

ETSI TS 126 511 V16.2.0 (2021-05)



**5G;
5G Media Streaming (5GMS);
Profiles, codecs and formats
(3GPP TS 26.511 version 16.2.0 Release 16)**



Reference

RTS/TSGS-0426511vg20

Keywords

5G

ETSI

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In the present document, modal verbs have the following meanings:

- shall** indicates a mandatory requirement to do something
- shall not** indicates an interdiction (prohibition) to do something

The constructions "shall" and "shall not" are confined to the context of normative provisions, and do not appear in Technical Reports.

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- should** indicates a recommendation to do something
- should not** indicates a recommendation not to do something
- may** indicates permission to do something
- need not** indicates permission not to do something

The construction "may not" is ambiguous and is not used in normative elements. The unambiguous constructions "might not" or "shall not" are used instead, depending upon the meaning intended.

- can** indicates that something is possible
- cannot** indicates that something is impossible

The constructions "can" and "cannot" are not substitutes for "may" and "need not".

- will** indicates that something is certain or expected to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- will not** indicates that something is certain or expected not to happen as a result of action taken by an agency the behaviour of which is outside the scope of the present document
- might** indicates a likelihood that something will happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

might not indicates a likelihood that something will not happen as a result of action taken by some agency the behaviour of which is outside the scope of the present document

In addition:

is (or any other verb in the indicative mood) indicates a statement of fact

is not (or any other negative verb in the indicative mood) indicates a statement of fact

The constructions "is" and "is not" do not indicate requirements.

1 Scope

The present document specifies the profiles, codecs and formats for 5G Media Streaming (5GMS) services based on the 5G Media Streaming Architecture (5GMSA) including both unicast downlink and unicast uplink. The codec and format recommendations defined for each profile apply to the 5GMSd Client components in the User Equipment (UE) as well as the Media Application Server (AS). Profiles are defined to address specific service scenarios. A default profile is defined in the case no other profile is claimed to be supported. 5G Media Streaming protocols and formats are defined based on the Common Media Application Format (CMAF).

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] ITU-T Recommendation H.264 (06/2019): "Advanced video coding for generic audiovisual services".
- [3] ITU-T Recommendation H.265 (02/2018): "High efficiency video coding".
- [4] 3GPP TS 26.117: "5G Media Streaming (5GMS); Speech and audio profiles".
- [5] 3GPP TS 26.501: "5G Media Streaming (5GMS); General description and architecture".
- [6] 3GPP TS 26.307: "Presentation Layer for 3GPP Services".
- [7] ISO/IEC 23000-19: "Information Technology Multimedia Application Format (MPEG-A) – Part 19: Common Media Application Format (CMAF) for segmented media".
- [8] ISO/IEC 23001-7: "MPEG systems technologies - Part 7: Common encryption in ISO base media file format files".
- [9] CTA-5003: "Web Application Video Ecosystem (WAVE): Device Playback Capabilities Specification", available at <https://cdn.cta.tech/cta/media/media/resources/standards/pdfs/cta-5003-final.pdf>.
- [10] 3GPP TS 26.512: "5G Media Streaming (5GMS); Protocols".
- [11] IETF RFC 6381: The 'Codecs' and 'Profiles' Parameters for "Bucket" Media Types.
- [12] 3GPP TS 26.116: "Television (TV) over 3GPP Services; Video Profiles".
- [13] 3GPP TS 26.118: "Virtual Reality (VR) profiles for streaming applications".
- [14] ISO/IEC 14496-12: "Information technology - Coding of audio-visual objects -Part 12: ISO base media file format".
- [15] ISO/IEC 14496-15: "Information technology - Coding of audio-visual objects - Part 15: Carriage of network abstraction layer (NAL) unit structured video in the ISO base media file format".
- [16] W3C IMSC1.1: "TTML Profiles for Internet Media Subtitles and Captions 1.1", available at <http://www.w3.org/TR/ttml-imsc1.1>.

- [17] ISO/IEC 14496-30: "Information technology - Coding of audio-visual objects - Part 30: Timed text and other visual overlays in ISO base media file format".
- [18] W3C Media Capabilities: "Media Capabilities", available at <https://w3c.github.io/media-capabilities/>
- [19] CTA-5000-B: " Web Application Video Ecosystem - Web Media API Snapshot 2019", available at https://cdn.cta.tech/cta/media/media/resources/standards/pdfs/cta-5000-b-final_v2.pdf.
- [20] ISO/IEC 23009-1: "Information Technology - Dynamic Adaptive Streaming Over HTTP (DASH) - Part 1: Media Presentation Description and Segment Formats".
- [21] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".
- [22] IETF RFC 8216: "HTTP Live Streaming".

3 Definitions of terms, symbols and abbreviations

3.1 Terms

For the purposes of the present document, the terms 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].

5GMS Profile: a set of UE capability requirements associated to a media-centric service scenario.

HD-HDR: the capability of a UE to present video signals with all the following: at least Full-HD resolution, bit depth of at least 10, at least 60 frames per second, Wide Colour Gamut and High Dynamic Range.

MPEG-H: It is a group of international standards under development by the ISO/IEC Moving Picture Experts Group (MPEG) - formally known as ISO/IEC 23008 - High efficiency coding and media delivery in heterogeneous environments

3.2 Symbols

Void.

3.3 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].

5GMS	5G Media Streaming
5GMSA	5G Media Streaming Architecture
AMR	Adaptive Multi Rate
AMR-WB	Adaptive Multi Rate – Wide Band
API	Application Programming Interface
AS	Application Server
AVC	Advanced Video Coding
AVC-HD	Advanced Video Codec – High Definition
CMAF	Common Media Application Format
DASH	Dynamic Adaptive Streaming over HTTP
EVS	Enhanced Voice Services
HD	High Definition
HDR	High Dynamic Range
HD-HDR	High Definition and High Dynamic Range
HEVC	High Efficiency Video Coding

HLG	Hybrid Log-Gamma
HLS	HTTP Live Streaming
IMSC	Internet Media Subtitles and Captions
MPEG	Moving Picture Experts Group
OMAF	Omnidirectional Media Application Format
PSS	Packet-switched Streaming Service
TTML	Timed Text Markup Language
TV	Television
UE	User Equipment
UHD	Ultra High Definition
VR	Virtual Reality
VCL	Video Coding Layer

3A Overview

3A.1 Introduction

This specification defines profiles, codecs and formats for 5G Media Streaming. In this clause, the connection to 5G Media Streaming Architecture in TS 26.501 [5] is introduced.

3A.2 Codecs and Formats in Downlink Media Streaming

3A.2.1 Architecture, Interfaces and APIs

According to TS 26.501 [5], Downlink Media Streaming provides the ability for content to be distributed using procedures and protocols defined by 5G Media Streaming as shown in Figure 3A.2.1-1. The detailed procedures for the interfaces and APIs for 5G Media Streaming are defined in TS 26.512 [10].

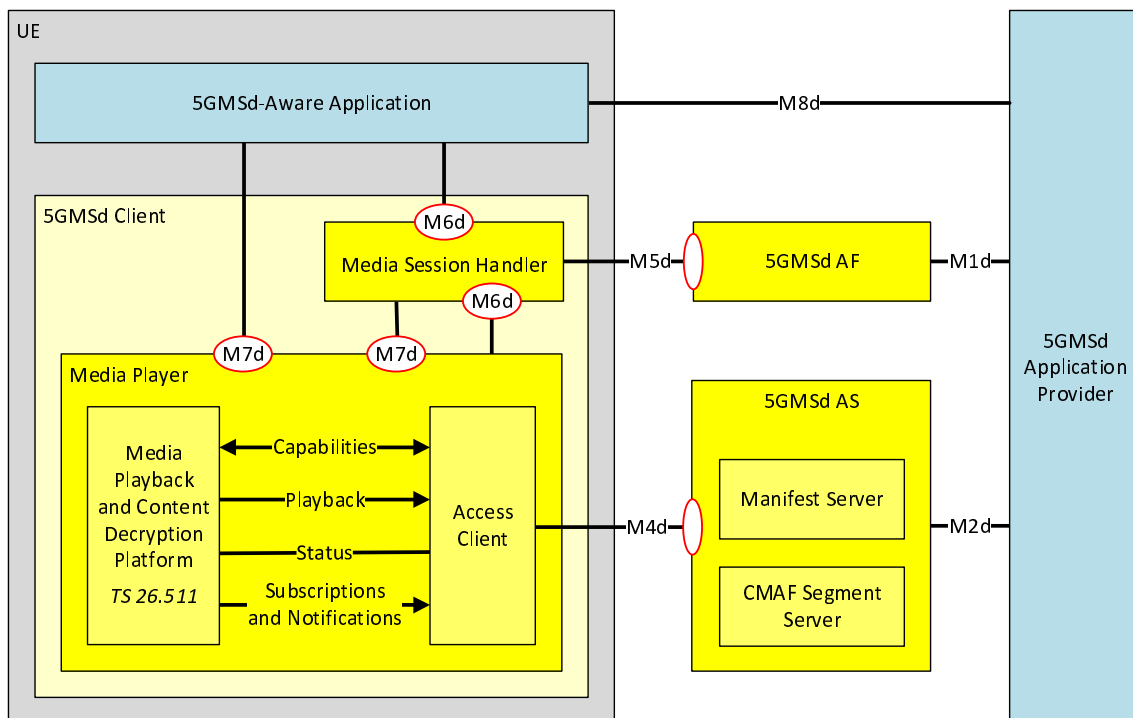


Figure 3A.2.1-1: Downlink 5G Media Streaming architecture

The present document primarily deals with the segment formats delivered on M4d and the requirements applicable to the media playback platform and content decryption module. According to Figure 3A.2.1-1, the Access Client in the 5GMSd Client uses the manifest, typically the Media Presentation Description (MPD) for Dynamic Streaming over HTTP (DASH) as defined in ISO/IEC 23009-1 [20] and TS 26.247 [21] or the Master Playlist for HTTP Live Streaming (HLS) as defined in IETF RFC 8216 [22] to download Segments to initiate a media playback session. A 5GMSd Application Provider may publish these segments directly through M2d such that the 5GMSd AS acts as a hosting server but does not require the media to be either transcoded or repackaged. Using these unified formats maximizes cacheability and improves general Content Delivery Network (CDN) operations, including usage of secure transport protocols such as HTTPS on interface M4d.

5G Media Streaming segment formats are defined based on the Common Media Application Format (CMAF) as specified in ISO/IEC 23000-19 [7]. By using this format, 5G Media Streaming is compatible with a broad set of segment-based streaming protocols including Dynamic Streaming over HTTP (DASH) and HTTP Live Streaming (HLS). For example, ISO/IEC 23009-1 [20] defines a detailed DASH profile for delivering CMAF content within a DASH Media Presentation using a converged format for segmented media content.

Readers of the present document are encouraged to familiarize themselves with terms defined in CMAF such as CMAF Headers, CMAF Fragments, CMAF Tracks and CMAF Switching Sets. CMAF defines a content model for adaptive playback of segmented media (enabling seamless switching across tracks encoded from the same media) and late binding of tracks from different media types, associated with the same presentation. CMAF also defines a content protection and encryption framework for multi-DRM support based on ISO/IEC 23001-7 [8]. Furthermore, CMAF defines media profiles, i.e. encoding constraints on a CMAF track and its contained media samples associated with a specific codec. This specification only uses the structural constraints of CMAF as defined in clause 7 of ISO/IEC 23000-19 [7] and in clause 8 of ISO/IEC 23000-19 [7] for encrypted content. Specific 5GMS media profiles for video, audio and subtitles based on the general constraints of ISO/IEC 23000-19 [7], clauses 9, 10 and 11, respectively, are defined in the present document. However, Downlink Media Streaming is not restricted to the media profiles defined in the present document: any codec that defines a CMAF media profile may be used and distributed with Downlink Media Streaming.

3A.2.2 Hypothetical Device Playback Model

The media playback platform is initiated and used by the Access Client to create a streaming session and experience. The Access Client itself handles the download of segmented media content via interface M4d. This specification is based on a hypothetical playback model that permits an 5GMSd-Aware Application and/or a media Access Client to play back segmented media content streamed via 5G Media Streaming for downlink. Playback receiver requirements for CMAF content are defined in the CTA WAVE Device Playback Specification [9] documenting how an Access Client can use manifest information for establishing and performing playback of CMAF content based on a CMAF Reference Player model.

Following the details in Figure 3A.2-1, playback functionalities include:

- 1) Querying the capabilities of the device to determine if it supports the playback of a specific media profile. Different means exist and are described in CTA-5003 [9], but minimally a well-defined MIME type and a well-defined `codecs` parameter following the requirements in RFC 6381 [11] is needed.
- 2) Initializing the playback platform with the codec by providing appropriate initialization information. At minimum, a CMAF Header is needed for initializing the decoder. Initialization of content decryption, if needed, depends on the used DRM system.
- 3) Playback itself, by appending data to source and track buffers and providing additional instructions such as seek, accelerated playback, random access, etc
- 4) The ability to check the status of the playback platform, for example the size and duration of the media buffers, current playback time, etc. Relevant APIs exposed by the 5GMSd Client via M7d are defined in TS 26.512 [21].
- 5) The ability to receive notifications and error events from the playback platform, for example non-conforming content, buffer unde-runs, etc. Relevant APIs exposed by the 5GMSd Client via M7d are defined in TS 26.512 [21].

3A.2.3 Necessary Conditions for Codecs and Formats in 5GMSd

In order to use a media codec or a specific media profile of the codec in the context of 5G Media Streaming, the following aspects need to be defined:

- A CMAF media profile definition with all the requirements according to ISO/IEC 23000-19 [7] for a media profile.
- A definition of how capability discovery can be done, at the minimum a suitable and well-defined MIME type following the requirements in RFC 6381 [11], and in particular the definition of the `codecs` and `profiles` parameters.
- The mapping of media profile parameters to a DASH MPD. The mapping includes the static information (i.e. fixed parameters in the MPD) and dynamic information (e.g., depending on information in the CMAF Header).
- Potential requirements and restrictions for encrypted content.

This specification defines the above information for several media codecs in clause 4, and provides requirements and recommendations for the support of these media profiles in specific 5G Media Streaming profiles in clause 5.

NOTE: Downlink Media Streaming is not restricted to the media profiles defined in this specification: any CMAF media profile may be used and distributed within Downlink Media Streaming as long as it can be used with APIs and interfaces defined in TS 26.512 [21] and the above information is provided.

3A.3 Codecs and Formats in Uplink Media Streaming

Codecs and formats for uplink streaming are defined in the remainder of this specification.

4 5GMS codecs and formats capabilities

4.1 Introduction

This clause defines codecs and formats capabilities for video, audio, speech and subtitles for 5G Media Streaming.

For each media type, decoding and encoding capabilities are defined. These capabilities are a combination of codecs, profiles, tiers (if applicable), levels and format restrictions. In order to use the codecs in 5G Media Streaming for each capability the following functionalities are defined:

- Mapping to the ISO Base Media File Format defining a track format.
- The definition of a CMAF Track
- The definition of a CMAF Switching Set and the media profile
- The playback requirements for this media profile
- The content generation requirements for this media profile

4.2 Video

4.2.1 H.264 (AVC)

4.2.1.1 Decoding

The following H.264 (AVC) media decoding capabilities are defined:

- **AVC-HD-Dec:** the capability to decode H.264 (AVC) Progressive High Profile Level 3.1 [2] bitstreams, for which the maximum VCL Bit Rate is constrained to be 14 Mbps with `cpbBrVclFactor` and `cpbBrNalFactor` being fixed to be 1,000 and 1,200, respectively.
- **AVC-FullHD-Dec:** the capability to decode H.264 (AVC) Progressive High Profile Level 4.0 [2] bitstreams.
- **AVC-UHD-Dec:** the capability to decode H.264/AVC Progressive High Profile Level 5.1 [2] bitstreams for H.264/AVC with the following additional restrictions and requirements:
 - the maximum VCL Bit Rate is constrained to be 120 Mbps with `cpbBrVclFactor` and `cpbBrNalFactor` being fixed to be 1250 and 1500, respectively.
 - the bitstream does not contain more than 10 slices per picture.

NOTE: High Profile for H.264/AVC excludes Flexible macro-block order, Arbitrary slice ordering, Redundant slices, Data partition.

4.2.1.2 Encoding

The following H.264 (AVC) media encoding capabilities are defined:

- **AVC-HD-Enc:** the capability to encode a video signal with:
 - up to 108,000 macroblocks per second;
 - up to a frame size of 3,600 macroblocks;
 - up to 120 frames per second;
 - the chroma format being 4:2:0; and
 - the bit depth being 8 bit;to a bitstream that is decodable by a decoder that is **AVC-HD-Dec** capable as defined in clause 4.2.1.1.
- **AVC-FullHD-Enc:** the capability to encode a video signal with:
 - up to 245,760 macroblocks per second;
 - up to a frame size of 8,192 macroblocks;
 - up to 240 frames per second;
 - the chroma format being 4:2:0; and
 - the bit depth being 8 bit;to a bitstream that is decodable by a decoder that is **AVC-FullHD-Dec** capable as defined in clause 4.2.1.1.
- **AVC-UHD-Enc:** the capability to encode a video signal with:
 - up to 983,040 macroblocks per second;
 - up to a frame size of 36,864 macroblocks;
 - up to 480 frames per second;
 - the chroma format being 4:2:0; and
 - the bit depth being 8 bit;to a bitstream that is decodable by a decoder that is **AVC-UHD-Dec** capable as defined in clause 4.2.1.1.

4.2.1.3 Media Profiles: Mapping to 5GMS Delivery

4.2.1.3.1 AVC-HD

4.2.1.3.1.1 ISO BMFF File Format

If AVC-HD media is provided in a bitstream that is decodable by a decoder capable of the **AVC-HD-Dec** decoding capabilities as defined in clause 4.2.1.1 and the media is encapsulated in an ISO BMFF Track [14], then the file format track shall conform with the requirements of the codec entry 'avc1' or 'avc3' as defined in ISO/IEC 14496-15 [15].

4.2.1.3.1.2 CMAF Track Definition

If AVC-HD media is provided in an CMAF track, then the CMAF track shall conform with:

- the requirements of the ISO BMFF File format track defined in clause 4.2.1.3.1.1;
- the general CMAF Track constraints in ISO/IEC 23000-19, clause 7;
- the general video track constraints defined in ISO/IEC 23000-19; clause 9.

4.2.1.3.1.3 CMAF Switching Set Definition

If AVC-HD media is provided in an CMAF Switching Set; then

- every CMAF track in the CMAF Switching Set shall conform with the requirements of CMAF Track in clause 4.2.1.3.1.2;
- the general CMAF Switching Set constraints in ISO/IEC 23000-19 [7], clause 7; and
- the general CMAF video track Switching Set constraints defined in ISO/IEC 23000-19 [7]; clause 9.

4.2.1.3.1.4 Playback Requirements

For a receiver supporting the AVC-HD media profile the following applies:

- It shall support the **AVC-HD-Dec** decoding capabilities as defined in clause 4.2.1.1.
- It shall support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.1.3.1.3 namely:
 - 8.2 Sequential Track Playback
 - 8.3 Random Access to Fragment
 - 8.4 Random Access to Time
 - 8.5 Switching Set Playback
 - 8.6 Regular Playback of Chunked Content
 - 8.7 Regular Playback of Chunked Content, non-aligned append
- It should support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.1.3.1.3 namely:
 - 8.9 Out-Of-Order Loading
 - 8.10 Overlapping Fragments
 - 8.12 Playback of Encrypted Content

4.2.1.3.1.5 Content Generation Requirements

For a transmitter supporting the AVC-HD media profile the following applies:

- It shall support the **AVC-HD-Enc** encoding capabilities as defined in clause 4.2.1.2.
- It shall support the generation of a CMAF Track that conforms to the requirements in clause 4.2.1.3.1.2.
- If used for Adaptive Bit Rate (ABR) distribution, it shall support the generation of a CMAF Switching Set as defined in clause 4.2.1.3.1.3.

4.2.1.3.2 AVC-FullHD

4.2.1.3.2.1 ISO BMFF File Format

If AVC-FullHD media is provided in a bitstream that is decodable by a decoder capable of the **AVC-FullHD-Dec** decoding capabilities as defined in clause 4.2.1.1 and the media is encapsulated in an ISO BMFF Track [14], then the file format track shall conform with the requirements of the codec entry 'avc1' or 'avc3' as defined in ISO/IEC 14496-15 [15].

4.2.1.3.2.2 CMAF Track Definition

If AVC-FullHD media is provided in an CMAF track, then the CMAF track shall conform with

- the requirements of the ISO BMFF File format track defined in clause 4.2.1.3.2.1;
- the general CMAF Track constraints in ISO/IEC 23000-19, clause 7; and
- the general video track constraints defined in ISO/IEC 23000-19, clause 9.

4.2.1.3.2.3 CMAF Switching Set Definition

If AVC-FullHD media is provided in an CMAF Switching Set, then:

- every CMAF track in the CMAF Switching Set shall conform with the requirements of CMAF Track in clause 4.2.1.3.2.2;
- the general CMAF Switching Set constraints in ISO/IEC 23000-19 [27], clause 7; and
- the general CMAF video track Switching Set constraints defined in ISO/IEC 23000-19 [7], clause 9.

4.2.1.3.2.4 Playback Requirements

For a receiver supporting the AVC-FullHD media profile the following applies:

- It shall support the **AVC-FullHD-Dec** decoding capabilities as defined in clause 4.2.1.1.
- It shall support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.1.3.2.3 namely:
 - 8.2 Sequential Track Playback
 - 8.3 Random Access to Fragment
 - 8.4 Random Access to Time
 - 8.5 Switching Set Playback
 - 8.6 Regular Playback of Chunked Content
 - 8.7 Regular Playback of Chunked Content, non-aligned append
- It should support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.1.3.2.3 namely:

- 8.9 Out-Of-Order Loading
- 8.10 Overlapping Fragments
- 8.12 Playback of Encrypted Content

4.2.1.3.2.5 Content Generation Requirements

For a transmitter supporting the AVC-FullHD media profile the following applies:

- It shall support the **AVC-FullHD-Enc** encoding capabilities as defined in clause 4.2.1.2.
- It shall support the generation of a CMAF Track that conforms to the requirements in clause 4.2.1.3.2.2.
- If used for Adaptive Bit Rate (ABR) distribution, it shall support the generation of a CMAF Switching Set as defined in clause 4.2.1.3.2.3.

4.2.1.3.3 AVC-UHD

4.2.1.3.3.1 ISO BMFF File Format

If AVC-UHD media is provided in a bitstream that is decodable by a decoder capable of the **AVC-UHD-Dec** decoding capabilities as defined in clause 4.2.1.1 and the media is encapsulated in an ISO BMFF Track [14], then the file format track shall conform with the requirements of the codec entry 'avc1' or 'avc3' as defined in ISO/IEC 14496-15 [15].

4.2.1.3.3.2 CMAF Track Definition

If AVC-UHD media is provided in an CMAF track, then the CMAF track shall conform with

- the requirements of the ISO BMFF File format track defined in clause 4.2.1.3.3.1;
- the general CMAF Track constraints in ISO/IEC 23000-19, clause 7; and
- the general video track constraints defined in ISO/IEC 23000-19, clause 9.

4.2.1.3.3.3 CMAF Switching Set Definition

If AVC-UHD media is provided in an CMAF Switching Set, then

- every CMAF track in the CMAF Switching Set shall conform with the requirements of CMAF Track in clause 4.2.1.3.3.2;
- the general CMAF Switching Set constraints in ISO/IEC 23000-19 [27], clause 7; and
- the general CMAF video track Switching Set constraints defined in ISO/IEC 23000-19 [7], clause 9.

4.2.1.3.3.4 Playback Requirements

For a receiver supporting the AVC-UHD media profile the following applies:

- It shall support the **AVC-UHD-Dec** decoding capabilities as defined in clause 4.2.1.1.
- It shall support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.1.3.3.3 namely:
 - 8.2 Sequential Track Playback
 - 8.3 Random Access to Fragment
 - 8.4 Random Access to Time
 - 8.5 Switching Set Playback
 - 8.6 Regular Playback of Chunked Content

- 8.7 Regular Playback of Chunked Content, non-aligned append
- It should support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.1.3.3.3 namely:
 - 8.9 Out-Of-Order Loading
 - 8.10 Overlapping Fragments
 - 8.12 Playback of Encrypted Content

4.2.1.3.3.5 Content Generation Requirements

For a transmitter supporting the AVC-UHD media profile the following applies:

- It shall support the AVC-UHD-Enc encoding capabilities as defined in clause 4.2.1.2.
- It shall support the generation of a CMAF Track that conforms to the requirements in clause 4.2.1.3.3.2.
- If used for Adaptive Bit Rate (ABR) distribution, it shall support the generation of a CMAF Switching Set as defined in clause 4.2.1.3.3.3.

4.2.2 H.265 (HEVC)

4.2.2.1 Decoding

The following H.265 (HEVC) media decoding capabilities are defined:

- **HEVC-HD-Dec**: the capability to decode H.265 (HEVC) Main Profile, Main Tier, Level 3.1[3] bitstreams that have `general_progressive_source_flag` equal to 1, `general_interlaced_source_flag` equal to 0, `general_non_packed_constraint_flag` equal to 1, and `general_frame_only_constraint_flag` equal to 1.
- **HEVC-FullHD-Dec**: the capability to decode H.265 (HEVC) Main10 Profile, Main Tier, Level 4.1[3] bitstreams that have `general_progressive_source_flag` equal to 1, `general_interlaced_source_flag` equal to 0, `general_non_packed_constraint_flag` equal to 1, and `general_frame_only_constraint_flag` equal to 1.
- **HEVC-UHD-Dec**: the capability to decode H.265 (HEVC) Main10 Profile, Main Tier, Level 5.1[3] bitstreams that have `general_progressive_source_flag` equal to 1, `general_interlaced_source_flag` equal to 0, `general_non_packed_constraint_flag` equal to 1, and `general_frame_only_constraint_flag` equal to 1.

4.2.2.2 Encoding

The following H.265 (HEVC) media encoding capabilities are defined:

- **HEVC-HD-Enc**: the capability to encode a video signal with
 - up to 33,177,600 luma samples per second;
 - up to a luma picture size of 983,040 samples;
 - up to 120 frames per second;
 - the Chroma format being 4:2:0; and
 - the bit depth being 8 bit;to a bitstream that is decodable by a decoder that is **HEVC-HD-Dec** capable as defined in clause 4.2.2.1.
- **HEVC-FullHD-Enc**: the capability to encode a video signal with
 - up to 133,693,440 luma samples per second;
 - up to a luma picture size of 2,228,224 samples;
 - up to 240 frames per second;

- the Chroma format being 4:2:0; and
- the bit depth being either 8 or 10 bit;

to a bitstream that is decodable by a decoder that is **HEVC-FullHD-Dec** capable as defined in clause 4.2.2.1.

- **HEVC-UHD-Enc**: the capability to encode a video signal with

- up to 534,773,760 luma samples per second;
- up to a luma picture size of 8,912,896 samples;
- up to 480 frames per second;
- the Chroma format being 4:2:0; and
- the bit depth being either 8 or 10 bit;

to a bitstream that is decodable by a decoder that is **HEVC-UHD-Dec** capable as defined in clause 4.2.2.1.

4.2.2.3 Media Profiles: Mapping to 5G Media Streaming

4.2.2.3.1 HEVC-HD

4.2.2.3.1.1 ISO BMFF File Format

If HEVC-HD media is provided in a bitstream that is decodable by a decoder capable of the **HEVC-HD-Dec** decoding capabilities as defined in clause 4.2.1.1 and the media is encapsulated in an ISO BMFF Track [14], then the file format track shall conform with the requirements of the codec entry 'hvc1' or 'hev1' as defined in ISO/IEC 14496-15 [15].

4.2.2.3.1.2 CMAF Track Definition

If HEVC-HD media is provided in an CMAF track, then the CMAF track shall conform with

- the requirements of the ISO BMFF File format track defined in clause 4.2.2.3.1.1;
- the general CMAF Track constraints in ISO/IEC 23000-19, clause 7; and
- the general video track constraints defined in ISO/IEC 23000-19; clause 9.

4.2.2.3.1.3 CMAF Switching Set Definition

If HEVC-HD media is provided in an CMAF Switching Set, then

- every CMAF track in the CMAF Switching Set shall conform with the requirements of CMAF Track in clause 4.2.2.3.1.2;
- the general CMAF Switching Set constraints in ISO/IEC 23000-19 [27], clause 7; and
- the general CMAF video track Switching Set constraints defined in ISO/IEC 23000-19 [7], clause 9.

4.2.2.3.1.4 Playback Requirements

For a receiver supporting the HEVC-HD media profile the following applies:

- It shall support the **HEVC-HD-Dec** decoding capabilities as defined in clause 4.2.1.1.
- It shall support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.2.3.1.3 namely:
 - 8.2 Sequential Track Playback
 - 8.3 Random Access to Fragment
 - 8.4 Random Access to Time

- 8.5 Switching Set Playback
- 8.6 Regular Playback of Chunked Content
- 8.7 Regular Playback of Chunked Content, non-aligned append
- It should support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.2.3.1.3 namely:
 - 8.9 Out-Of-Order Loading
 - 8.10 Overlapping Fragments
 - 8.12 Playback of Encrypted Content

4.2.2.3.1.5 Content Generation Requirements

For a transmitter supporting the **HEVC-HD** media profile the following applies:

- It shall support the HEVC-HD-Enc encoding capabilities as defined in clause 4.2.2.2.
- It shall support the generation of a CMAF Track that conforms to the requirements in clause 4.2.2.3.1.2.
- If used for Adaptive Bit Rate (ABR) distribution, it shall support the generation of a CMAF Switching Set as defined in clause 4.2.2.3.1.3.

4.2.2.3.2 HEVC-FullHD

4.2.2.3.2.1 ISO BMFF File Format

If HEVC-FullHD media is provided in a bitstream that is decodable by a decoder capable of the **HEVC-FullHD-Dec** decoding capabilities as defined in clause 4.2.1.1 and the media is encapsulated in an ISO BMFF Track [14], then the file format track shall conform with the requirements of the codec entry 'hvc1' or 'hev1' as defined in ISO/IEC 14496-15 [15].

4.2.2.3.2.2 CMAF Track Definition

If HEVC-FullHD media is provided in an CMAF track, then the CMAF track shall conform with

- the requirements of the ISO BMFF File format track defined in clause 4.2.2.3.2.1;
- the general CMAF Track constraints in ISO/IEC 23000-19, clause 7; and
- the general video track constraints defined in ISO/IEC 23000-19, clause 9.

4.2.2.3.2.3 CMAF Switching Set Definition

If HEVC-FullHD media is provided in an CMAF Switching Set, then

- every CMAF track in the CMAF Switching Set shall conform with the requirements of CMAF Track in clause 4.2.2.3.2.2,
- the general CMAF Switching Set constraints in ISO/IEC 23000-19 [27], clause 7; and
- the general CMAF video track Switching Set constraints defined in ISO/IEC 23000-19 [7], clause 9.

4.2.2.3.2.4 Playback Requirements

For a receiver supporting the HEVC-FullHD media profile the following applies:

- It shall support the **HEVC-FullHD-Dec** decoding capabilities as defined in clause 4.2.1.1.
- It shall support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.2.3.2.3 namely:

- 8.2 Sequential Track Playback
- 8.3 Random Access to Fragment
- 8.4 Random Access to Time
- 8.5 Switching Set Playback
- 8.6 Regular Playback of Chunked Content
- 8.7 Regular Playback of Chunked Content, non-aligned append
- It should support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.2.3.2.3 namely:
 - 8.9 Out-Of-Order Loading
 - 8.10 Overlapping Fragments
 - 8.12 Playback of Encrypted Content

4.2.2.3.2.5 Content Generation Requirements

For a transmitter supporting the HEVC-FullHD media profile the following applies:

- It shall support the **HEVC-FullHD-Enc** encoding capabilities as defined in clause 4.2.2.2.
- It shall support the generation of a CMAF Track that conforms to the requirements in clause 4.2.2.3.2.2.
- If used for Adaptive Bit Rate (ABR) distribution, it shall support the generation of a CMAF Switching Set as defined in clause 4.2.2.3.2.3.

4.2.2.3.3 HEVC-UHD

4.2.2.3.3.1 ISO BMFF File Format

If HEVC-UHD media is provided in a bitstream that is decodable by a decoder capable of the **HEVC-UHD-Dec** decoding capabilities as defined in clause 4.2.1.1 and the media is encapsulated in an ISO BMFF Track [14], then the file format track shall conform with the requirements of the codec entry 'hvc1' or 'hev1' as defined in ISO/IEC 14496-15 [15].

4.2.2.3.3.2 CMAF Track Definition

If HEVC-UHD media is provided in an CMAF track, then the CMAF track shall conform with

- the requirements of the ISO BMFF File format track defined in clause 4.2.2.3.3.1;
- the general CMAF Track constraints in ISO/IEC 23000-19, clause 7; and
- the general video track constraints defined in ISO/IEC 23000-19, clause 9.

4.2.2.3.3.3 CMAF Switching Set Definition

If HEVC-UHD media is provided in an CMAF Switching Set, then

- every CMAF track in the CMAF Switching Set shall conform with the requirements of CMAF Track in clause 4.2.2.3.3.2;
- the general CMAF Switching Set constraints in ISO/IEC 23000-19 [27], clause 7; and
- the general CMAF video track Switching Set constraints defined in ISO/IEC 23000-19 [7], clause 9.

4.2.2.3.3.4 Playback Requirements

For a receiver supporting the HEVC-UHD media profile the following applies:

- It shall support the **HEVC-UHD-Dec** decoding capabilities as defined in clause 4.2.1.1.
- It shall support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.2.3.3.3 namely:
 - 8.2 Sequential Track Playback
 - 8.3 Random Access to Fragment
 - 8.4 Random Access to Time
 - 8.5 Switching Set Playback
 - 8.6 Regular Playback of Chunked Content
 - 8.7 Regular Playback of Chunked Content, non-aligned append
- It should support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.2.3.3.3 namely:
 - 8.9 Out-Of-Order Loading
 - 8.10 Overlapping Fragments
 - 8.12 Playback of Encrypted Content

4.2.2.3.3.5 Content Generation Requirements

For a transmitter supporting the HEVC-UHD media profile the following applies:

- It shall support the **HEVC-UHD-Enc** encoding capabilities as defined in clause 4.2.2.2.
- It shall support the generation of a CMAF Track that conforms to the requirements in clause 4.2.2.3.3.2.
- If used for Adaptive Bit Rate (ABR) distribution, it shall support the generation of a CMAF Switching Set as defined in clause 4.2.2.3.3.3.

4.3 Audio

4.3.1 Decoding

Audio decoding capabilities are defined in 3GPP TS 26.117 [4] clause 5.3.

4.3.2 Encoding

Audio encoding capabilities are defined in 3GPP TS 26.117 [4] clause 5.3.

4.4 Speech

4.4.1 Decoding

Speech decoding capabilities are defined in 3GPP TS 26.117 [4] clause 5.2.

4.4.2 Encoding

Speech encoding capabilities are defined in 3GPP TS 26.117 [4] clause 5.3.4.5.

4.5 Subtitles

4.5.1 IMSC1.1. Text Track

4.5.1.1 Decoding Capability

The IMSC1.1. Text Track decoding capability is defined as IMSC1.1-TEXT-DEC. Support for IMSC1.1-TEXT-DEC requires the support of an IMSC1.1 text processor as defined in W3C IMSC1.1 [16].

4.5.1.2 ISO BMFF File Format

If an IMSC1.1 Text Track is provided in a bitstream that is decodable by a decoder capable of the IMSC1.1-TEXT-DEC decoding capabilities as defined in clause 4.5.1.1 and the media is encapsulated in an ISO BMFF Track [14], then the file format track shall conform with the requirements of the codec entry 'imt2' as defined in ISO/IEC 14496-30 [17].

4.5.1.3 CMAF Track Definition

If IMSC1.1-TEXT-DEC media is provided in an CMAF track, then the CMAF track shall conform with

- the requirements of the ISO BMFF File format track defined in clause 4.5.1.2;
- the general CMAF Track constraints in ISO/IEC 23000-19, clause 7;
- the general subtitle track constraints defined in ISO/IEC 23000-19, clause 11; and
- the IMSC1.1. text track constraints defined in ISO/IEC 23000-19, Annex L.2.

4.5.1.4 CMAF Switching Set Definition

If IMSC1.1-TEXT-DEC media is provided in an CMAF Switching Set, then:

- only a single CMAF track according to the requirements in clause 4.5.1.3 shall be present.

4.5.1.5 Playback Requirements

For a receiver supporting the IMSC1.1. Text Track media profile the following applies:

- It shall support the IMSC1.1-TEXT-DEC decoding capabilities as defined in clause 4.5.1.1.
- It shall support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.5.1.4, namely:
 - 8.2 Sequential Track Playback
 - 8.3 Random Access to Fragment
 - 8.4 Random Access to Time
- It should support the following playback requirements as documented in clause 8 of CTA-WAVE 5003 [9] for any content conforming to a CMAF Switching Set as defined in clause 4.2.1.4 namely:
 - 8.9 Out-Of-Order Loading
 - 8.10 Overlapping Fragments
 - 8.12 Playback of Encrypted Content

5 5GMS Profiles

5.1 Introduction

A 5GMS profile describes a set of capability requirements associated to a service scenario. A default profile is defined for minimum media requirements to be supported in case no other profile is claimed to be supported. The Television (TV) profile covers live and on demand streaming of audio-visual TV services. The Virtual Reality (VR) profile covers the live and on demand streaming of omnidirectional media including spherical video and 3D audio.

5.2 Downlink streaming default profile

5.2.1 Introduction

This profile defines required capabilities for UE-based 5GMSd Client functionalities as defined in TS26.501 [5] and shown in Figure 4.2.2-1 in TS 26.501 [5]. Requirements for the following functions are defined in this clause:

- Media Decapsulation
- Media Decryption
- Media Decoding
- Media Presentation and Rendering

5.2.2 Video decoding

If the 5GMSd Client supports the reception of video, then

- **AVC-HD-Dec** decoding capability shall be supported as defined in clause 4.2.1.1.
- **HEVC-HD-Dec** decoding capability should be supported as defined in clause 4.2.2.1.

If the 5GMSd Client supports the reception of video and HD-HDR capabilities, then:

- **AVC-FullHD-Dec** decoding capability shall be supported as defined in clause 4.2.1.1.
- **HEVC-FullHD-Dec** decoding capability shall be supported as defined in clause 4.2.2.1.

5.2.3 Audio decoding

If the 5GMSd Client supports the reception of audio:

- **eAAC+** decoding capability should be supported as defined in 3GPP TS 26.117 [4] clause 5.3.
- **AMR-WB+** decoding capability may be supported as defined in 3GPP TS 26.117 [4] clause 5.3.

5.2.4 Speech decoding

If the 5GMSd Client supports the reception of speech:

- the **EVS** decoding capability shall be supported as defined in 3GPP TS 26.117 [4] clause 5.2.
- the **AMR-WB** decoding capability should be supported as defined in 3GPP TS 26.117 [4] clause 5.2.
- the **AMR** decoding capability may be supported as defined in 3GPP TS 26.117 [4] clause 5.2.

5.2.5 Subtitles

If the 5GMSd Client supports the reception of subtitles:

- the IMSC1.1 Text Track decoding capabilities IMSC1.1-TEXT-DEC as defined in clause 4.5.1.1 should be supported.

5.2.6 Presentation format

If 5GMSd Client supports presentation, then 3GPP HTML5 Profile as defined in 3GPP TS 26.307 [6] should be supported.

For a relevant set of media related APIs, please also take into account the Web Media API Snapshot 2019 (CTA-5000-B) [19].

5.2.7 Decapsulation and decryption

5.2.7.1 Introduction

This clause defines the requirements in terms of decapsulation and decryption of media for a 5GMSd Media Player in combination with codecs. Media Encapsulation in 5G Media Streaming for downlink is defined based on the MPEG Common Media Application Format (CMAF) [7]. Based on this, this clause documents the requirements and recommendations for the support of media profiles by the definition of media player requirements.

5.2.7.2 Video media profiles

If the 5GMSd Client supports the reception of video, then the following applies:

- the AVC-HD playback requirements as defined in clause 4.2.1.3.1.4 shall be supported.
- the HEVC-HD playback requirements as defined in clause 4.2.2.3.1.4 should be supported.

If the 5GMSd Client supports the reception of video and HD-HDR Capabilities, then the following applies:

- the AVC-FullHD playback requirements as defined in clause 4.2.1.3.2.4 shall be supported.
- the HEVC-FullHD playback requirements as defined in clause 4.2.2.3.2.4 shall be supported.
- the HEVC-UHD playback requirements as defined in clause 4.2.2.3.3.4 may be supported.

5.2.7.3 Speech media profiles

If the 5GMSd Client supports the reception of speech, then the following shall be supported:

- the **EVS** playback requirements as defined in 3GPP TS 26.117 [4] clause 7.4.2.4.

If the 5GMSd Client supports the reception of speech, then the following should be supported:

- the **AMR-WB** playback requirements as defined in 3GPP TS 26.117 [4] clause 7.3.2.4.

If the 5GMSd Client supports the reception of speech, then the following may be supported:

- the **AMR** playback requirements as defined in 3GPP TS 26.117 [4] clause 7.2.2.4.

5.2.7.4 Audio media profiles

If the 5GMSd Client supports the reception of audio, then the following should be supported:

- the **eAAC+ stereo** playback requirements as defined in 3GPP TS 26.117 [4] clause 7.5.2.4.

If the 5GMSd Client supports the reception of audio, then the following may be supported:

- the **AMR-WB+** playback requirements as defined in 3GPP TS 26.117 [4] clause 7.6.2.4.

5.2.7.5 Subtitle media profiles

If the 5GMSd Client supports the reception of subtitle, then the following should be supported:

- the IMSC1.1 text track playback requirements as defined in clause 4.5.1.5.

5.2.7.6 Encrypted content

If the 5GMSd Client supports encrypted content and any of the video playback requirement as defined in clause 5.2.7.2, then the 5GMSd client shall support the playback requirements for encrypted content as documented in clause 8 of CTA-WAVE 5003 [9], clause 8.12 for either:

- video content encrypted according to [7] clause 8, using the 'cenc' AES-CTR subsample pattern encryption scheme, as specified in [8], clause 10.1; or
- video content encrypted according to [7] clause 8, using the 'cbc1' AES-CBC subsample pattern encryption scheme, as specified in [8], clause 10.4, with the following restrictions Pattern Block length of 10 and an `encrypt:skip` pattern of 1:9 as defined in clause 9.6 of [8].

If the 5GMSd Client supports decrypted content and any of the video playback requirement in clause 5.2.7.2, then the 5GMSd client should support the playback requirements for encrypted content as documented in clause 8 of CTA-WAVE 5003 [9], clause 8.12 for both:

- video content encrypted according to [7] clause 8, using the 'cenc' AES-CTR subsample pattern encryption scheme, as specified in [8], clause 10.1; and
- video content encrypted according to [7] clause 8, using the 'cbc1' AES-CBC subsample pattern encryption scheme, as specified in [8], clause 10.4, with the following restrictions Pattern Block length of 10 and an `encrypt:skip` pattern of 1:9 as defined in clause 9.6 of [8].

If the 5GMSd Client supports encrypted content and any of the speech and audio playback requirement in clause 5.2.7.3 and clause 5.2.7.4, then the 5GMSd client shall support the playback requirements for encrypted content as documented in clause 8 of CTA-WAVE 5003 [9], clause 8.12 for either:

- audio content encrypted according to [7] clause 8, using the 'cenc' AES-CTR subsample pattern encryption scheme, as specified in [8], clause 10.1; or
- audio content encrypted according to [7] clause 8, using the 'cbc1' AES-CBC subsample pattern encryption scheme, as specified in [8], clause 9.7.

If the 5GMSd client supports encrypted content and any of the speech and audio playback requirement in clause 5.2.7.3 and clause 5.2.7.4, then the 5GMSd client should support the playback requirements for encrypted content as documented in clause 8 of CTA-WAVE 5003 [9], clause 8.12 for both:

- audio content encrypted according to [7] clause 8, using the 'cenc' AES-CTR subsample pattern encryption scheme, as specified in [8], clause 10.1; and
- audio content encrypted according to [7] clause 8, using the 'cbc1' AES-CBC subsample pattern encryption scheme, as specified in [8], clause 9.7.

Any subtitle track, if present, should not be encrypted.

5.2.8 Capability discovery

5.2.8.1 General

A 5GMSd Client is expected to support capability discovery such that 5GMS-Aware Applications can identify if a specific media profile is supported. In order to identify whether a media profile is supported, the 5GMSd Client may provide an API as defined in TS 26.512 [10] via the M7d interface, for which the client can be queried with a specific MIME type string, if the media profile is supported.

The MIME types follow RFC 6381 [11].

A 5GMSd Client should support at least one of the following capability discovery mechanisms for media profiles:

- If `isTypeSupported()` for the media profile with argument `<profiles>` results in a yes, then the respective media profile is supported with the requirements defined in a specific clause.
- If `isTypeSupported()` for the media profile with argument `<codecs>` results in a yes, then the respective media profile is supported with the requirements defined in a specific clause.
- If a conforming CMAF header is provided for playback initialization and the 5GMSd Client does not throw an error response, then the respective media profile is supported with the requirements defined in a specific clause.

For each media profile mentioned in clause 5.2.6, the `<profiles>` parameter and the `<codecs>` parameter are provided in the following. These parameters should be used in the capability exchange.

5.2.8.2 Video media profiles

NOTE: In the following, "compatible" means either that the parameter is identical to the value specified or, if a different value is used for the parameter in a capability query, then it has the same positive result.

For AVC-HD:

- the `<profiles>` parameter is compatible to `video/mp4 profiles='cmfc'`
- the `<codecs>` parameter is compatible to either `'avc1.640028'` or `'avc3.640028'`

For AVC-FullHD:

- the `<profiles>` parameter is compatible with `video/mp4 profiles='cmfc'`
- the `<codecs>` parameter is compatible with either `'avc1.640029'` or `'avc3.640029'`

For AVC-UHD:

- the `<profiles>` parameter is compatible with `video/mp4 profiles='cmfc'`
- the `<codecs>` parameter is compatible with either `'avc1.640028'` or `'avc3.640028'`

For HEVC-HD:

- the `<profiles>` parameter is compatible with `video/mp4 profiles='cmfc'`
- the `<codecs>` parameter is compatible with either `'hvc1.1.2.L93.B0'` or `'hev1.1.2.L93.B0'`

For HEVC-FullHD:

- the `<profiles>` parameter is compatible with `video/mp4 profiles='cmfc'`
- the `<codecs>` parameter is compatible with either `'hvc1.2.4.L123.B0'` or `'hev1.2.4.L123.B0'`

For HEVC-UHD:

- the `<profiles>` parameter is compatible with `video/mp4 profiles='cmfc'`
- the `<codecs>` parameter is compatible with either `'hvc1.2.4.L153.B0'` or `'hev1.2.4.L153.B0'`

5.2.8.3 Audio media profiles

For AMR:

- the `<profiles>` parameter is defined in TS 26.117, clause 7.2.2.4 as `audio/mp4 profiles='camr'`
- the `<codecss>` parameter is defined in TS 26.117, clause 7.2.2.4 as `'samr'`

For AMR-WB:

- the <profiles> parameter is defined in TS 26.117, clause 7.3.2.4 as `audio/mp4 profiles='camw'`
- the <codecs> parameter is defined in TS 26.117, clause 7.3.2.4 as `'samw'`

For EVS:

- the <profiles> parameter is defined in TS 26.117, clause 7.4.2.4 as `audio/mp4 profiles='cevs'`
- the <codecs> parameter is defined in TS 26.117, clause 7.4.2.4 as `'sevs'`

For eAAC+ stereo:

- the <profiles> parameter is defined in TS 26.117, clause 7.6.2.4 as `audio/mp4 profiles='ceac'`
- the <codecs> parameter is defined in TS 26.117, clause 7.6.2.4 as `'mp4a'`

For AMR-WB+:

- the <profiles> parameter is defined in TS:26.117, clause 7.7.2.4 as `audio/mp4 profiles='camp'`
- the <codecs> parameter is defined in TS:26.117, clause 7.7.2.4 as `'sawp'`

5.2.8.4 Subtitle media profiles

For IMSC1.1 Text Tracks:

- the <profiles> parameter is defined in ISO/IEC 23000-19 [7], clause 11.3.3 as `application/mp4 profiles='im2t'`;
- the <codecs> parameter is defined in ISO/IEC 23000-19 [7], clause 11.3.3 as `'stpp.ttml.im2t'`.

5.2.8.5 Encryption mode discovery

Encryption mode discovery will be studied in due course.

5.3 Uplink streaming default profile

5.3.1 Introduction

This profile defines required capabilities for UE-based 5GMS Media Streamer functionalities as defined in TS 26.501[5] and shown in Figure 4.3.2-1 in TS 26.501 [5]. Requirements for the following functions are defined in this clause:

- Media Encoding
- Media Upstream Client Encapsulation

5.3.2 Video encoding

If the 5GMS UE supports the transmission of video:

- the real-time encoding capabilities for **HEVC-FullHD-Enc** as defined in clause 4.2.2.2 defined as the sender requirements for **HEVC-FullHD-Enc** Operation Point shall be supported.

5.3.3 Audio encoding

If the 5GMS UE supports the transmission of audio:

- the sender requirements for the **eAAC+ stereo** Operation Point as defined in 3GPP TS 26.117 [4] clause 6.3.2.3 should be supported.

5.3.4 Speech encoding

If the 5GMS UE supports the transmission of speech:

- the sender requirements for the EVS Operation Point as defined in 3GPP TS 26.117 [4] clause 6.2.4.3 shall be supported;
- the sender requirements for the AMR-WB Operation Point as defined in 3GPP TS 26.117 [4] clause 6.2.3.3 should be supported;
- the sender requirements for the AMR Operation Point as defined in 3GPP TS 26.117 [4] clause 6.2.2.3 may be supported.

5.3.5 Encapsulation

5.3.5.1 Introduction

This clause defines the requirements in terms of encapsulation of media for a 5GMSu Media Streamer in combination with codecs. Media Encapsulation in 5G Media Streaming for uplink is defined based on the MPEG Common Media Application Format (CMAF) [7]. Based on this, this clause documents the requirements and recommendations for the support of media profiles by the definition of media streamer requirements.

5.3.5.2 Video media profile

If the 5GMS UE supports the streaming of video, then the following shall be supported:

- the content generation requirements for the HEVC-FullHD Media Profile as defined in clause 4.2.2.3.2.5;
- the sender requirements for the HEVC-FullHD Operation Point as defined in clause 5.3.2.

5.3.5.3 Speech media profile

If the 5GMSu Client supports the transmission of speech, then the following shall be supported:

- the EVS content generation requirements as defined in 3GPP TS 26.117 [4] clause 7.4.2.5.

If the 5GMSu Client supports the transmission of speech, then the following should be supported:

- the AMR-WB content generation requirements as defined in 3GPP TS 26.117 [4] clause 7.3.2.5.

If the 5GMSu Client supports the transmission of speech, then the following may be supported:

- the AMR content generation requirements as defined in 3GPP TS 26.117 [4] clause 7.2.2.5.

5.3.5.4 Audio media profile

If the 5GMSu Client supports the transmission of audio, then the following should be supported:

- the eAAC+ stereo content generation requirements as defined in 3GPP TS 26.117 [4] clause 7.6.2.5.

5.4 Television (TV) profile

5.4.1 Video decoding

5.4.1.1 H.264 (AVC)

If the 5GMSd Client supports the Television (TV) profile, it shall support the *H.264/AVC 720p HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.4.2.6.

If the 5GMSd Client supports the Television (TV) profile, it should support the *H.264/AVC Full HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.4.3.6.

5.4.1.2 H.265 (HEVC)

If the 5GMSd Client supports the Television (TV) profile, it should support:

- *H.265/HEVC 720p HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.2.7;
- *H.265/HEVC Full HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.3.7;
- *H.265/HEVC UHD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.4.7;
- *H.265/HEVC Full HD HDR* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.5.8;
- *H.265/HEVC UHD HDR* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.6.8;
- *H.265/HEVC Full HD HDR HLG* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.7.7; and
- *H.265/HEVC UHD HDR HLG* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.8.7.

If the 5GMSd Client supports the Television (TV) profile and HD-HDR capabilities, it shall support:

- *H.265/HEVC Full HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.3.7.

5.4.2 Audio decoding

If the 5GMSd Client supports the Television (TV) profile, it /should support *eAAC+ stereo* Operation point as defined in 3GPP TS 26. 117 [4], clause 6.3.3.

5.4.3 Subtitle decoding

If the 5GMSd Client supports the Television (TV) profile, it should support the **IMSC-1.1-TEXT-DEC** decoding capabilities as defined in clause 4.5.1.1.

5.4.4 Decapsulation and decryption

5.4.4.1 Introduction

This clause defines the requirements in terms of decapsulation and decryption of media for a Television (TV) Profile Media Player in combination with codecs. Media Encapsulation in 5G Media Streaming for downlink is defined based on the MPEG Common Media Application Format (CMAF) [7]. However, TS 26.116 [7] defines file format encapsulation and DASH Mapping in clause 5.

This clause addresses decapsulation and decryption requirements in a sense that a 5GMSd Client supporting the Television (TV) profile requires to be able to process content that conforms to TS26.116 [7] encapsulation and CMAF encapsulation.

The CMAF Track and Switching Set constraints in the present document and the Representation and Adaptation Set constraints in TS26.116 [7] are considered almost identical, but it still needs to be checked in detail. In the absence of both, it is expected that content offered for TV Profile receivers conform with both specifications.

5.4.4.2 Video media profiles

If the 5GMSd client supports the Television (TV) profile, then the following applies:

- the AVC-HD playback requirements as defined in clause 4.2.1.3.1.4 and the *H.264/AVC 720p HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.4.2.6 shall be supported.
- the AVC-FullHD playback requirements as defined in clause 4.2.1.3.1.4 and the *H.264/AVC Full HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.4.3.6 should be supported.
- the HEVC-HD playback requirements as defined in clause 4.2.2.3.1.4 and the *H.265/HEVC 720p HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.2.7 should be supported.
- the HEVC-FullHD playback requirements as defined in clause 4.2.2.3.2.4 and the *H.265/HEVC Full HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.3.7 should be supported.
- the HEVC-FullHD playback requirements as defined in clause 4.2.2.3.2.4 and the *H.265/HEVC Full HD HDR* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.5.7 should be supported.
- the HEVC-FullHD playback requirements as defined in clause 4.2.2.3.2.4 and the *H.265/HEVC Full HD HLG* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.7.7 should be supported.
- the HEVC-UHD playback requirements as defined in clause 4.2.2.3.3.4 and the *H.265/HEVC UHD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.4.7 may be supported.
- the HEVC-UHD playback requirements as defined in clause 4.2.2.3.3.4 and the *H.265/HEVC UHD HDR* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.5.7 may be supported.
- the HEVC-UHD playback requirements as defined in clause 4.2.2.3.3.4 and the *H.265/HEVC UHD HLG* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.8.7 may be supported.

If the 5GMSd Client supports the Television (TV) profile and HD-HDR capabilities, then the following applies:

- the HEVC-FullHD playback requirements as defined in clause 4.2.2.3.2.4 and the *H.265/HEVC Full HD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.3.7 shall be supported.
- the HEVC-FullHD playback requirements as defined in clause 4.2.2.3.2.4 and the *H.265/HEVC Full HD HDR* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.5.7 shall be supported.
- the HEVC-FullHD playback requirements as defined in clause 4.2.2.3.2.4 and the *H.265/HEVC Full HD HLG* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.7.7 shall be supported.
- the HEVC-UHD playback requirements as defined in clause 4.2.2.3.3.4 and the *H.265/HEVC UHD* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.4.7 may be supported.
- the HEVC-UHD playback requirements as defined in clause 4.2.2.3.3.4 and the *H.265/HEVC UHD HDR* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.5.7 may be supported.
- the HEVC-UHD playback requirements as defined in clause 4.2.2.3.3.4 and the *H.265/HEVC UHD HLG* Operation Point Receiver requirements as specified in TS 26.116 [12], clause 4.5.8.7 may be supported.

5.4.4.3 Audio media profiles

If the 5GMSd Client supports the Television (TV) profile, then the following should be supported:

- the **eAAC+ stereo** playback requirements as defined in 3GPP TS 26.117 [4] clause 7.5.2.4.

5.4.4.4 Subtitle media profiles

If the 5GMSd Client supports the Television (TV) profile, then the following should be supported:

- the **IMSC1.1 text track** playback requirements as defined in clause 4.5.1.5.

5.4.4.5 Encrypted content

If the 5GMSd Client supports the Television (TV) profile the same requirements apply as in clause 5.2.7.6 for the default profile.

5.4.5 Capability discovery

If the 5GMSd Client supports the Television (TV) profile it is expected to support capability discovery such that 5GMS-aware applications can identify if a specific media profile is supported.

The same requirements apply as in clause 5.2.8 for the default profile.

A 5GMSd Client that supports the Television (TV) profile may support additional capability methods that permits to identify additional capabilities of media profile playback taking into account information provided in the MPD for TV Video Profiles. Examples include the W3C Media Capability APIs [18].

5.5 Downlink 360 Virtual Reality (VR) profile

5.5.1 Video

5.5.1.1 Operation Points

If the 5GMS UE supports 360 VR video, it shall include a receiver that complies with:

- the *Basic H.264/AVC* Operation Point Receiver requirements as specified in TS 26.118 [13], clause 5.1.4.

If the 5GMS UE supports 360 VR video, it should include a receiver that complies with:

- the *Main H.265/HEVC* Operation Point Receiver requirements as specified in TS 26.118 [13], clause 5.1.5.

If the 5GMS UE supports 360 VR video, it may include a receiver that complies with:

- the *Flexible H.265/HEVC* Operation Point Receiver requirements as specified in TS 26.118 [13], clause 5.1.6.

5.5.1.2 DASH encapsulation

If the 5GMS UE supports 360 VR video for DASH services, it shall include a receiver that complies with:

- the Basic Video Media Profile Receiver requirements for DASH as specified in TS 26.118 [13], clause 5.2.2.3.

If the 5GMS UE supports 360 VR video for DASH services, it should include a receiver that complies with:

- the Main Video Media Profile Receiver requirements for DASH as specified in TS 26.118 [13], clause 5.2.3.3.

If the 5GMS UE supports 360 VR video for DASH services, it may include a receiver that complies with:

- the Advanced Video Media Profile Receiver requirements for DASH as specified in TS 26.118 [13], clause 5.2.3.4.

5.5.2 Audio

5.5.2.1 Operation Points

If the 5GMS UE supports 3D/VR audio, it should include a receiver that complies with:

- the *3GPP MPEG-H Audio* Operation Point Receiver requirements as specified in TS 26.118 [13], clause 6.1.4.

5.5.2.2 DASH encapsulation

If the 5GMS UE supports 3D/VR audio for DASH services, it should include a receiver that complies with:

- the *OMAF 3D Audio Baseline* Media Profile Receiver requirements for file format signalling and encapsulation as specified in TS 26.118 [13], clause 6.2.2.3.

5.6 Uplink 360 Virtual Reality (VR) profile

5.6.1 Video

5.6.1.1 Operation Points

If the 5GMS UE supports 360 VR video, it shall include an encoder that can encode a bitstream at a minimum of 1080p resolution 60 fps that can be decoded by a receiver that complies with:

- the Basic H.264/AVC Operation Point Receiver requirements as specified in TS 26.118 [13], clause 5.1.4.

If the 5GMS UE supports 360 VR video, it should include an encoder that can encode a bitstream at a minimum of 2160p resolution 60 fps that can be decoded by a receiver that complies with:

- the Main H.265/HEVC Operation Point Receiver requirements as specified in TS 26.118 [13], clause 5.1.5.

If the 5GMS UE supports 360 VR video, it may include an encoder that can encode a bitstream at a minimum of 2160p resolution 60 fps that can be decoded by a receiver that complies with:

- the Flexible H.265/HEVC Operation Point Receiver requirements as specified in TS 26.118 [13], clause 5.1.6.

5.6.1.2 Encapsulation

Media Encapsulation in 5G Media Streaming for uplink is defined based on the MPEG Common Media Application Format (CMAF) [7]. A sender shall at least support the generation of CMAF tracks.

5.6.2 Audio

5.6.2.1 Operation Points

If the 5GMS UE supports 3D/VR audio, it should include an encoder that can encode a bitstream that can be decoded by a receiver that complies with:

- the 3GPP MPEG-H Audio Operation Point Receiver requirements as specified in TS 26.118 [13], clause 6.1.4.

5.6.2.2 Encapsulation

Media Encapsulation in 5G Media Streaming for uplink is defined based on the MPEG Common Media Application Format (CMAF) [7]. A sender shall at least support the generation of CMAF tracks.

Annex A (informative): Change history

Change history							
Date	Meeting	TDoc	CR	Rev	Cat	Subject/Comment	New version
2019-12	SA#86	SP=19xxx				Presented to TSG SA#86 (for information)	1.0.0
2020-01	SA4#107	S4-200314				Integration of S4-200033 and S4-200272	1.1.0
2020-04	SA4#108-e	S4-200510				Integration of S4-AHI936	1.2.0
2020-04	SA4#108-e	S4-200631				Integration of support for subtitles in S4-200626	1.3.0
2020-06	SA4#109-e	S4-200761 S4-200760				Inclusion of CMAF references in presentation format capabilities Implementation of working assumption on video codec requirements for default downlink and TV profiles	1.4.0
2020-06	SA4#109-e	SA4 plenary decision				Inclusion of 10-bit bit depth into the HD-HDR capability	1.4.1
2020-06	SA#88-e	SP-200405				Profiles, Codecs and Formats (Version 2.0.0)	2.0.0
2020-06	SA#88-e	SP-200405				Profiles, Codecs and Formats (UCC)	16.0.0
2020-09	SA#89-e	SP-201261	0001	1	B	Corrections to 5G Media Streaming	16.1.0
2021-04	SA#91-e	SP-210039	0002	1	F	Various Corrections to 5GMS Codecs and Formats	16.2.0

History

Document history		
V16.0.0	September 2020	Publication
V16.1.0	October 2020	Publication
V16.2.0	May 2021	Publication