TV Video Profiles	13.1.0

History

Document history		
V13.0.0	May 2016	Publication
V13.1.0	January 2018	Publication