ETSI TS 126 512 V18.6.0 (2025-07)

TECHNICAL SPECIFICATION

5G;
5G Media Streaming (5GMS);
Protocols
(3GPP TS 26.512 version 18.6.0 Release 18)

Reference
RTS/TSGS-0426512vi60

Keywords
5G

ETSI

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Sous-Préfecture de Grasse (06) N° w061004871

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Contents

Foreword

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

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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

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should indicates a recommendation to do something

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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

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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 set of protocols and APIs for 5G Media Streaming (5GMS) services based on the 5G Media Streaming Architecture (5GMSA). 5GMS supports services including MNO and third-party Downlink Media Streaming Services, and MNO and third-party Uplink Media Streaming Services.

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 TS 26.501: "5G Media Streaming (5GMS); General description and architecture".

[3] DASH Industry Forum, "Specification of Live Media Ingest", https://dashif-documents.azurewebsites.net/Ingest/master/DASH-IF-Ingest.pdf

[4] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".

[5] Standard ECMA-262, 5.1 Edition: "ECMAScript Language Specification", June 2011.

[6] IETF RFC 6234: "US Secure Hash Algorithms (SHA and SHA-based HMAC and HKDF)".

[7] 3GPP TS 23.003: "Numbering, addressing and identification".

[8] ITU-T Recommendation X.509 (2005) | ISO/IEC 9594-8:2005: "Information Technology – Open Systems Interconnection – The Directory: Public-key and attribute certificate frameworks".

[9] Void

[10] IETF RFC 4648: "The Base16, Base32, and Base64 Data Encodings".

[11] IEEE Standard 1003.1™, Issue 7: "The Open Group Base Specifications", 2018. https://pubs.opengroup.org/onlinepubs/9699919799/

[12] 3GPP TS 29.571: "Common Data Types for Service Based Interfaces; Stage 3".

[13] 3GPP TS 38.321: "NR; Medium Access Control (MAC) protocol specification".

[14] 3GPP TS 36.321: "Evolved Universal Terrestrial Radio Access (E-UTRA); Medium Access Control (MAC) protocol specification".

[15] 3GPP TS 27.007: "AT Command set for User Equipment (UE)".

[16] Void[17] IETF RFC 7468: "Textual Encodings of PKIX, PKCS, and CMS Structures", April 2015.

[18] ISO 3166-1: "Codes for the representation of names of countries and their subdivisions — Part 1: Country codes".

[19] ISO 3166-2: "Codes for the representation of names of countries and their subdivisions — Part 2: Country subdivision code".

[20] IETF RFC 5280: "Internet X.509 Public Key Infrastructure Certificate and Certificate Revocation List (CRL) Profile", May 2008.

[21] 3GPP TS 29.500: "5G System; Technical Realization of Service Based Architecture; Stage 3".

[22] 3GPP TS 29.501: "5G System; Principles and Guidelines for Services Definition; Stage 3".

[23] OpenAPI: "OpenAPI 3.0.0 Specification", https://github.com/OAI/OpenAPI-Specification/blob/master/versions/3.0.0.md.

[24] IETF RFC 9112: "HTTP/1.1", June 2022.

[25] IETF RFC 9110: "HTTP Semantics", June 2022.

[26] Void

[27] Void

[28] IETF RFC 9111: "HTTP Caching", June 2022.

[29] Void

[30] IETF RFC 8446: "The Transport Layer Security (TLS) Protocol Version 1.3", August 2018.

[31] IETF RFC 9113: "HTTP/2", June 2022.

[32] ISO/IEC 23009-1: "Information technology; Dynamic adaptive streaming over HTTP (DASH) — Part 1: Media presentation description and segment formats".

[33] 3GPP TS 23.503: "Policy and charging control framework for the 5G System (5GS); Stage 2".

[34] 3GPP TS 29.514: "5G System; Policy Authorization Service; Stage 3".

[35] 3GPP TS 26.511: "5G Media Streaming (5GMS); Profiles, codecs and formats".

[36] Void.

[37] 3GPP TS 26.244: "Transparent end-to-end packet switched streaming service (PSS); 3GPP file format (3GP)".

[38] IETF RFC 8259: "The JavaScript Object Notation (JSON) Data Interchange Format", December 2017.

[39] ISO 14496-12: "Information technology – Coding of audio-visual objects – Part 12: ISO base media file format".

[40] ISO 23000-19: "Information technology – Coding of audio-visual objects – Part 19: Common media application format (CMAF) for segmented media".

[41] IETF RFC 3986: "URI Generic Syntax".

[42] 3GPP TS 26.118: "Virtual Reality (VR) profiles for streaming applications".

[43] 3GPP TS 24.558: "Enabling Edge Applications; Protocol specification".

[44] 3GPP TS 29.558: "Enabling Edge Applications; Application Programming Interface (API) specification; Stage 3".

[45] 3GPP TS 23.502: "Procedures for the 5G System (5GS); Stage 2".

[46] 3GPP TS 29.517: "5G System; Application Function Event Exposure Service; Stage 3".

[47] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[48] 3GPP TS 26.531: "Data Collection and Reporting; General Description and Architecture".

[49] 3GPP TS 26.532: "Data Collection and Reporting; Protocols and Formats".

[50] 3GPP TS 29.522: "5G System. Network Exposure Function Northbound APIs; Stage 3".

[51] 3GPP TS 26.346: "Multimedia Broadcast/Multicast Service (MBMS); Protocols and codecs".

[52] 3GPP TS 26.347: "Multimedia Broadcast/Multicast Service (MBMS); Application Programming Interface and URL".

[53] IETF draft-bhutton-json-schema-validation: "JSON Schema Validation: A Vocabulary for Structural Validation of JSON", June 2022.

[54] IETF RFC 3339: "Date and Time on the Internet: Timestamps", July 2002.

[55] 3GPP 29.591: "Network Exposure Function Southbound Services; Stage 3".

[56] 3GPP TS 26.510: "Media delivery; interactions and APIs for provisioning and media session handling".

[57] IETF RFC 2045: "Multipurpose Internet Mail Extensions (MIME) Part One: Format of Internet Message Bodies".

[58] IETF RFC 9000: "QUIC: A UDP-Based Multiplexed and Secure Transport", May 2021.

[59] IETF RFC 9001: "Using TLS to Secure QUIC", May 2021.

[60] IETF RFC 9114: "HTTP/3", June 2022.

[61] IETF RFC 8673: "HTTP Random Access and Live Content", November 2019.

[62] Consumer Technology Association CTA-5005-A: "Web Application Video Ecosystem – DASH-HLS Interoperability Specification".

[63] DASH-IF Guidelines: "Low-latency Modes for DASH", available here: https://dash-industry-forum.github.io/docs/CR-Low-Latency-Live-r8.pdf

[64] 3GPP TS 26.517: "5G Multicast-Broadcast User Services; Protocols and Formats".

[65] Consumer Technology Association CTA-5004: "Web Application Video Ecosystem – Common Media Client Data", September 2020, https://cdn.cta.tech/cta/media/media/resources/standards/pdfs/cta-5004-final.pdf.

[66] IETF RFC 4122: "A Universally Unique IDentifier (UUID) URN Namespace", July 2005.

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].

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
5GMSd	5GMS downlink
5GMSu	5GMS uplink
5GMSA	5GMS Architecture
5GMS EAS	Edge-enabled 5GMS Application Server
BMFF	(ISO) Base Media File Format
ABR	Adaptive Bit Rate
ACR	Application Context Relocation
AF	Application Function
ANBR	Access Network Bit rate Recommendation
AS	Application Server
BM-SC	Broadcast Multicast Switching Centre
CDN	Content Delivery Network / Content Distribution Network
CGI	Cell Global Identifier
CMAF	Common Media Application Format
CRUD	Create, Read, Update, Delete
CNAME	Canonical Name
CORS	Cross-Origin Resource Sharing
CRL	Certificate Revocation List
DASH	Dynamic Adaptive Streaming over HTTP
DER	Distinguished Encoding Rule
DNN	Domain Name News
DNS	Domain Name Server
EAS	Edge Application Server
ECGI	E-UTRAN Cell Global Identifier
ECMA	European Computer Manufacturers Association
EES	Edge Enabler Server
eMBMS	evolved MBMS
FQDN	Fully Qualified Domain Name
GPSI	Generic Public Subscription Identifier
HLS	HTTP Live Streaming
ISO	International Organization for Standardization
JSON	JavaScript Object Notation
LCID	Logical Channel IDentifier
MBMS	Multimedia Broadcast Multicast Service
MBS	Multicast-Broadcast Service
MBSTF	MBS Transport Function
MFBR	Maximum Flow Bit Rate
MIME	Multipurpose Internet Mail Extensions
MNO	Mobile Network Operator
MPD	Media Presentation Description
MSISDN	Mobile Subscriber ISDN number
NCGI	NR Cell Global Identifier
NEF	Network Exposure Function
OAM	Operations, Administration and Maintenance
PCC	Policy Control and Charging
PCF	Policy Control Function
PEM	Privacy-Enhanced Mail
PFD	Packet Flow Description
PFDF	Packet Flow Description Function
QoE	Quality of Experience
QoS	Quality of Service
SDF	Service Data Flow
SHA	Secure Hash Algorithm
TLS	Transport Layer Security

URI Uniform Resource Identifier
URL Uniform Resource Locator
UTC Coordinated Universal Time

4 Procedures for Downlink Media Streaming

4.1 General

This clause defines all procedures for Downlink Media Streaming using the different 5G Media Streaming Reference Points.

NOTE: The descriptions of certain M1 interface procedures in clause 4.3, and of certain M5 interface procedures in clause 4.7, indicate applicability of those procedures to both downlink and uplink media streaming. This avoids redundant duplication of normative text in clause 5, regarding M1 and M5 procedures for uplink media streaming.

4.2 APIs relevant to downlink media streaming

Table 4.2-1 summarises the APIs used to provision and use the various downlink media streaming features specified in TS 26.501 [2].

Table 4.2-1: Summary of APIs relevant to downlink media streaming features

5GMSd feature	Abstract	Relevant APIs		
		Interface	API name	Clause
Content protocols discovery	Used by the 5GMSd Application Provider to interrogate which content ingest protocols are supported by 5GMSd AS(s).	M1d	Content Protocols Discovery API	7.5
Content hosting	Content is ingested, hosted and distributed by the 5GMSd AS according to a Content Hosting Configuration associated with a Provisioning Session.	M1d	Provisioning Sessions API	7.2
			Server Certificates Provisioning API	7.3
			Content Preparation Templates Provisioning API	7.4
			Content Hosting Provisioning API	7.6
		M2d	HTTP pull-based content ingest protocol	8.2
			DASH-IF push-based content ingest protocol	8.3
			HTTP low-latency pull-based content ingest protocol	8.4
		M3d	Server Certificates configuration API	9.2
			Content Preparation Templates configuration API	9.3
			Content Hosting configuration API	9.4
		M4d	MPEG-DASH [4] or 3GP-DASH [37] or DASH-IF push-based content distribution	10.2
			HTTP low-latency content distribution	10.3
		M5d	Service Access Information API	11.2
Metrics reporting	The 5GMSd Client uploads metrics reports to the 5GMSd AF according to a provisioned Metrics Reporting Configuration it obtains from the Service Access Information for its Provisioning Session.	M1d	Provisioning Sessions API	7.2
			Metrics Reporting Provisioning API	7.8
		M5d	Service Access Information API	11.2
			Metrics Reporting API	11.4
		M1d	Provisioning Sessions API	7.2

5GMSd feature	Abstract	Relevant APIs		
		Interface	API name	Clause
Consumption reporting	The 5GMSd Client provides feedback reports on currently consumed content according to a provisioned Consumption Reporting Configuration it obtains from the Service Access Information for its Provisioning Session.		Consumption Reporting Provisioning API	7.7
		M5d	Service Access Information API	11.2
			Consumption Reporting API	11.3
Dynamic Policy invocation	The 5GMSd Client activates different traffic treatment policies selected from a set of Policy Templates configured in its Provisioning Session.	M1d	Provisioning Sessions API	7.2
			Policy Templates Provisioning API	7.9
		M5d	Service Access Information API	11.2
			Dynamic Policies API	11.5
Network Assistance	The 5GMSd Client requests bit rate recommendations and delivery boosts from the 5GMSd AF.	M5d	Service Access Information API	11.2
			Network Assistance API	11.6
Edge content processing	Edge resources are provisioned for processing content in 5GMS downlink media streaming sessions.	M1d	Provisioning Sessions API	7.2
			Edge Resources Provisioning API	7.10
		M5d	Service Access Information API	11.2
5GMS via eMBMS	The 5GMSd AF provisions the delivery of content via eMBMS and MBMS User Services.	M1d	Provisioning Sessions API	7.2
		M5d	Service Access Information API	11.2
		M4d	MPEG-DASH [4] or 3GP-DASH [37] or HLS	10
5GMS via MBS	The 5GMSd AF provisions the delivery of content via MBS User Services.	M1d	Provisioning Sessions API	7.2
		M5d	Service Access Information API	11.2
		M4d	MPEG-DASH [4] or 3GP-DASH [37] or HLS	10
5GMS via eMBMS	The 5GMSd AF provisions the delivery of content via eMBMS.	M1d	Provisioning Sessions API	7.2
		M5d	Service Access Information API	11.2
		M4d	MPEG-DASH [4] or 3GP-DASH [37] or HLS content distribution	10
UE data collection, reporting and exposure	UE data related to downlink 5G Media Streaming is reported to the Data Collection AF instantiated in the 5GMSd AF for exposure to Event consumers.	M1d	Event Data Processing Provisioning API	7.11
		R4	*Ndcaf_DataReporting* service	17
		R5, R6	*Naf_EventExposure* service	18

4.3 Procedures of the M1 (5GMS Provisioning) interface

4.3.1 General

A 5GMS Application Provider may use the procedures in this clause to provision the network for media streaming sessions that are operated by that 5GMS Application Provider. For downlink media streaming, these sessions may be DASH streaming sessions, progressive download sessions, or any other type of media streaming or distribution (e.g. HLS) sessions. For uplink media streaming, the content format and delivery protocol are defined by the 5GMSu Application Provider and may be either non-fully standardized or employ standardized HTTP-based streaming of ISO BMFF content fragments as profiled by CMAF [39].

Reference point M1 offers three different sets of procedures:

- For downlink media streaming, configuration of content ingest at reference point M2d for onward distribution by the 5GMSd AS over reference point M4d or via other distribution systems such as eMBMS or MBS. The API at this reference point is designed to offer equivalent functionality as that exposed by a public CDN. For uplink media streaming, configuration of content egest at reference point M2u for the media content received by the 5GMSu AS from the 5GMSu Client over reference point M4u. The resource types involved in content hosting configuration are provisioning session (see clause 4.3.2), content hosting procedures (see clause 4.3.3), ingest protocols (see clause 4.3.4), content preparation template (see clause 4.3.5), and server certificates (see clause 4.3.6).

- Configuration of dynamic policies: allows the configuration of Policy Templates at M5 that can be applied to M4 downlink/uplink media streaming sessions.
- Configuration of reporting: permits the MNO to collect, at M5, QoE metrics and consumption reports about M4 downlink sessions, as well as permits the MNO to collect, at M5, QoE metrics reports about M4 uplink sessions.

A 5GMS Application Provider may use any of these procedures, in any combination, to support its media streaming sessions.

4.3.2 Provisioning Session procedures

4.3.2.1 General

Prior to configuring content hosting, dynamic policies, or reporting, the 5GMS Application Provider shall create a new Provisioning Session in the 5GMS AF. The 5GMS Application Provider shall use the operations specified in clause 5.2.2 of TS 26.510 [56] at reference point M1 to create and subsequently manipulate Provisioning Sessions in the 5GMS AF.

4.3.2.2 Void

4.3.2.3 Void

4.3.2.4 Void

4.3.2.5 Void

4.3.3 Content Hosting provisioning procedures

4.3.3.1 General

The 5GMSd Application Provider shall use the operations specified in clause 5.2.8 of TS 26.510 [56] at reference point M1d when it wants to create and subsequently manipulate Content Hosting Configurations in the 5GMSd AF in order to provision the content hosting feature for downlink media streaming.

The *canonicalDomainName* property nominated by the 5GMS AF for each distribution configuration in the Content Hosting Configuration shall comply with clause 6.0.2.2.

In the case where the *entryPoint* of a distribution configuration describes a Media Entry Point resource (e.g. MPEG-DASH MPD), the 5GMS AF shall not prefix additional path elements to the *relativePath* when it nominates the *baseURL* property.

4.3.3.2 Void

4.3.3.3 Void

4.3.3.4 Void

4.3.3.5 Void

4.3.3.6 Void

4.3.3A Content Publishing provisioning procedures

4.3.3A.1 General

The 5GMSu Application Provider shall use the operations specified in clause 5.2.9 of TS 26.510 [56] at reference point M1u when it wants to create and subsequently manipulate Content Publishing Configurations in the 5GMSu AF in order to provision the content publishing feature for uplink media streaming.

The *canonicalDomainName* property nominated by the 5GMS AF for each contribution configuration in the Content Publishing Configuration shall comply with clause 6.0.2.2.

In the case where the *entryPoint* of a contribution configuration describes a Media Entry Point resource (e.g. MPEG-DASH MPD), the 5GMS AF shall not prefix additional path elements to the *relativePath* when it nominates the *baseURL* property.

4.3.4 Content Protocols Discovery procedures

4.3.4.1 General

The 5GMS Application Provider shall use the operations specified in clause 5.2.3 of TS 26.510 [56] at reference point M1 when it wants to discover the set of downlink content ingest or uplink content egest protocols supported by the 5GMS AS at reference point M2.

4.3.4.2 Void

4.3.4.3 Void

4.3.4.4 Void

4.3.4.5 Void

4.3.5 Content Preparation Template provisioning procedures

4.3.5.1 General

For downlink media streaming, the 5GMSd AS may be required to process content ingested at reference point M2d before serving it from reference point M4d. For uplink media streaming, the 5GMSu AS may be required to process content it receives from the 5GMSu Client at reference point M4u before passing it to the 5GMSu Application Provider on the egest interface at reference point M2u.

The 5GMS Application Provider shall use the operations specified in clause 5.2.5 of TS 26.510 [56] at reference point M1 when it wants to create and subsequently manipulate Content Preparation Templates in the 5GMS AF.

4.3.5.2 Void

4.3.5.3 Void

4.3.5.4 Void

4.3.5.5 Void

4.3.6 Server Certificate provisioning procedures

4.3.6.1 General

Each X.509 server certificate [8] presented by the 5GMSd AS at reference point M4d or at reference point xMB-U is represented by a Server Certificate resource at M1d. The 5GMS Application Provider shall use the operations specified in clause 5.2.4 of TS 26.510 [56] at reference point M1 when it wants to create and subsequently manipulate Server Certificates in the 5GMS AF. These enable a Server Certificate resource to be created within the scope of a Provisioning Session, and subsequently referenced by a Content Hosting Configuration created in the scope of the same Provisioning Session.

NOTE: As a consumer of media from the 5GMSd AS in a combined architecture using 5GMS and eMBMS, the BM-SC needs to be able to trust the content it is receiving comes from a *bona fide* source. This issue is left to implementation. Likewise, in the case of a combined architecture using 5GMS and MBS, the MBSTF needs to be able to trust the content it ingests.

4.3.6.2 Void

4.3.6.3 Void

4.3.6.4 Void

4.3.6.5 Void

4.3.6.6 Void

4.3.6.7 Void

4.3.7 Dynamic Policy provisioning procedures

4.3.7.1 General

The 5GMS Application Provider shall use the operations specified in clause 5.2.7 of TS 26.510 [56] at reference point M1 when it wants to create and subsequently manipulate Policy Templates available for the use of downlink or uplink media streaming sessions of a particular Provisioning Session in the 5GMS AF.

4.3.7.2 Void

4.3.7.3 Void

4.3.7.4 Void

4.3.7.5 Void

4.3.8 Consumption Reporting Configuration provisioning procedures

4.3.8.1 General

The 5GMSd Application Provider shall use the interactions specified in clause 5.2.12 of TS 26.510 [56] at reference point M1 when it wants to activate and configure consumption reporting for a Provisioning Session in the 5GMSd AF.

4.3.8.2 Void

4.3.8.3 Void

4.3.8.4 Void

4.3.8.5 Void

4.3.9 Metrics Reporting provisioning procedures

4.3.9.1 General

The 5GMS Application Provider shall use the operations specified in clause 5.2.11 of TS 26.510 [56] at reference point M1 when it wants to configure QoE metrics reporting functionality associated with a downlink or uplink media streaming Provisioning Session in the 5GMS AF.

4.3.9.2 Void

4.3.9.3 Void

4.3.9.4 Void

4.3.9.5 Void

4.3.10 Edge Resources provisioning procedures

4.3.10.1 General

The 5GMS Application Provider shall use the operations specified in clause 5.2.6 of TS 26.510 [56] at reference point M1 when it wants to provision edge resources for downlink or uplink media streaming associated with a Provisioning Session in the 5GMS AF.

4.3.10.2 Void

4.3.10.3 Void

4.3.10.4 Void

4.3.10.5 Void

4.3.11 Event Data Processing provisioning procedures

4.3.11.1 General

The 5GMS Application Provider shall use the operations specified in clause 5.2.13 of TS 26.510 [56] at reference point M1 to configure the collection and processing of UE data related to 5G Media Streaming and to restrict its exposure over reference points R5 and R6 by configuring the Data Collection AF instantiated in the 5GMS AF (as defined in TS 26.531 [46] and clause 4.7 of TS 26.501 [2]) with one or more Event Data Processing Configurations and Data Access Profiles for a particular Event ID.

Each instance of a Data Access Profile specifies a set of data processing operations to be performed by the Data Collection AF on its collected UE data in order to synthesize the event data to be exposed to a specific Event service consumer entity. In this release, eligible Event service consumer entities of 5GMS event data are the NWDAF, the Event Consumer AF and the NEF.

4.3.11.2 Void

4.3.11.3 Void

4.3.11.3A Void

4.3.11.4 Void

4.4 Procedures of the M2d (5GMS content ingest) interface

The following 5GMS AS content ingest protocols are specified by the present document at reference point M2d to support downlink media streaming:

- An *HTTP pull-based content ingest protocol* is specified in clause 8.2, including specific handling for HTTP redirects issued to the 5GMS AS by the 5GMS Application Provider's origin server.
- A *DASH-IF push-based content ingest protocol* is specified in clause 8.3.

4.5 Procedures of the M3d interface

4.5.1 General

The procedures at reference point M3 defined in the following clauses should be used by the 5GMS AF to configure Server Certificate and Content Preparation Template resources in the 5GMS AS as well as Content Hosting and/or Content Publishing configuration resources that refer to them. The corresponding APIs specified in clause 9 should be used to realise these procedures.

4.5.2 Server Certificate configuration procedures

4.5.2.1 General

The 5GMS AF configures Server Certificate resources in the 5GMS AS using the procedures defined in this clause such that they remain synchronised with the Server Certificates provisioned at reference point M1 using the procedures defined in clause 4.3.6.

Each Server Certificate resource at reference point M3 is represented by a PEM-formatted X.509 certificate bundle.

4.5.2.2 Enumerate Server Certificates collection

This procedure is used by the 5GMS AF to determine the configuration state of the Server Certificates collection in a running 5GMS AS instance. The HTTP `GET` method shall be used for this purpose. The request URL shall be that of the Server Certificates collection on the 5GMS AS instance.

If the operation is successful, the 5GMS AS shall return an HTTP *200 (OK)* response. The resource body shall be a JSON array of Server Certificate resource identifiers. The array shall be empty if no Server Certificate resources currently exist in the collection.

4.5.2.3 Create Server Certificate

This procedure is used by the 5GMS AF to create a new Server Certificate resource in the target 5GMS AS instance. The HTTP `POST` method shall be used for this purpose. The 5GMS AF shall nominate the resource identifier to be used to identify the new resource in the Server Certificates collection as part of the request URL. A representation of the resource, in the form of a PEM-formatted X.509 certificate bundle that includes the private key, shall be provided as the request body.

If the operation is successful, the 5GMS AS shall return an HTTP *201 (Created)* response with an empty response body. The content of the `Location` header may differ from the request URL if the request was satisfied by a different 5GMS AS instance.

If a Server Certificate resource already exists at the request URL an HTTP *409 (Conflict)* error response shall be returned by the 5GMS AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

If a Server Certificate resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMS AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.2.4 Retrieve Server Certificate

Retrieval of individual Server Certificate resources from the 5GMS AS is not permitted at reference point M3.

4.5.2.5 Update Server Certificate

This procedure is used by the 5GMS AF to replace a Server Certificate resource in the target 5GMS AS instance. The HTTP `PUT` method shall be used for this purpose. The target resource shall be indicated in the request URL. The replacement resource representation, in the form of a PEM-formatted X.509 certificate bundle that includes the private key, shall be provided as the request body.

If the operation is successful, the 5GMS AS shall return an HTTP *200 (OK)* response with an empty response body.

If the replacement PEM bundle is identical to the current resource representation the 5GMS AS shall return an HTTP *204 (No Content)* response with an empty response body to indicate a "no-op".

If a Server Certificate resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMS AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMS AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.2.6 Destroy Server Certificate

This procedure is used by the 5GMS AF to destroy a Server Certificate resource in the target 5GMS AS instance. The HTTP `DELETE` method shall be used for this purpose. The target resource shall be indicated in the request URL. The request body shall be empty.

If the operation is successful, the 5GMS AS shall return an HTTP *204 (No Content)* response with an empty response body. Any subsequent attempt to recreate a Server Certificate resource with the same resource identifier shall fail as specified in clause 4.5.2.3.

If the target Server Certificate resource is still referenced by a Content Hosting Configuration or Content Publishing Configuration, an HTTP *409 (Conflict)* error response shall be returned by the 5GMS AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12]

If a Server Certificate resource previously existed at the request URL and was destroyed using this procedure an HTTP *410 (Gone)* error response should be returned by the 5GMS AS. If no server certificate resource has ever existed at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMS AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.3 Content Preparation Template configuration procedures

4.5.3.1 General

The 5GMS AF shall configure Content Preparation Template resources in the 5GMS AS using the procedures defined in this clause such that they remain synchronised with the Content Preparation Templates provisioned at reference point M1 using the procedures defined in clause 4.3.5.

The format of the Content Preparation Template resource representation is not specified in the present document.

4.5.3.2 Enumerate Content Preparation Templates collection

This procedure is used by the 5GMS AF to determine the configuration state of the Content Preparation Templates collection in a running 5GMS AS instance. The HTTP `GET` method shall be used for this purpose. The request URL shall be that of the Content Preparation Templates collection on the 5GMS AS instance.

If the operation is successful, the 5GMS AS shall return an HTTP *200 (OK)* response. The resource body shall be a JSON array of Content Preparation Template resource identifiers. The array shall be empty if no Content Preparation Template resources currently exist in the collection.

4.5.3.3 Create Content Preparation Template

This procedure is used by the 5GMS AF to create a new Content Preparation Template resource in the target 5GMS AS instance. The HTTP `POST` method shall be used for this purpose. The 5GMS AF shall nominate the resource identifier to be used to identify the new resource in the Content Preparation Templates collection as part of the request URL. A representation of the resource shall be provided as the request body.

If the operation is successful, the 5GMS AS shall return an HTTP *201 (Created)* response with an empty response body. The content of the `Location` header may differ from the request URL if the request was satisfied by a different 5GMS AS instance.

If a Content Preparation Template resource already exists at the request URL an HTTP *409 (Conflict)* error response shall be returned by the 5GMS AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

If a Content Preparation Template resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMS AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.3.4 Retrieve Content Preparation Template

Retrieval of individual Content Preparation Template resources is not permitted at reference point M3.

4.5.3.5 Update Content Preparation Template

This procedure is used by the 5GMS AF to replace a Content Preparation Template resource in the target 5GMS AS instance. The HTTP `PUT` method shall be used for this purpose. The target resource shall be indicated in the request URL. The replacement resource representation shall be provided as the request body.

If the operation is successful, the 5GMS AS shall return an HTTP *200 (OK)* response with an empty response body.

If the replacement Content Preparation Template is identical to the current resource representation the 5GMS AS shall return an HTTP *204 (No Content)* response with an empty response body to indicate a "no-op".

If the Media AS does not support modification of the Content Preparation Template, the update operation shall fail with a *403 (Forbidden)* HTTP response that includes a *ProblemDetails* error message body as specified in clause 5.2.4.1 of TS 29.571 [12].

If a Content Preparation Template resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMS AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMS AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.3.6 Destroy Content Preparation Template

This procedure is used by the 5GMS AF to destroy a Content Preparation Template resource in the target 5GMS AS instance. The HTTP `DELETE` method shall be used for this purpose. The target resource shall be indicated in the request URL. The request body shall be empty.

If the operation is successful, the 5GMS AS shall return an HTTP *204 (No Content)* response with an empty response body. Any subsequent attempt to recreate a Content Preparation Template resource with the same resource identifier shall fail as specified in clause 4.5.3.3.

If the target Content Preparation Template resource is still referenced by a Content Hosting Configuration or Content Publishing Configuration, an HTTP *409 (Conflict)* error response shall be returned by the 5GMS AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12]

If a Content Preparation Template resource previously existed at the request URL and was destroyed using this procedure an HTTP *410 (Gone)* error response should be returned by the 5GMS AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMS AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.4 Content Hosting Configuration procedures

4.5.4.1 General

The 5GMSd AF shall configure Content Hosting Configuration resources of type *ApplicationServerContentHosting Configuration* in the 5GMSd AS using the procedures defined in this clause such that they remain synchronised with the Content Hosting Configurations provisioned at reference point M1 using the procedures defined in clause 4.3.3.

The format of the Content Hosting Configuration resource representation at reference point M3 is as specified in clause 8.8.3.1 of TS 26.510 [56]. The 5GMS AF shall populate the *canonicalDomainName* and *baseURL* properties of each distribution configuration with the values it has chosen.

NOTE: The 5GMSd AS implementation converts received Content Hosting Configurations into a format suitable for configuring the HTTP server that realises the content hosting feature.

4.5.4.2 Enumerate Content Hosting Configurations collection

This procedure is used by the 5GMSd AF to determine the configuration state of the Content Hosting Configurations collection in a running 5GMSd AS instance. The HTTP `GET` method shall be used for this purpose. The request URL shall be that of the Content Hosting Configuration collection on the 5GMSd AS instance.

If the operation is successful, the 5GMSd AS shall return an HTTP *200 (OK)* response. The resource body shall be a JSON array of Content Hosting Configuration resource identifiers. The array shall be empty if no Content Hosting Configuration resources currently exist in the collection.

4.5.4.3 Create Content Hosting Configuration

This procedure is used by the 5GMSd AF to create a new Content Hosting Configuration resource in the target 5GMSd AS instance. The HTTP `POST` method shall be used for this purpose. The 5GMSd AF shall nominate the resource identifier to be used to identify the new resource in the Content Hosting Configurations collection as part of the request URL. A representation of the resource shall be provided as the request body.

If the operation is successful, the 5GMSd AS shall return an HTTP *201 (Created)* response with an empty response body. The content of the `Location` header may differ from the request URL if the request was satisfied by a different 5GMSd AS instance.

If a Content Hosting Configuration resource already exists at the request URL an HTTP *409 (Conflict)* error response shall be returned by the 5GMSd AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

If any resources referenced by the supplied Content Hosting Configuration resource representation are invalid, the create operation shall fail with an HTTP response status code of *400 (Bad Request).* The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12]. In this case, the Content Hosting Configuration resource shall remain in an uncreated state in the target 5GMSd AS instance.

If a Content Hosting Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMSd AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.4.4 Retrieve Content Hosting Configuration

Retrieval of individual Content Hosting Configuration resources is not permitted at reference point M3.

4.5.4.5 Update Content Hosting Configuration

This procedure is used by the 5GMSd AF to replace a Content Hosting Configuration resource in the target 5GMSd AS instance. The HTTP `PUT` method shall be used for this purpose. The target resource shall be indicated in the request URL. The replacement resource representation shall be provided as the request body.

If the operation is successful, the 5GMSd AS shall return an HTTP *200 (OK)* response with an empty response body.

If the replacement Content Hosting Configuration is identical to the current resource representation the 5GMSd AS shall return an HTTP *204 (No Content)* response with an empty response body to indicate a "no-op".

If any resources referenced by the replacement Content Hosting Configuration resource representation are invalid, the update operation shall fail with an HTTP response status code of 4*00 (Bad Request).* The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12]. In this case, the target Content Hosting Configuration resource shall remain in the state immediately prior to the update operation.

If a Content Hosting Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMSd AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMSd AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.4.6 Destroy Content Hosting Configuration

This procedure is used by the 5GMSd AF to destroy a Content Hosting Configuration resource in the target 5GMSd AS instance. The HTTP `DELETE` method shall be used for this purpose. The target resource shall be indicated in the request URL. The request body shall be empty.

If the operation is successful, the 5GMSd AS shall return an HTTP *204 (No Content)* response with an empty response body. Any subsequent attempt to recreate a Content Hosting Configuration resource with the same resource identifier shall fail as specified in clause 4.5.4.3.

If a Content Hosting Configuration resource previously existed at the request URL and was destroyed using this procedure an HTTP *410 (Gone)* error response should be returned by the 5GMSd AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMSd AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.4.7 (De)activate Content Hosting Configuration

This procedure is used by the 5GMSd AF to activate or deactivate a Content Hosting Configuration resource in the target 5GMSd AS instance. The HTTP `POST` method shall be used for this purpose. The target resource shall be identified in the request URL. The request body shall be a single JSON *boolean* indicating the desired state of the target resource: *true* for active and *false* for inactive.

If the Content Hosting Configuration can be (de)activated immediately by the 5GMSd AS, or if it is already in the desired state indicated in the request, the HTTP *204 (No Content)* response shall be returned by the 5GMSd AS with an empty response body. If the activation request is otherwise acceptable to the 5GMSd AS, but the Content Hosting Configuration cannot be (de)activated immediately, the HTTP *202 (Accepted)* response shall be returned by the 5GMSd AS with an empty response body to indicate that (de)activation is in progress. The state of the Content Hosting Configuration may then be polled using the procedure specified in clause 4.5.4.8.

If a Content Hosting Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMSd AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMSd AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.4.8 Interrogate Content Hosting Configuration state

This procedure is used by the 5GMSd AF to interrogate the current state of a Content Hosting Configuration resource in the target 5GMSd AS instance. The HTTP `GET` method shall be used for this purpose. The target resource shall be indicated in the request URL. The request body shall be empty.

If the Content Hosting Configuration is known to the 5GMSd AS, the HTTP *200 (OK)* response shall be returned with an indication of its current state provided in the response body as a JSON object of type *boolean* with the value *true* for active and *false* for inactive.

If a Content Hosting Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMS AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMS AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.4.9 Purge Content Hosting cache

This procedure is used by the 5GMSd AF to purge one or more content items from the 5GMSd AS cache associated with a Content Hosting Configuration resource in the target 5GMSd AS instance. The HTTP `POST` method shall be used for this purpose. A Content Hosting Configuration resource shall be indicated in the request URL. The request body shall be a single key–value pair encoded per the *application/x-www-form-urlencoded* MIME content type. The key shall

be the string *pattern* and the value shall be a regular expression [5] identifying the media resource URL(s) to be purged from the associated content cache.

If the operation is successful, the 5GMSd AS shall return an HTTP *200 (OK)* response. The resource body should indicate the total number of cache entries purged encoded as a positive JSON integer. If the purge request is otherwise acceptable to the 5GMSd AS, but no cache entries were purged because none matched the supplied regular expression, the HTTP *204 (No Content)* response shall instead be returned by the 5GMSd AS with an empty response body.

If the request message body – or the regular expression contained in it – are found by the 5GMSd AS to be syntactically malformed the HTTP *400 (Bad Request)* error response shall be returned. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

If a Content Hosting Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMSd AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMSd AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.5 Content Publishing Configuration procedures

4.5.5.1 General

The 5GMSu AF shall configure Content Publishing Configuration resources of type *ApplicationServerContentPublishingConfiguration* in the 5GMSu AS using the procedures defined in this clause such that they remain synchronised with the Content Publishing Configurations provisioned at reference point M1 using the procedures defined in clause 4.3.3.

The format of the Content Publishing Configuration resource representation at reference point M3 is as specified in clause 8.9.3.1 of TS 26.510 [56]. The 5GMS AF shall populate the *canonicalDomainName* and *baseURL* properties of each contribution configuration with the values it has chosen.

NOTE: The 5GMSu AS implementation converts received Content Publishing Configurations into a format suitable for configuring the HTTP server that realises the content publishing feature.

4.5.5.2 Enumerate Content Publishing Configurations collection

This procedure is used by the 5GMSu AF to determine the configuration state of a running 5GMSu AS instance. The HTTP `GET` method shall be used for this purpose. The request URL shall be that of the Content Publishing Configuration collection on the 5GMSu AS instance.

If the operation is successful, the 5GMSu AS shall return an HTTP *200 (OK)* response. The resource body shall be a JSON array of Content Publishing Configuration resource identifiers. The array shall be empty if no Content Publishing Configuration resources currently exist in the collection.

4.5.5.3 Create Content Publishing Configuration

This procedure is used by the 5GMSu AF to create a new Content Publishing Configuration resource in the target 5GMSu AS instance. The HTTP `POST` method shall be used for this purpose. The 5GMSu AF shall nominate the resource identifier to be used to identify the new resource in the Content Publishing Configurations collection as part of the request URL. A representation of the resource shall be provided as the request body.

If the operation is successful, the 5GMSu AS shall return an HTTP *201 (Created)* response with an empty response body. The content of the `Location` header may differ from the request URL if the request was satisfied by a different 5GMSu AS instance.

If a Content Publishing Configuration resource already exists at the request URL an HTTP *409 (Conflict)* error response shall be returned by the 5GMSu AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

If any resources referenced by the supplied Content Publishing Configuration resource representation are invalid, the create operation shall fail with an HTTP response status code of *400 (Bad Request)*. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12]. In this case, the Content Publishing Configuration resource shall remain in an uncreated state in the target 5GMSu AS instance.

If a Content Publishing Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMSu AS. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.5.4 Retrieve Content Publishing Configuration

Retrieval of individual Content Publishing Configuration resources is not permitted at reference point M3.

4.5.5.5 Update Content Publishing Configuration

This procedure is used by the 5GMSu AF to replace a Content Publishing Configuration resource in the target 5GMSu AS instance. The HTTP `PUT` method shall be used for this purpose. The target resource shall be indicated in the request URL. The replacement resource representation shall be provided as the request body.

If the operation is successful, the 5GMSu AS shall return an HTTP *200 (OK)* response with an empty response body.

If the replacement Content Publishing Configuration is identical to the current resource representation the 5GMSu AS shall return an HTTP *204 (No Content)* response with an empty response body to indicate a "no-op".

If any resources referenced by the replacement Content Publishing Configuration resource representation are invalid, the update operation shall fail with an HTTP response status code of *400 (Bad Request).* The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12]. In this case, the target Content Publishing Configuration resource shall remain in the state immediately prior to the update operation.

If a Content Publishing Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMSu AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMSu AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.5.6 Destroy Content Publishing Configuration

This procedure is used by the 5GMSu AF to destroy a Content Publishing Configuration resource in the target 5GMSu AS instance. The HTTP `DELETE` method shall be used for this purpose. The target resource shall be indicated in the request URL. The request body shall be empty.

If the operation is successful, the 5GMSu AS shall return an HTTP *204 (No Content)* response with an empty response body. Any subsequent attempt to recreate a Content Publishing Configuration resource with the same resource identifier shall fail as specified in clause 4.5.3.3.

If a Content Publishing Configuration resource previously existed at the request URL and was destroyed using this procedure an HTTP *410 (Gone)* error response should be returned by the 5GMSu AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMSu AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.4.7 (De)activate Content Publishing Configuration

This procedure is used by the 5GMSu AF to activate or deactivate a Content Publishing Configuration resource in the target 5GMSu AS instance. The HTTP `POST` method shall be used for this purpose. The target resource shall be identified in the request URL. The request body shall be a single JSON *boolean* indicating the desired state of the target resource: *true* for active and *false* for inactive.

If the Content Publishing Configuration can be (de)activated immediately by the 5GMSu AS, or if it is already in the desired state indicated in the request, the HTTP *204 (No Content)* response shall be returned by the 5GMSu AS with an empty response body. If the activation request is otherwise acceptable to the 5GMSu AS, but the Content Publishing Configuration cannot be (de)activated immediately, the HTTP *202 (Accepted)* response shall be returned by the 5GMSu AS with an empty response body to indicate that (de)activation is in progress. The state of the Content Publishing Configuration may then be polled using the procedure specified in clause 4.5.4.8.

If a Content Publishing Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMSu AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMSu AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.4.8 Interrogate Content Publishing Configuration state

This procedure is used by the 5GMSu AF to interrogate the current state of a Content Publishing Configuration resource in the target 5GMSu AS instance. The HTTP `GET` method shall be used for this purpose. The target resource shall be indicated in the request URL. The request body shall be empty.

If the Content Publishing Configuration is known to the 5GMSu AS, the HTTP *200 (OK)* response shall be returned with an indication of its current state provided in the response body as a JSON object of type *boolean* with the value *true* for active and *false* for inactive.

If a Content Publishing Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMS AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMS AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.5.5.9 Purge Content Publishing cache

This procedure is used by the 5GMSu AF to purge one or more content items from the 5GMSu AS cache associated with a Content Publishing Configuration resource in the target 5GMSu AS instance. The HTTP `POST` method shall be used for this purpose. A Content Publishing Configuration resource shall be indicated in the request URL. The request body shall be a single key–value pair encoded per the *application/x-www-form-urlencoded* MIME content type. The key shall be the string *pattern* and the value shall be a regular expression [5] identifying the media resource URL(s) to be purged from the associated content cache.

If the operation is successful, the 5GMSu AS shall return an HTTP *200 (OK)* response. The resource body should indicate the total number of cache entries purged encoded as a positive JSON integer. If the purge request is otherwise acceptable to the 5GMSu AS, but no cache entries were purged because none matched the supplied regular expression, the HTTP *204 (No Content)* response shall instead be returned by the 5GMSu AS with an empty response body.

If the request message body – or the regular expression contained in it – are found by the 5GMSu AS to be syntactically malformed the HTTP *400 (Bad Request)* error response shall be returned. The response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

If a Content Publishing Configuration resource previously existed at the request URL and was destroyed an HTTP *410 (Gone)* error response should be returned by the 5GMSu AS. Otherwise, if no resource exists at the request URL an HTTP *404 (Not Found)* error response shall be returned by the 5GMSu AS. In either case the response body shall be a *ProblemDetails* document as specified in clause 5.2.4.1 of TS 29.571 [12].

4.6 Procedures of the M4d (Media Streaming) interface

4.6.1 Procedures for DASH session

This procedure is used by a 5GMSd Client to establish a DASH session via the M4d interface. In order to establish such a session, the 5GMSd AS shall host an MPD as defined in ISO/IEC 23009-1 [32] or TS 26.247 [4] and the MPD URL is known to the 5GMSd Client typically using M8d.

The Media Player receives an MPD URL from the 5GMSd-Aware Application through M7d by methods defined in clause 13. The Media Player shall send an HTTP `GET` message to the 5GMSd AS including the URL of the MPD resource. On success, the 5GMSd AS shall respond with a *200 (OK)* message that includes the requested MPD resource.

Additional procedures for reactions to different HTTP status codes are provided in TS 26.247 [4], clause A.7 and ISO/IEC 23009-1 [32] clause A.7.

Additional procedures for handling partial file responses are provided in TS 26.247 [4], clause A.9.

This information is provided through M7d to the application for selection. In addition, the currently used service description parameters are provided as status information at reference point M11d in order for the Media Session Handler to make use of this information, for example for Dynamic Policy and Network Assistance.

The detailed handling of service description information is documented in clause 13.2 of the present document.

4.6.2 Procedures for Progressive Download Session

This procedure is used by a 5GMSd client to establish a Progressive Download session via the M4d interface. In order to establish such a session, the 5GMSd AS shall host an 3GP/MP4 file as defined in TS 26.247 [4]. The 3GP/MP4 URL is known to the Media Player (in this case a progressive download player), typically by using M8d.

The Media Player receives a URL from the 5GMSd-Aware Application through M7d by methods defined in clause 13. The Media Player shall send an HTTP `GET` message to the 5GMSd AS including the URL of the 3GP/MP4 resource. On success, the 5GMSd AS shall respond with a *200 (OK)* message that includes the requested 3GP/MP4 resource.

Additional procedures for reactions to different HTTP status codes are provided in TS 26.247 [4].

4.7 Procedures of the M5 (Media Session Handling) interface

4.7.1 Introduction

The procedures at reference point M5 are used by a Media Session Handler within a 5GMS Client to invoke services relating to downlink or uplink media streaming on the 5GMS AF.

4.7.2 Procedures for Service Access Information

4.7.2.1 General

Service Access Information is the set of parameters and addresses needed by the 5GMSd Client to activate reception of a downlink media streaming session or by a 5GMSu Client to activate an uplink media streaming session for contribution. Service Access Information additionally includes configuration information to allow the Media Session Handler to invoke procedures for dynamic policy (see clause 4.7.3), consumption reporting (clause 4.7.4), metrics reporting (clause 4.7.5) and network assistance (clause 4.7.6).

The Media Session Handler may obtain Service Access Information from either the 5GMS-Aware Application (via reference point M6) or from the 5GMS AF (via reference point M5). In the former case, the Service Access Information is initially acquired by the 5GMS-Aware Application from the 5GMS Application Provider via reference point M8. In the latter case, the Media Session Handler shall use the operations specified in clause 5.3.2 of TS 26.510 [56] at reference point M5 to acquire Service Access Information from the 5GMS AF, citing an external service identifier and the Service Access Information is derived by the 5GMS AF from the Provisioning Session established at reference point M1 (see clause 4.3.2) that is tagged with the same external service identifier.

Typically, the Service Access Information for media streaming includes a set of Media Entry Points (e.g. a URL to a DASH MPD or a URL to a progressive download file) that can be consumed by the Media Stream Handler (Media Player or Media Streamer).

Based on the MIME media type or protocol, as well as the conformance profiles declared in the Service Access Information, one of these Media Entry Points is selected by the Media Session Handler or by the 5GMS-Aware Application and is handed to the Media Player via reference point M11 or M7 respectively.

NOTE: The Media Session Handler and 5GMS-Aware Application are assumed to have prior knowledge of the types of Media Entry Point supported by the Media Player.

For downlink media streaming exclusively via eMBMS and for hybrid 5GMSd/eMBMS services as defined in clauses 5.10.2 and 5.10.5 respectively of TS 26.501 [2], the Service Access Information indicates that the 5GMSd Client acts as an MBMS-Aware Application.

For dynamically provisioned downlink media streaming via eMBMS as defined in clause 5.10.6 of TS 26.501 [2], the 5GMSd AS creates a presentation manifest that is regularly polled by the Media Player for a potential update. When an eMBMS User Service carrying the 5GMSd content is dynamically provisioned or removed by the 5GMSd AF, the 5GMSd AS shall update the presentation manifest with the locations where the updated manifest and the media segments are now available, for example to add or change to the media server in the MBMS Client.

For downlink media streaming exclusively via MBS and for hybrid 5GMSd/MBS services as defined in clauses 5.12.2 and 5.12.4 respectively of TS 26.501 [2], the Service Access Information indicates that the 5GMSd Client acts as an MBS-Aware Application.

For dynamically provisioned downlink media streaming via MBS as defined in clause 5.12.4 of TS 26.501 [2], the 5GMSd AS creates or hosts a presentation manifest that is regularly polled by the Media Player for a potential update. When an MBS User Service carrying the 5GMSd content is dynamically provisioned or removed by the 5GMSd AF, the 5GMSd AS shall update the presentation manifest with the resource locations where the updated manifest and the media segments are now available, for example to additionally or alternatively point to the Media Server in the MBSTF Client.

If an Edge Resources Configuration with client-driven management is provisioned, a Client Edge Resources Configuration is included in the corresponding Service Access Information.

4.7.2.2 Void

4.7.2.3 Void

4.7.2.4 Void

4.7.2.5 Void

4.7.3 Procedures for dynamic policy invocation

These procedures are used by a Media Session Handler to manage Dynamic Policy Instance resources in the 5GMS AF. To do this, the Media Session Handler shall use the operations specified in clause 5.3.3 of TS 26.510 [56] at reference point M5 to instantiate Policy Templates in the 5GMS AF that are described in the Dynamic Policy Configuration provided in the Service Access Information (see clause 4.7.2).

4.7.4 Procedures for consumption reporting

These procedures are used by the Media Session Handler and the Consumption Reporting function of the 5GMSd Client to submit a consumption report to the 5GMSd AF via reference point M5d if consumption reporting is applied for a downlink media streaming session. This is indicated by the presence of a Client Consumption Reporting Configuration in the Service Access Information. To determine whether and how to send consumption reports to the 5GMSd AF at reference point M5, the Media Session Handler shall use the procedures and operations specified in clause 5.3.6 of TS 26.510 [56].

4.7.5 Procedures for metrics reporting

These procedures are used by the Media Session Handler and the Metrics Reporting function of the 5GMS Client to submit a QoE metrics report to the 5GMS AF via reference point M5 if metrics reporting is applied for a media streaming session. To determine whether and how to send metrics reports the 5GMSd AF at reference point M5, the Media Session Handler shall use the procedures and operations specified in clause 5.3.5 of TS 26.510 [56].

When the metrics collection and reporting feature is provisioned for a media streaming Provisioning Session, one or more Client Metrics Reporting Configurations, each associated with a metrics scheme, are provided to the 5GMS Client in the Service Access Information (see clause 4.7.2).

- For progressive download and DASH streaming services, the listed metrics in a given Client Metrics Reporting Configuration are associated with the 3GPP metrics scheme and shall correspond to one or more of the metrics as specified in clauses 10.3 and 10.4, respectively, of TS 26.247 [4].
- Metrics related to Virtual Reality media, as specified in clause 9.3 of TS 26.118 [42], may be listed in a Client Metrics Reporting Configuration.
- Metrics related to eMBMS delivery, as specified in clause 9.4.6 of TS 26.346 [51], may be listed in a Metrics Reporting Configuration.

NOTE: Metrics reporting for MBS is not specified by TS 26.517 [64] in this release.

4.7.6 Procedures for network assistance

These procedures are used by the 5GMS Client to request Network Assistance from one of the 5GMS AF instances listed in the Network Assistance Configuration of the Service Access Information. To do this, the Media Session Handler shall use the procedures and operations specified in clause 5.3.4 of TS 26.510 [56] at reference point M5.

4.8 Procedures of the M6d (UE Media Session Handling) interface

4.8.1 General

This clause contains the procedures for the interaction between the 5GMSd-Aware application or the Media Player and the Media Session Handler through the M6d API. Details are provided in clause 12.

4.8.2 Consumption reporting procedures

When consumption reporting for this session is active for a given media delivery session, the Media Session Handler and Media Streamer (downlink Media Player or uplink Media Streamer) shall follow the procedures specified in clause 5.4.6 of TS 26.510 [56] to support consumption reporting.

4.8.3 3GPP Service URL handling procedures

4.8.3.1 Launch of 5G Media Streaming session

The Media Session Handler shall play the role of 3GPP Service Handler for Service URLs as defined in clause 6 of TS 26.510 [56] by registering itself as the URL handler for the domain name *launch.3gppservices.org* and the initial path element */ms* (e.g., by declaring an intent filter in the application manifest). Hence, the Media Session Handler is launched when a 5GMS-Aware Application requests a 5GMS Service URL (e.g., by means of an intent filter).

As a result of being invoked in this way, the Media Session Handler shall initiate a new media delivery session according to clause 5.4.2.2 of TS 26.510 [56].

4.8.3.2 Retrieval of Service Access Information from 5GMS AF

If it needs to retrieve whole Service Access Information from the 5GMS AF (because a full set of Service Access Information has not been supplied as additional parameters of the 3GPP Service URL) the Media Session Handler shall decompose the 3GPP Service URL into the prefix and suffix, and shall form the M5 request URL for Service Access Information as specified in clause 9.2.2 of TS 26.510 [56].

1. If the 3GPP Service URL carries one or more *af-host-address* query parameters, the Media Session Handler shall choose one to substitute into *{apiRoot}* in the above request URL. If the port number is omitted from any *af-host-address*, port 80 (for HTTP) or 443 (for HTTPS) shall be assumed.

NOTE 1: This corresponds to collaboration scenarios where the 5GMS AF is deployed in the External DN.

The party operating the 5GMS AF is responsible for ensuring that the hostname(s) resolve to the correct IP address(es) in the External DN.

If more than one *af-host-address* query parameter is supplied in the 3GPP Service URL, the Media Session Handler may use an alternative host endpoint address at reference point M5 if the one it is using fails to respond after some implementation-specific number of retries.

2. If the *af-host-address* query parameter is omitted from the 3GPP Service URL, the default host name *ms.af.3gppservices.org* and port number 80 (HTTP) or 443 (HTTPS) shall be used instead.

NOTE 2 This corresponds to collaboration scenarios where the 5GMS AF is deployed in the Trusted DN.

The 5G System operator is responsible for supporting resolution of this well-known host name to the correct IP address(es) in the Trusted DN, e.g., by managing appropriate DNS records.

The 5G System operator is responsible for ensuring that a resilient service is available at this host endpoint address. If the hostname resolves to multiple IP addresses, the Media Session Handler may use a different one at reference point M5 if the one it is using fails to respond after some implementation-specific number of retries.

NOTE 3 It is recognised that correct resolution of the hostname may be hampered if the end user configures an alternative DNS resolution service. Unless the Media Session Handler is able to override this and use the 5G System DNS resolution service, this is considered a failure case for 5G Media Streaming session initiation that is reportable to the end user.

4.8.3.3 Processing of 5GMS-specific parameters in 3GPP Service URL

Once the Media Session Handler is in possession of whole Service Access Information, it shall process the 5GMS-specific parameters present in the 3GPP Service URL as follows. URL query parameters not specified in clause 12.4 may be ignored by the Media Session Handler.

1. If the 3GPP Service URL includes the optional *media-entry-point* query parameter, the Media Session Handler shall invoke the Media Stream Handler with the URL of the Media Entry Point conveyed in the value of this parameter.

2. Otherwise, if the 3GPP Service URL omits the optional *media-entry-point* query parameter, the Media Session Handler shall instead select one of the Media Entry Points listed in the *streamingAccess.entryPoints* array of the Service Access Information (see clause 9.2.3.1 of TS 26.510 [56]). In making its selection, the Media Session Handler can take into account the capabilities of available Media Stream Handler(s) as well as the requesting application's preferences for particular content type(s) and/or media profile(s) expressed respectively in (possibly multiple instances of) the *content-type* and *profile* query parameters if they are present in the 3GPP Service URL.

3. If the 3GPP Service URL includes the optional *service-operation-point* query parameter, the Media Session Handler shall, before instantiating a Media Stream Handler, attempt to instantiate a Dynamic Policy for the Policy Template binding listed in the whole Service Access Information that carries an *externalReference* with the same value as this query parameter (see *policyTemplateBindings* property in clause 9.2.3.1 of TS 26.510 [56]) using the procedures specified in clause 4.7.3. If no matching Policy Template binding can be identified by the Media Session Handler no Media Stream Handler shall be instantiated.

3. If the 3GPP Service URL includes the optional *estimated-volume* query parameter, the *service-operation-point* query parameter shall also be present. The Media Session Handler shall, before instantiating a Media Stream Handler, attempt to instantiate a Dynamic Policy for the Policy Template binding listed in the whole Service Access Information that carries an *externalReference* with the same value as the *service-operation-point* query parameter (see *policyTemplateBindings* property in clause 9.2.3.1 of TS 26.510 [56]) using the procedures specified in clause 4.7.3. If no matching Policy Template binding can be identified by the Media Session Handler, or if the matching Policy Template binding does not advertise any upcoming Background Data Transfer windows in its *bdtWindows* array no Media Stream Handler shall be instantiated.

4.8.3.4 Responding to the requesting application

Depending on the success (or otherwise) of retrieving the Service Access Information (and optionally chaining the Media Stream Handler with the Media Entry Point), the Media Session Handler should return an appropriate HTTP status code to the application that requested the 3GPP Service URL.

4.9 Procedures of the M7d (UE Media Player) interface

4.9.1 General

This clause contains the procedures for the interaction between the 5GMSd-Aware Application or the Media Session Handler and the Media Player through the M7d API. Details are provided in clause 13.

4.9.2 Metrics reporting procedures

These procedures shall be used by the Media Session Handler function to control metrics reporting when such reporting is configured via metadata sent in-band via the media manifest.

When a streaming session is started, the Media Session Handler shall check if the manifest contains any metrics configuration, as specified in TS 26.247 clauses 10.4 and 10.5, or TS 26.118 [42] clause 9.3. If such a configuration is found, the Media Session Handler shall use it for the current streaming session.

The Media Session Handler shall first determine whether metrics from this session shall be reported. The determination shall be based on the *samplePercentage* attribute specified in the metrics configuration, according to TS 26.247 clause 10.5.

If metrics are reported for the session, the Media Session Handler shall request the Media Player to create a metrics collection job. The Media Player shall return a reference to the created job, which the Media Session Handler shall use in all subsequent actions related to this job.

The Media Session Handler shall configure the metrics collector job with the set of metrics which shall be collected during the session. The format of the configuration shall be according to TS 26.247 clause L.2, but note that only the *metrics* attribute in the configuration shall be used for this purpose.

The Media Session Handler shall regularly request the collected metrics from the Media Player according to the *reportingInterval* specified in the metrics configuration. The metrics returned by the Media Player shall use the format as described in TS 26.247 clause 10.6, and (for virtual reality media) in TS 26.118 [42] clause 9.4 and the Media Session Handler shall forward these to the server address(es) specified in the metrics configuration using the specified *DNN* according to the procedures described in TS 26.247 clause 10.6.

When the session is finished the Media Session Handler shall delete the metrics collection job.

4.10 Procedures of the M8d interface

This clause defines basic procedures for M8d.

No specific procedures are defined but it is expected that the 5GMSd Application Provider can provide media session entry points to a 5GMSd-Aware Application through M8d. The 5GMSd-Aware Application would then initiate the media session by providing such an entry point to the 5GMSd Client through M7d. Multiple alternative entry points of the same media streaming service may be provided.

4.11 Data collection and reporting procedures at reference point R4

4.11.1 General

These procedures are used by the 5GMS AS, as a type of data collection client, to acquire its data collection and reporting client configuration from, and subsequently report media streaming access activity to, the Data Collection AF instantiated in the 5GMS AF. It does so by invoking the *Ndcaf_DataReporting* service offered by the Data Collection AF at reference point R4, as specified in clause 7 of TS 26.532 [49].

4.11.2 5GMS AS data collection and reporting client configuration

The 5GMS AS shall use the service operations and procedures specified in TS 26.532 [49] to obtain its data collection and reporting client configuration from the Data Collection AF instantiated in the 5GMS AF at reference point R4:

- In the case where both the 5GMS AS and the 5GMS AF reside in the trusted domain, the 5GMS AS shall obtain its data collection client configuration directly from the Data Collection AF by invoking appropriate *Ndcaf_DataReporting* service operations as specified in clause 7.2 of [49] according to the procedures specified in clauses 4.2.5 of [49].

- Should the 5GMS AS and the 5GMS AF reside in different trust domains, the 5GMS AS shall instead obtain its configuration from the Data Collection AF indirectly via the NEF by invoking the equivalent operations on the *Nnef_DataReporting* service as defined in TS 26.531 [48].

In both cases, the 5GMS AS shall declare that it supports the *MS_ACCESS_ACTIVITY* data reporting domain in *DataReportingSession.supportedDomains* (see clauses 7.2.3.2.1 and 7.2.3.3.1 of TS 26.532 [49]) and the Data Collection AF instantiated in the 5GMS AF shall request reporting for this domain by including the same value as a key to the *DataReportingSession.reportingConditions* dictionary. The value of the *ReportingCondition.type* property at this key shall be *INTERVAL*, *THRESHOLD* or *OFF*.

No data packaging strategies are specified in this release for the data reporting domains associated with the 5GMS AS at reference point R4.

Default data packaging strategies for the data reporting domains associated with the 5GMS AS at reference point R4 are not specified in this release.

The 5GMS AS shall refresh its data collection and reporting client configuration according to the procedures specified in clause 4.2.5.3 of TS 26.532 [49].

4.11.3 5GMS AS data reporting

The 5GMS AS shall use the service operations and procedures specified in TS 26.532 [49] to report media streaming access activity to the Data Collection AF instantiated in the 5GMS AF at reference point R4:

- In the case where both the 5GMS AS and the 5GMS AF reside in the trusted domain, the 5GMS AS shall submit media streaming access activity reports directly to the Data Collection AF by invoking appropriate *Ndcaf_DataReporting* service operations as specified in clause 7.3 of [49] according to the procedures specified in clauses 4.2.7 of [49].

- Should the 5GMS AS and the 5GMS AF reside in different trust domains, the 5GMS AS shall instead submit media streaming access activity reports indirectly to the 5GMS AF via the NEF by invoking the equivalent operations on the *Nnef_DataReporting* service as defined in TS 26.531 [48].

In both cases, the conditions for sending a downlink media streaming access activity report by the 5GMSd AS and the parameters of such report are signalled in the data collection and reporting client configuration obtained using the procedure specified in clause 4.11.2.

In order to submit a media streaming access activity report, the 5GMS AS shall send an HTTP `POST` message to the Data Collection AF instantiated in the 5GMS AF. The request body shall be a JSON document of type *DataReport* (as defined in clause 7.3.3.2.1 of TS 26.532 [49]) containing one or more *MediaStreamingAccessRecord* structures, as specified in clauses 17.2 and C.5.1 of the present document.

The Data Collection AF shall respond with a *200 (OK)* message to acknowledge successful processing of the media streaming access activity report.

4.11A Data collection and reporting procedures at reference point R2

4.11A.1 General

These procedures are used by the Direct Data Collection Client instantiated in the Media Session Handler to acquire its data collection and reporting client configuration from, and subsequently report media streaming access activity to, the Data Collection AF instantiated in the 5GMS AF. It does so by invoking the *Ndcaf_DataReporting* service offered by the Data Collection AF at reference point R2, as specified in clause 7 of TS 26.532 [49].

4.11A.2 Data collection and reporting client configuration

The Direct Data Collection Client instantiated in the Media Session Handler shall use the service operations and procedures specified in TS 26.532 [49] to obtain its data collection and reporting client configuration from the Data Collection AF instantiated in the 5GMS AF at reference point R2 by invoking appropriate *Ndcaf_DataReporting* service operations as specified in clause 7.2 of [49] according to the procedures specified in clauses 4.3.2 of [49].

The Direct Data Collection Client instantiated in the Media Session Handler shall declare that it supports the *MS_ANBR_NETWORK_ASSISTANCE* data reporting domain in *DataReportingSession.supportedDomains* (see clauses 7.3.2.1 and 7.3.3.1 of TS 26.532 [49]) and the Data Collection AF instantiated in the 5GMS AF shall request reporting for this domain by including the same value as a key to the *DataReportingSession.reportingConditions* dictionary. The value of the *ReportingCondition.type* property at this key shall be *EVENT* or *OFF*.

No data packaging strategies are specified in this release for the data reporting domains associated with the Direct Data Collection Client instantiated in the Media Session Handler at reference point R2.

Default data packaging strategies for the data reporting domains associated with the Direct Data Collection Client instantiated in the Media Session Handler at reference point R2 are not specified in this release.

The Direct Data Collection Client instantiated in the Media Session Handler shall refresh its data collection and reporting client configuration according to the procedures specified in clause 4.3.2.3 of TS 26.532 [49].

4.11A.3 ANBR-based Network Assistance invocation reporting

The Direct Data Collection Client instantiated in the Media Session Handler shall use the service operations and procedures specified in TS 26.532 [49] to report ANBR-based Network Assistance invocations to the Data Collection AF instantiated in the 5GMS AF at reference point R2 by invoking appropriate *Ndcaf_DataReporting* service operations as specified in clause 7.3 of [49] according to the procedures specified in clauses 4.3.3 of [49].

The conditions for sending an ANBR-based Network Assistance invocation report and the parameters of such report are signalled in the data collection and reporting client configuration obtained using the procedure specified in clause 4.11A.2.

In order to submit an ANBR-based Network Assistance invocation report, the Direct Data Collection Client instantiated in the Media Session Handler shall send an HTTP `POST` message to the Data Collection AF instantiated in the 5GMS AF. The request body shall be a JSON document of type *DataReport* (as defined in clause 7.3 of TS 26.532 [49]) containing a *ANBRNetworkAssistanceInvocationRecord* structure, as specified in clauses 17A.2 and C.5.2 of the present document.

The Data Collection AF shall respond with a *200 (OK)* message to acknowledge successful processing of the ANBR-based Network Assistance invocation report.

4.12 Event Exposure procedures at reference points R5 and R6

4.12.1 General

As specified in clauses 4.7.1 and 4.7.4 of TS 26.501 [2], Events relating to 5G Media Streaming are exposed to Event consumers at reference points R5 and R6 by the Data Collection AF instantiated in the 5GMS AF (playing the role of

Event service provider). Procedures for event exposure are specified in clauses 5.11.3 (for downlink media streaming) and 6.8.3 (for uplink media streaming) respectively of [2].

The following *Naf_EventExposure* service operations as defined in TS 23.502 [45] apply for such interactions between the Data Collection AF and consumer entities:

- *Naf_EventExposure_Subscribe*,
- *Naf_EventExposure_Unsubscribe*, and
- *Naf_EventExposure* Notify.

In this release, eligible Event service consumers of 5GMS Event services are the NWDAF and NEF as NFs, and the Event Consumer AF of the 5GMS Application Provider.

4.12.2 Event Exposure subscription procedure

The definition of input and output parameters of the *Naf_EventExposure_Subscribe* service operation is identical to that specified in clause 5.2.19.2.2 of TS 23.502 [45], except that "AF" is replaced by "Data Collection AF" and "consumer NF" (or "NF consumer") is replaced by "Event service consumer".

4.12.3 Event Exposure unsubscription procedure

The definition of input and output parameters of the *Naf_EventExposure_Unsubscribe* service operation is identical to that specified in clause 5.2.19.2.3 of TS 23.502 [45], except that "AF" is replaced by "Data Collection AF" and "consumer NF" (or "NF consumer") is replaced by "Event service consumer".

4.12.4 Event Exposure notification procedure

The definition of input and output parameters of the *Naf_EventExposure_Notify* service operation is identical to that specified in clause 5.2.19.2.4 of TS 23.502 [45], except that "AF" is replaced by "Data Collection AF" and "consumer NF" (or "NF consumer") is replaced by "Event service consumer".

4.13 Procedures for downlink media streaming via eMBMS

This procedure is used by a 5GMSd Client to establish a 5GMSd session either completely, or at least partially, through eMBMS.

- For downlink media streaming exclusively via eMBMS and for hybrid 5GMSd/eMBMS services, as defined in clauses 5.10.2 and 5.10.5 respectively of TS 26.501 [2]:
  - The 5GMSd Application Provider shall provision a supplementary distribution network of type *DISTRIBUTION_NETWORK_EMBMS* in the Content Hosting configuration at reference point M1d, as specified in clause 7.6.3.1, with either *MODE_EXCLUSIVE* or *MODE_HYBRID* (as appropriate).
  - The 5GMSd Application Provider may additionally provision access reporting in the Consumption Reporting Configuration at M1d, as specified in clause 7.7.3.1.
  - The MBMS Client shall host an MPD as defined in ISO/IEC 23009-1 [32] or in TS 26.247 [4], or any other presentation manifest as the 5GMSd Media Entry Point such as an HLS Master Playlist.
  - The URL of this presentation manifest shall be signalled to the 5GMSd Client through the 5GMSd session establishment procedure.
  - The MBMS Client shall be invoked by the Media Session Handler via reference point MBMS-API-C using the procedures defined in TS 26.347 [52].

- For dynamically provisioned downlink media streaming via eMBMS as defined in clause 5.10.6 TS 26.501 [2]:

  - The 5GMSd Application Provider shall provision a supplementary distribution network of type *DISTRIBUTION_NETWORK_EMBMS* in the Content Hosting configuration at reference point M1d, as specified in clause 7.6.3.1, with *MODE_DYNAMIC*.

  - The 5GMSd Application Provider shall additionally provision access reporting in the Consumption Reporting Configuration at M1d, as specified in clause 7.7.3.1.

  - The 5GMSd AS shall host an MPD as defined in ISO/IEC 23009-1 [32] or in TS 26.247 [4], or any other presentation manifest as the 5GMSd Media Entry Point.

  - The URL of this presentation manifest shall be signalled to the 5GMSd Client through the 5GMSd session establishment procedure. If the 5GMSd service is currently available as an MBMS User Service, the 5GMSd Client forwards the manifest request to the MBMS Client; otherwise, it forwards the request to the 5GMSd AS via reference point M4d.

NOTE: The detailed execution of dynamically handling this decision is left to implementation.

  - The MBMS Client shall be invoked dynamically, paused or destroyed by the Media Session Handler via reference point MBMS-API-C using the procedures defined in TS 26.347 [52].

Additional procedures for reactions to different HTTP status codes are provided in clause A.7 of TS 26.247 [4] and clause A.7 of ISO/IEC 23009-1 [32].

Additional procedures for handling partial file responses are provided in clause A.9 of TS 26.247 [4].

4.14 Procedures for downlink media streaming via MBS

This procedure is used by a 5GMSd Client to establish a downlink media streaming session either completely, or at least partially, through MBS.

- For downlink media streaming exclusively via MBS and for hybrid 5GMSd/MBS services, as defined in clauses 5.12.2 and 5.12.4 respectively of TS 26.501 [2]:

  - The 5GMSd Application Provider shall provision a supplementary distribution network of type *DISTRIBUTION_NETWORK_MBS* in the Content Hosting Configuration at reference point M1d, as specified in clause 8.8.3.1 of TS 26.510 [56], with either *MODE_EXCLUSIVE* or *MODE_HYBRID* (as appropriate).

  - The 5GMSd Application Provider may additionally provision access reporting in the Consumption Reporting Configuration at M1d, as specified in clause 8.12.3.1 of TS 26.510 [56].

  - The MBSTF Client shall host an MPD as defined in ISO/IEC 23009-1 [32] or in TS 26.247 [4], or any other presentation manifest such as an HLS Variant Playlist, as the 5GMSd Media Entry Point.

  - The URL of this presentation manifest shall be signalled to the 5GMSd Client through the 5GMSd session establishment procedure.

  - The MBSTF Client shall be invoked by the Media Session Handler via reference point MBS-7 using the procedures defined in TS 26.517 [64].

- For dynamically provisioned downlink media streaming via MBS as defined in clause 5.12.5 TS 26.501 [2]:

  - The 5GMSd Application Provider shall provision a supplementary distribution network of type *DISTRIBUTION_NETWORK_MBS* in the Content Hosting configuration at reference point M1d, as specified in clause 8.8.3.1 of TS 26.510 [56], with *MODE_DYNAMIC*.

  - The 5GMSd Application Provider shall additionally provision access reporting in the Consumption Reporting Configuration at M1d, as specified in clause 8.12.3.1 of TS 26.510 [56].

  - The 5GMSd AS shall host an MPD as defined in ISO/IEC 23009-1 [32] or in TS 26.247 [4], or any other presentation manifest such as an HLS Variant Playlist as the 5GMSd Media Entry Point.

  - The URL of this presentation manifest shall be signalled to the 5GMSd Client through the 5GMSd session establishment procedure. If the 5GMSd service is currently available as an MBS User Service, the 5GMSd

Client forwards the manifest request to the Media Server in the MBSTF Client via reference point MBS-7; otherwise, it forwards the request to the 5GMSd AS via reference point M4d.

NOTE: The detailed execution of dynamically handling this decision is left to implementation.

- The MBS Client shall be invoked dynamically, paused or destroyed by the Media Session Handler via reference point MBS-7 using the procedures defined in TS 26.517 [64].

Additional procedures for reactions to different HTTP status codes are provided in clause A.7 of TS 26.247 [4] and clause A.7 of ISO/IEC 23009-1 [32].

Additional procedures for handling partial file responses are provided in clause A.9 of TS 26.247 [4].

5 Procedures for Uplink Media streaming

5.1 General

Uplink media streaming functional entities in the 5GMS System include the 5GMSu Application Provider, 5GMSu AF, 5GMSu AS and the UE. To make use of these other entities, the UE includes a 5GMSu-Aware Application that is provided by the 5GMSu Application Provider and a 5GMSu Client comprising the Media Session Handler and the Media Streamer.

The M1 Provisioning API enables the 5GMSu Application Provider to establish and manage the uplink media session handling and streaming options of the 5GMSu System.

The content egest interface at reference point M2u enables uplink media streaming content that has been sent by the 5GMSu Client to the 5GMSu AS at reference point M4u to be subsequently delivered to the 5GMSu Application Provider. Uplink media streaming media transfer from the 5GMSu AS to the 5GMSu Application Provider may be either pull-based and initiated by the 5GMSu Application Provider using the HTTP `GET` method, or push-based and initiated by the 5GMSu AS using the HTTP `PUT` method. The 5GMSu Application Provider's target endpoint for push-based streaming content delivery at reference point M2u is provided to the 5GMSu AF as part of the M1 Provisioning Session and this is passed to the 5GMSu AS as part of the M3u configuration procedures.

The 5GMSu AF, having been successfully provisioned at reference point M1u, sets up corresponding resources at a reference point M5u endpoint from which Service Access Information for uplink media streaming session management, metrics reporting, network assistance and request for policy and/or charging treatment may be retrieved using its provisioned external application identifier. Certain types of configuration and policy information accessed over reference point M5u by the Media Session Handler, such as uplink metrics reporting, QoS policy, or support for AF-based network assistance are further passed to the Media Streamer via the M7u API.

The 5GMSu-Aware Application initiates a new uplink media streaming session by launching the Media Stream Handler at reference point M6u using a 3GPP Service URL for 5GMS (see clause 4.8.3). The 3GPP Service URL indicates the external application identifier. This may be used to retrieve Service Access Information from the 5GMSu AF at reference point M5. Alternatively, if the 5GMSu-Aware Application has already acquired all necessary Service Access Information via private means at reference point M8, this may be supplied directly to the Media Session Handler at reference point M6u as additional parameters.

Based on a request from the 5GMSu-Aware Application or from the Media Streamer received over the M6u API, and based on the Service Access Information acquired from the 5GMSu AF via reference point M5u, the Media Session Handler sets up an uplink media streaming session with a unique media delivery session identifier. Upon successful session establishment, the Media Session Handler triggers the Media Streamer to begin uplink media streaming of media content to the 5GMSu AS over reference point M4u.

Subscription to status and other event notification services is offered by the Media Session Handler to the 5GMSu-Aware Application and to the Media Streamer via the UE media session handling APIs exposed by the Media Session Handler at reference point M6u.

Subscription to status and other event notification services is also offered by the Media Streamer to the 5GMSu-Aware Application and to the Media Session Handler via the UE media stream handling APIs exposed by the Media Player at reference point M11u.

5.2 APIs relevant to Uplink Media Streaming

Table 5.2-1 summarises the APIs used to provision and use the various uplink media streaming features specified in TS 26.501 [2].

T Table 5.2-1: Summary of APIs relevant to uplink media streaming features

5GMSu feature	Abstract	Relevant APIs		
		Interface	API name	Clause
Content protocols discovery	Used by the 5GMSu Application Provider to query which content egest protocols are supported by 5GMSu AS(s).	M1u	Content Protocols Discovery API	7.5
Content publishing	Content is contributed to the 5GMSu AS and published to 5GMSu Application Providers according to a Content Publishing Configuration associated with a Provisioning Session.	M1u	Provisioning Sessions API	7.2
			Server Certificates Provisioning API	7.3
			Content Preparation Templates Provisioning API	7.4
			Content Publication Provisioning API	7.6A
		M2u	HTTP pull-based content egest protocol	8.5
			DASH-IF push-based content egest protocol	8.6
			HTTP low-latency pull-based content egest protocol	8.7
		M3u	Server Certificates configuration API	9.2
			Content Preparation Templates configuration API	9.3
			Content Publication configuration API	9.5
		M4u	DASH-IF push-based contribution protocol	10.4.2
		M5u	Service Access Information API	11.2
Metrics reporting	The 5GMSu Client uploads metrics reports to the 5GMSu AF according to a provisioned Metrics Reporting Configuration it obtains from the Service Access Information for its Provisioning Session.	M1u	Provisioning Sessions API	7.2
			Metrics Reporting Provisioning API	7.8
		M5u	Service Access Information API	11.2
			Metrics Reporting API	11.4
Dynamic Policy invocation	The 5GMSu Client activates different traffic treatment policies selected from a set of Policy Templates configured in its Provisioning Session.	M1u	Provisioning Sessions API	7.2
			Policy Templates Provisioning API	7.9
		M5u	Service Access Information API	11.2
			Dynamic Policies API	11.5
Network Assistance	The 5GMSu Client requests bit rate recommendations and delivery boosts from the 5GMSu AF.	M5u	Service Access Information API	11.2
			Network Assistance API	11.6
Edge content processing	Edge resources are provisioned for processing content in 5GMS uplink media streaming sessions.	M1u	Provisioning Sessions API	7.2
			Edge Resources Provisioning API	7.10
		M5u	Service Access Information API	11.2
UE data collection, reporting and exposure	UE data related to uplink 5G Media Streaming is reported to the Data Collection AF instantiated in the 5GMSu AF for exposure to Event consumers.	M1u	Event Data processing Provisioning API	7.11
		R4	*Ndcaf_DataReporting* service	17
		R5, R6	*Naf_EventExposure* service	18

6 General aspects of APIs for 5G Media Streaming

6.0 HTTP endpoint addresses

6.0.1 Default 5GMS AF endpoint addresses

6.0.1.1 Default 5GMS AF endpoint address at reference point M1

This version of the present document does not specify a default host name for the 5GMS AF at reference point M1.

The 5GMS AF shall expose the Provisioning network APIs specified in clause 7 via the default listening port number(s) for the version(s) of HTTP specified for reference point M1 in clause 6.2.1.1.

6.0.1.2 Default 5GMS AF endpoint address at reference point M3

This version of the present document does not specify a default host name for the 5GMS AF at reference point M3.

The 5GMS AF shall expose the Provisioning network APIs specified in clause 7 via the default listening port number(s) for the version(s) of HTTP specified for reference point M3 in clause 6.2.1.1.

6.0.1.3 Default 5GMS AF endpoint address at reference point M5

Except where the host name of an externally deployed 5GMS AF is explicitly signalled as a parameter of a 3GPP Service URL passed to the Media Session Handler at reference point M6, the following default 5GMS AF host name shall be inserted into *{apiRoot}* (see clause 6.1) for the Media Session Handler's first request at reference point M5 to the 5GMS AF for each media streaming session (see clause 11.2):

```
ms.af.3gppservices.org
```

The DNS service provided by the 5G System shall resolve this host name to the IP address(es) of deployed 5GMS AF instance(s), if any.

The 5GMS AF shall expose the Media Session Handling network APIs specified in clause 11 via the default listening port number(s) for the version(s) of HTTP specified for reference point M5 in clause 6.2.1.1.

6.0.2 Default 5GMS AS endpoint addresses

6.0.2.1 Default 5GMS AS endpoint address at reference point M3

This version of the present document does not specify a default host name for the 5GMS AS at reference point M3.

The 5GMS AS shall expose the Application Server Configuration APIs specified in clause 9 via the default listening port number(s) for the version(s) of HTTP specified for reference point M3 in clause 6.2.1.2.

6.0.2.2 Canonical 5GMS AS authority at reference point M4

Media Entry Points provisioned in distribution configurations of a Content Hosting Configuration or in contribution configurations of Content Publishing Configuration shall be exposed by the 5GMS AS at reference point M4 from endpoint(s) with the following canonical domain name:

{modifiedExternalServiceId}`.ms.as.3gppservices.org`

where *{modifiedExternalServiceId}* is a modified form of the external service identifier indicated by the 5GMS Application Provider in the parent Provisioning Session resource at reference point M1 (see clause 4.3.2) in which each period character ('`.`') is replaced with a single hyphen character ('`-`').

For example, the canonical 5GMS AS domain name for a Content Hosting Configuration or Content Publishing Configuration created under the Provisioning Session with external service identifier `com.provider.service` is:

```
com-provider-service.ms.as.3gppservices.org
```

The DNS service provided by the 5G System shall resolve each such canonical domain name to the IP address(es) of deployed 5GMS AS instance(s) providing content hosting or content publishing endpoint(s) at reference point M4 on behalf of the parent Provisioning Session in question.

NOTE: Access to the 5GMS AS using domain name aliases at this reference point is not precluded.

The 5GMS AS shall expose all endpoints at reference point M4 via the default listening port number(s) for the version(s) of HTTP specified in clause 6.2.1.2 for use at this reference point.

6.1 HTTP resource URIs

6.1.1 5GMS AF resource URIs

The resource URI used in each HTTP request to the *Maf_Provisioning* API provider at reference point M1 shall have the structure defined in clause 7.1.3 of TS 29.510 [56].

The resource URI used in each HTTP request to the *Maf_SessionHandling* API provider at reference points M3 or M5 shall have the structure defined in clause 7.1.3 of TS 29.510 [56].

6.1.2 5GMS AS resource URIs

The resource URI used in each HTTP request to the API provider shall have the structure defined in clause 4.4.1 of TS 29.501 [22], i.e.:

{apiRoot}/{apiName}/{apiVersion}/{apiSpecificResourceUriPart}

with the following components:

- *{apiRoot}* shall be set as described in TS 29.501 [22].
- *{apiName}* shall be set as defined by the following clauses.
- *{apiVersion}* shall be set to "v1" in this release.
- *{apiSpecificResourceUriPart}* shall be set as specified in clause 9.

6.2 Usage of HTTP

6.2.1 HTTP protocol version

6.2.1.1 5GMS AF

Implementations of the 5GMS AF shall comply with clause 7.1.1 of TS 26.510 [56].

6.2.1.2 5GMS AS

Implementations of the 5GMS AS shall expose HTTP/1.1 [24] endpoints at reference points M2 and M4 and may additionally expose HTTP/2 [31] endpoints at these reference points. In both protocol versions, TLS [16] shall be supported and HTTPS interactions should be used in preference to cleartext HTTP.

For pull-based content ingest, the 5GMS Application Provider shall expose an HTTP/1.1-based origin endpoint to the 5GMSd AS at reference point M2 and may additionally expose HTTP/2- and/or HTTP/3-based origin endpoints.

For push-based content ingest, the 5GMS Application Provider may use any supported HTTP protocol version at reference point M2.

Implementations of the 5GMS AS should expose HTTP/3 [60] endpoints at reference point M4. In HTTP/3, the QUIC protocol [58] is used for transport, and TLS [59] is used for the initial handshake and key exchange.

The 5GMS AF may use any supported HTTP protocol version at reference point M3.

The Media Stream Handler may use any supported HTTP protocol version at reference point M4.

6.2.2 HTTP message bodies for API resources

The OpenAPI [23] specification of HTTP messages and their content bodies is contained in annex C of the present document and in annex A of TS 26.510 [56].

6.2.3 Usage of HTTP headers

6.2.3.1 General

Standard HTTP headers shall be used in accordance with clause 5.2.2 of TS 29.500 [21] for all versions of HTTP/1.1 [24], HTTP/2 [31] and HTTP/3 [60] messages.

6.2.3.2 User Agent identification

6.2.3.2.1 Media Stream Handler identification

The Media Stream Handler in the 5GMS Client shall identify itself to the 5GMS AS at reference point M4 using a `User-Agent` request header (see section 5.5.3 of RFC 7231 [25]) that should include the *product* token `5GMSMedia StreamHandler`. If this product identifier is supplied, the optional *product-version* suffix shall be present. This should indicate the version number of the present document (without the leading "V") with which the Media Stream Handler implementation complies and shall, at minimum, indicate the 3GPP release number with which the implementation complies.

The Media Stream Handler may additionally supply a *comment* element in the `User-Agent` request header containing vendor-specific information.

EXAMPLE 1: `5GMSMediaStreamHandler/17.5.0 (build2634) ExoPlayerLib/2.17.1`

EXAMPLE 2: `5GMSMediaStreamHandler/17`

6.2.3.2.2 Media Session Handler identification

The Media Session Handler in the 5GMS Client shall identify itself to the 5GMS AF at reference point M5 using a User-Agent request header (see section 5.5.3 of RFC 7231 [25]) in which the first element shall be a *product* identified by the token `5GMSMediaSessionHandler`. The optional *product-version* suffix shall be present. This should indicate the version number of the present document (without the leading "V") with which the Media Session Handler implementation complies and shall, at minimum, indicate the 3GPP release number with which the implementation complies.

The Media Session Handler may supply additional vendor-specific product identifiers in the `User-Agent` request header and may additionally supply a *comment* element containing vendor-specific information.

EXAMPLE 1: `5GMSMediaSessionHandler/17.5.0 (build1536) lib5gmsclient/0.3.1`

EXAMPLE 2: `5GMSMediaSessionHandler/17`

6.2.3.3 Server identification

6.2.3.3.1 5GMS AF identification

The 5GMS AF shall identify itself at reference points M1 and M5 using a `Server` response header (see section 7.4.2 of RFC 7231 [25]) that includes a product string of the following form:

`5GMSAF-`*`{FQDN}`*`/`*`{complianceInformation}`*

where *{FQDN}* shall be the Fully-Qualified Domain Name of the 5GMS AF exposed to the requesting client, and *{complianceInformation}* should indicate the version number of the present document (without the leading "V") with which the 5GMS AF implementation complies and shall, at minimum, indicate the 3GPP release number with which the implementation complies.

The `Server` response header may also include comments strings and vendor-specific subproduct strings compliant with the syntax and guidance provided in section 7.4.2 of [25].

EXAMPLE 1: `5GMSAF-vm10664.mno.net/17.4.0 (api=2.1.0) libsbi/2.1 libnf/1.2 libaf/1.1`

EXAMPLE 2: `5GMSAF-vm10664.mno.net/17 (api=2.1.0) libsbi/2.1 libnf/1.2 libaf/1.1`

6.2.3.4 Support for conditional HTTP GET requests

All responses from the 5GMS AF that carry a resource message body shall comply with clause 7.1.4.2 of TS 26.510 [56].

6.2.3.5 Support for conditional HTTP POST, PUT, PATCH and DELETE requests

All API endpoints on the 5GMS AF that expose the HTTP `POST`, `PUT`, `PATCH` or `DELETE` methods shall comply with clause 7.1.4.3 of TS 26.510 [56].

6.2.3.6 Media delivery session identifier

At applicable reference points, the media delivery session identifier specified in clause 7.3.2 of TS 26.510 [56] shall be conveyed in the HTTP header `CMCD-Session:sid` as specified in table 1 of CTA-5004 [65]. As such, the media delivery session identifier for 5G Media Streaming shall be a UUID [66].

EXAMPLE: `CMCD-Session:sid: 8bf9f090-82fd-4686-aa4a-39e6a9381b76`

6.3 HTTP response codes

Guidelines for error responses to the invocation of APIs of NF services are specified in clause 4.8 of TS 29.501 [22]. API-specific error responses are specified in the respective technical specifications.

6.4 Common API data types

6.4.1 General

The data types defined in this clause are intended to be used by more than one of the 5GMS APIs.

6.4.2 Simple data types

Table 6.4.2-1 below specifies common simple data types used within the 5GMS APIs, including a short description of each. In cases where types from other specifications are reused, a reference is provided.

Table 6.4.2-1: Simple data types

Type name	Type definition	Description	Reference
ResourceId	`string`	String chosen by the 5GMS AF to serve as an identifier in a resource URL.	TS 26.510 [56] table 7.3.2-1
Uri	`string`	Uniform Resource Identifier conforming with the URI Generic Syntax.	TS 29.571 [12] table 5.2.2-1
Url	`string`	Uniform Resource Locator, conforming with the URI Generic Syntax.	TS 26.510 [56] table 7.3.2-1. IETF RFC 3986 [41]
RelativeUrl	`string`	Relative Uniform Resource Locator, conforming with the *relative-ref* production of the URI Generic Syntax. Both *query* and *fragment* suffixes are permitted.	TS 26.510 [56] table 7.3.2-1. IETF RFC 3986 [41].
AbsoluteUrl	`string`	Absolute Uniform Resource Locator, conforming with the *absolute-URI* production of the URI Generic Syntax in which the scheme part is *http* or *https*. The *query* suffix is permitted but the *fragment* suffix is not.	TS 26.510 [56] table 7.3.2-1. IETF RFC 3986 [41]
Percentage	`number`	A percentage expressed as a floating-point value between 0.0 and 100.0 (inclusive).	TS 26.510 [56] table 7.2.2-1
Duration	`string`	A period of time expressed as a string compliant with the *duration* format specified in section 7.3.1 of the JSON Schema specification [52].	TS 26.510 [56] table 7.3.2-1. IETF RFC 3339 [53] appendix A.
DurationSec	`integer`	An unsigned integer identifying a period of time expressed in units of seconds.	TS 29.571 [12] table 5.2.2-1
DateTime	`string`	An absolute date and time expressed using the OpenAPI *date-time* string format.	TS 29.571 [12] table 5.2.2-1
Ipv4Addr	`string`	Ipv4 address formatted in “dotted decimal” notation	TS 29.571 [12] table 5.2.2-1
Ipv6Addr	`string`	Ipv6 address formatted in colon-separated hexadecimal quartet notation.	TS 29.571 [12] table 5.2.2-1
Uinteger	`integer`	Unsigned integer.	TS 29.571 [12] table 5.2.2-1
Dnn	`string`	Data Network Name.	TS 29.571 [12] table 5.2.2-1
BitRate	`string`	A bit rate expressed as a string-encoded decimal value and unit.	TS 29.571 [12] table 5.2.2-1
MediaDelivery SessionId	`string`	A unique identifier for a media delivery session. This should not contain any user-identifiable data.	TS 26.510 [56] table 7.3.2-1

6.4.3 Structured data types

6.4.3.1 Void

6.4.3.2 Void

6.4.3.3 Void

6.4.3.4 Void

6.4.3.5 Void

6.4.3.6 Void

6.4.3.7 Void

6.4.3.8 Void

6.4.3.9 Void

6.4.3.9A MediaStreamingBaseReportingRecord type

This data type is intended to be used as a building block in other data types.

Table 6.4.3.9A-1: Definition of MediaStreamingBaseReportingRecord type

Property name	Data Type	Cardinality	Description
sliceInfo	`Snssai`	0..1	Identifying the target slice to which the reporting record pertains.
dataNetworkName	`Dnn`	0..1	The name of the target Data Network to which the reporting record pertains.
location	`TypedLocation`	0..1	The location of the UE to which the reporting record pertains.

6.4.3.10 MediaStreamingSessionIdentification type

This data type is intended to be used as a building block in other data types.

Table 6.4.3.10-1: Definition of MediaStreamingSessionIdentification type

Property name	Data Type	Cardinality	Description
sessionId	`MediaDelivery SessionId`	1..1	An identifier for a media streaming session. This should not contain any user-identifiable data.

6.4.3.11 MediaStreamingAccess type

This data type is intended to be used as a building block in other data types.

Table 6.4.3.11-1: Definition of MediaStreamingAccess type

Property name	Data Type	Cardinality	Description
mediaStreamHandler EndpointAddress	`Endpoint Address`	1..1	The endpoint address of the Media Stream Handler accessing the 5GMS AS. (See clause 6.4.3.8.)
applicationServer EndpointAddress	`Endpoint Address`	1..1	The service endpoint on the 5GMS AS to which the Media Stream Handler is connected. (See clause 6.4.3.8.)

Property name	Data Type	Cardinality	Description
requestMessage	`object`	1..1	Details of the HTTP request message submitted to the 5GMS AS by the Media Stream Handler for this media access.
method	`string`	1..1	The request method.
url	`AbsoluteUrl`	1..1	The request URL. (See table 6.4.2-1.)
protocolVersion	`string`	1..1	The HTTP protocol version, e.g., "HTTP/1.1".
range	`string`	0..1	The value of the Range request header, if present.
size	`Uinteger`	1..1	The total number of bytes in the request message.
bodySize	`Uinteger`	1..1	The number of bytes supplied by the Media Stream Handler in the HTTP request message body. Zero if there is no request body.
contentType	`string`	0..1	The MIME content type of the request message, if any.
userAgent	`string`	0..1	A string describing the requesting Media Stream Handler, if it supplies a `User-Agent` request header.
userIdentity	`string`	0..1	A string identifying the user that made the access, if supplied.
referer	`AbsoluteUrl`	0..1	The URL that the Media Player reports being referred from, if the `Referer` request header is supplied. (See table 6.4.2-1.)
cacheStatus	`CacheStatus`	0..1	An indication of whether the 5GMS AS is able to serve an object corresponding to *requestMessage,url* from cache (*HIT*) or whether there is a stale object cached (*EXPIRED*) or the requested object is not present in cache (*MISS*). (See table 6.4.4.4.) For non-caching implementations of the 5GMS AS, the property shall be omitted.
responseMessage	`object`	1..1	Details of the HTTP response message returned by the 5GMS AS to the Media Stream Handler for this media access.
responseCode	`Uinteger`	1..1	The HTTP response code.
size	`Uinteger`	1..1	The total number of bytes in the response message.
bodySize	`Uinteger`	1..1	The number of bytes in the HTTP response message body.
contentType	`string`	0..1	The MIME content type of response message, if any.
processingLatency	`Float`	1..1	The time, expressed in milliseconds, taken by the 5GMS AS to respond to the Media Stream Handler request, measured from the first byte of the HTTP request being processed by the 5GMS AS to the last byte of the response being sent.
connectionMetrics	`object`	0..1	Metrics about the performance of the transport connection underlying the HTTP session serving this media access.
meanNetwork RoundTripTime	`Float`	1..1	A rolling mean average, expressed in milliseconds, of the network round-trip time for the HTTP session.
networkRoundTrip TimeVariation	`Float`	1..1	The variation in *meanNetworkRoundTripTime*, expressed in milliseconds, during the averaging period.
congestion WindowSize	`Uinteger`	1..1	The current size (in bytes) of the congestion window for the transport connection underlying the HTTP session.

6.4.3.12 NetworkAssistanceInvocation type

This data type is intended to be used as a building block in other data types.

Table 6.4.3.11-1: Definition of NetworkAssistanceInvocation type

Property name	Data Type	Cardinality	Description
policyTemplateId	`ResourceId`	0..1	Identifying the Policy Template (if any) referenced by the Media Session Handler in the parent Network Assistance Session.
applicationFlow Descriptions	`array( ApplicationFlow Description)`	0..1	If present, a set of one or more Application Flow Descriptions (see clause 7.3.3.2 of TS 26.510 [56]) to which the Network Assistance session has been applied. Present only for individual data samples and, in exposed events, only when exposure is permitted by the data exposure restrictions in force.
requestedQoS	`Unidirectional QoSSpecification`	0..1	The network QoS parameters (if any) requested by the Media Session Handler from the 5GMS AF in the parent Network Assistance Session or from the RAN (see clause 6.4.3.13).
recommendedQoS	`object`	0..1	The network QoS parameters (if any) recommended to the Media Session Handler by the 5GMS AF in the parent Network Assistance Session or by the RAN.
maximumBitRate	`BitRate`	1..1	The maximum recommended bit rate.
minimumBitRate	`BitRate`	1..1	The minimum recommended bit rate.

6.4.3.13 Void

6.4.4 Enumerated data types

6.4.4.1 Void

6.4.4.2 Void

6.4.4.3 Void

6.4.4.4 Void

6.4.4.5 CacheStatus enumeration

Table 6.4.4.5-1: Definition of CacheStatus enumeration

Enumeration value	Description
HIT	The requested object is present in the 5GMS AS cache and is still valid.
MISS	The requested object is not present in the 5GMS AS cache.
EXPIRED	The requested object is present in the 5GMS AS cache but is stale.

6.5 Void

6.6 Security

6.6.1 General

The 5GMS AF shall enable secure provision of information in the 5GMS System by authenticated and authorised 5GMS Application Providers or 5GMS-Aware Applications.

6.6.2 Authorising 5GMS Application Provider access to the 5GMS AF at reference point M1

Implementations of the 5GMS Application Provider shall comply with the authorisation provisions specified in clause 7.4.2 of TS 26.510 [56].

6.6.3 Authorising 5GMS AF access to the 5GMS AS at reference point M3

When a 5GMS AF deployed outside the Trusted DN attempts to access a 5GMS AS deployed inside the Trusted DN, the 5GMS System shall authenticate and authorise the 5GMS AF.

Access to the *Mas_Configuration* API of the 5GMS AS by the 5GMS AF at reference point M3 may be authorised by means of the OAuth 2.0 protocol specified in RFC 6749 [47]), using the *client credentials* authorization grant. Based on the content of the access token, the 5GMS AS determines whether the 5GMS AF is authorised to invoke a given configuration operation in terms of at least the targeted resource and HTTP method, and hence the underlying 5GMS feature.

NOTE: The provisioning and negotiation of the security method is not specified in this release.

When CAPIF (see TS 29.222 [48]) is used for external API exposure:

- The CAPIF core function shall play the role of authorization server, the 5GMS AS shall play the role of resource server and the 5GMS AF shall play the role of client.
- Before invoking any service operation exposed by the 5GMS AS, the 5GMS AF shall negotiate the security method (PKI, TLS-PSK or OAuth 2.0) with the CAPIF core function and shall ensure that the 5GMS AS has the required credentials to authenticate access tokens subsequently presented by the 5GMS Application Provider (see clauses 5.6.2.2 and 6.2.2.2 of TS 29.222 [48]).
- If PKI or TLS-PSK is the selected security method between the 5GMS AF and the 5GMS AS shall, upon invocation of a *Mas_Configuration* service operation by the 5GMS AF at reference point M3, retrieve the authorisation information from the CAPIF core function as described in clause 5.6.2.4 of TS 29.222 [48].
- If OAuth 2.0 [47] is the selected security method between the 5GMS AF and the 5GMS AS, the 5GMS AF shall, prior to invoking *Mas_Configuration* service operations on the 5GMS AS at reference point M3, obtain an access token from the authorization server (CAPIF core function) by invoking the *Obtain_Authorization* service operation specified in clause 5.6.2.3.2 of TS 29.222 [48].

Otherwise:

- The 5GMS AS shall play the role of both authorization server and resource server, and the 5GMS AF shall play the role of client.
- The 5GMS AF shall obtain an access token from the authorization server (5GMS AS) using the client credentials authorization grant specified in section 4.4 of RFC 6749 [47] prior to invoking *Mas_Configuration* service operations on the resource server (5GMS AS) at reference point M3.

6.6.4 Authorising Media Session Handler access to the 5GMS AF at reference point M5

Implementations of the Media Session Handler shall comply with the authorisation provisions specified in clause 7.4.3 of TS 26.510 [56].

7 Provisioning (M1) APIs

7.1 General

This clause defines the provisioning API used by a 5GMS Application Provider to configure downlink or uplink 5G Media Streaming services.

7.2 Provisioning Sessions API

7.2.1 Overview

The API used by the 5GMS Application Provider to instantiate and manipulate downlink or uplink media streaming Provisioning Sessions in the 5GMS AF at reference point M1 is specified in clause 8.2 of TS 26.510 [56]. Having created a Provisioning Session, the 5GMS Application Provider then goes on to provision other 5GMS features in the context of this Provisioning Session, using the APIs specified in clause 7.3 *et seq*. Certain of these features are only applicable to the type of Provisioning Session created.

7.2.2 Void

7.2.3 Void

7.3 Server Certificates Provisioning API

7.3.1 Overview

The API used by the 5GMS Application Provider at reference point M1 to instantiate and manipulate Server Certificates associated with a particular downlink or uplink media streaming Provisioning Session in the 5GMS AF is specified in clause 8.4 of TS 26.510 [56]. It is used to provision X.509 [8] server certificates that can be referenced by a Content Hosting Configuration or Content Publishing Configuration and subsequently presented to the 5GMS Client when it connects to a 5GMS AS endpoint at reference point M4 using Transport Layer Security [30]. Server Certificate resources are provisioned within the scope of an enclosing Provisioning Session.

7.3.2 Void

7.3.3 Void

7.4 Content Preparation Templates Provisioning API

7.4.1 Overview

The API used by the 5GMS Application Provider at reference point M1 to instantiate and manipulate Content Preparation Templates associated with a particular downlink or uplink media streaming Provisioning Session in the 5GMS AF is specified in clause 8.5 of TS 26.510 [56]. Content Preparation Templates are used to specify manipulations applied by a 5GMS AS to downlink media resources ingested at reference point M2d for distribution at interface M4d, or to uplink media resources contributed at reference point M4u for egest at interface M2u. The Content Preparation Templates Provisioning API is used to provision a Content Preparation Template within the scope of a Provisioning Session that can subsequently be referenced from a Content Hosting Configuration.

7.4.2 Void

7.4.3 Void

7.4.4 Void

7.5 Content Protocols Discovery API

7.5.1 Overview

The API used by the 5GMS Application Provider at reference point M1 to discover which content ingest or egest protocols are supported at reference point M2 by the 5GMS AS instance(s) associated with a 5GMS AF is specified in clause 8.3 of TS 26.510 [56]. The controlled vocabulary of term identifiers used in this API to advertise support for these content protocols is specified in clause 8.1 of the present document.

- One of the supported ingest protocols may subsequently be provisioned in a Content Hosting Configuration for downlink media streaming (see clause 7.6).
- One of the supported egest protocols may subsequently be provisioned in a Content Publishing Configuration for uplink media streaming (see clause 7.6A).

The Content Protocols resource shall specify the set of geo-fencing locator types supported by the 5GMS System in relation to the Content Hosting feature using the controlled vocabulary specified in clause B.1 of TS 26.510 [56]. Every 5GMS System shall support at least the ISO 3166 administrative area locator type. Refer to clause 7.6.4.6 of the present document for usage.

7.5.2 Void

7.5.3 Void

7.6 Content Hosting Provisioning API

7.6.1 Overview

The API used by the 5GMSd Application Provider at reference point M1d to create and manipulate the 5GMSd AS Content Hosting Configuration associated with a particular downlink media streaming Provisioning Session in the 5GMSd AF is specified in clause 8.8 of TS 26.510 [56].

7.6.2 Void

7.6.3 Void

7.6.4 5GMSd AS functions supporting Content Hosting

7.6.4.1 Overview

This clause defines the behaviour that is expected from the 5GMSd AS when the Content Hosting Configuration has been successfully provisioned as specified in clause 5.2.8 of TS 26.510 [56]. The main operations that are performed affect content caching and purging of cached content, as well as media processing for content preparation prior to distribution.

7.6.4.2 Content caching

A distribution configuration defined within the Content Hosting Configuration may specify caching rules to be applied to media resources when they are distributed by the 5GMSd AS over reference point M4d. The 5GMSd AS shall use the *DistributionConfiguration*.*CachingConfiguration*.*urlPatternFilter* property of the Content Hosting Configuration resource specified in clause 8.8.3.1 of TS 26.510 [56] to determine which caching directives apply to that media resource. In case a media resource's URL matches the pattern filter of more than one *cachingConfiguration*, the first match shall apply. In case no *cachingConfiguration* is identified as a match, the 5GMSd AS shall apply the caching directives that were received from the origin. In the absence of these, the 5GMSd AS shall apply default caching directives as specified in clause 8.8.3.1 of TS 26.510 [56] based on the media resource type.

A caching directive shall indicate that a matching media resource is:

- Not to be cached by the 5GMSd AS, nor by downstream M4d clients, when *noCache* is set to *true*, or
- To be cached for *maxAge* seconds by the 5GMSd AS, and potentially by downstream M4d clients, when *noCache* is set to *false*.

The *maxAge* value applies relative to the time when a media resource was ingested by the 5GMSd AS, defined here as *t_ingest*. For an HTTP-based ingest, this corresponds to the `Date` header field in the HTTP request/response that carries the media resource at M2d. At the time *t_ingest* + *maxAge*, the media resource is considered stale and should not be served from the 5GMSd AS cache. The 5GMSd AS shall compensate for any synchronization skew between the origin and its own clock. For instance, this can be done by including the `max-stale` HTTP cache directive in HTTP responses sent at reference point M4d.

The *maxAge* value may be signalled by the 5GMSd AS at reference point M4d using the `Expires` HTTP response header or the HTTP `Cache-Control` directives `max-age` or `s-maxage`.

When distributing a media resource using HTTP, a *no-cache* request may be translated into a `no-cache` and `no-store` HTTP `Cache-Control` directive and/or a `max-age=0` HTTP `Cache-Control` directive.

By default, all origin HTTP header fields shall be assumed as not forwarded by the 5GMSd AS, unless specified otherwise by setting the flag *originCacheHeaders* to *true*.

7.6.4.3 Cache purging

The 5GMSd Application Provider shall use the procedures and operations specified in clause 5.2.8.6 of TS 26.510 [56] to invalidate some or all cached media resources of a particular Content Hosting Configuration. As a consequence, the 5GMSd AF shall invoke an operation on the 5GMSd AS at reference point M3d to remove those media resources from the 5GMSd AS cache associated with that Content Hosting Configuration, as specified in clause 9.

7.6.4.4 Content processing

The 5GMSd AS may be required to perform various content processing tasks (such as repackaging, encryption, ABR transcoding) on media resources ingested at reference point M2d prior to distributing them at reference point M4d. These processing tasks shall be specified in a Content Preparation Template resource referenced from a distribution configuration within the Content Hosting Configuration.

7.6.4.5 URL signing

The URL signing procedure allows the 5GMSd Application Provider to prevent deep linking and unauthorized access to M4d media resources. It works by cryptographically signing some elements of the M4d request URL and then

appending this authentication token to the URL as an additional query parameter. The token is generated by the 5GMSd Application Provider and supplied to the player, for example as part of an initial URL. When it receives a request that requires URL signing, the 5GMSd AS verifies the presence and validity of the token in the M4d request URL before allowing access to the requested media resource. The 5GMSd AS instance(s) and the origin share a secret that is encoded as part of the query parameter hash, but not shared with the 5GMSd Media Player.

The validity of the authentication token can also be limited to a single UE. If *useIPAddress* is set to True, then the public IP address of the UE as viewed by the 5GMSd AS, *ue_public_ip_address*, shall be incorporated into the token calculation. The parameter name shall be indicated by *ipAddressName*.

The shared secret shall be provided in the *urlSignature.passphrase* property of the Content Hosting Configuration resource. The parameter name for the passphrase to be used in the authentication token shall be provided by *passphraseName*.

The expiry time of the signed URL, *tokenExpiry*, shall be included as an additional query parameter in the URL exposed at M4d with the name indicated in *tokenExpiryName*. The expiry time shall be the string representation of the number of seconds from 1970-01-01T00:00:00Z UTC until the desired expiry UTC date/time, ignoring leap seconds, as defined in section 4.16 of POSIX.1 [11].

Given the above, the authentication token shall be calculated as:

token := SHA512(*url*&*UrlSignature.tokenExpiryName*=*token_expiry*&*UrlSignature.ipAddressName*=*ue_public_ip_address*&*UrlSignature.passphraseName*=*passphrase*)

where the SHA512 function shall be the SHA-512 hash [6] of the enclosed string. The *url* parameter shall be the original M4d media resource request URL, including the scheme, authority and path components but excluding any query and fragment components.

The resulting token value shall be “base64url” encoded, as specified in section 5 of RFC 4648 [10], prior to inclusion in the M4d URL.

The query part of the signed URL presented by the 5GMSd Media Player at M4d as proof of authenticity shall be composed as follows:

query := *urlSignature.tokenExpiryName*=*token_expiry*&*urlSignature.tokenName*=base64url(*token*)

For all media resources requested at reference point M4d that match the regular expression specified in *urlSignature.urlPattern*, the 5GMSd AS shall validate the *query* presented in the request URL according to the following steps:

1) If the parameter indicated by *urlSignature.tokenName* is absent from *query*, or if the supplied *token* value is malformed, the 5GMSd AS shall respond with a *403 (Forbidden)* error response message and terminate further processing of the M4d request.

2) If the parameter indicated by *urlSignature.tokenExpiryName* is absent from *query*, or if the supplied *token_expiry* value has expired, or if the supplied *token_expiry* is malformed, the 5GMSd AS shall respond with a *403 (Forbidden)* error response message and terminate further processing of the M4d request.

3) The 5GMSd AS shall compute the authentication token according to the *token* production specified above using the requesting UE’s public IP address as the value of *ue_public_ip_address* if required by *urlSignature.useIPAddress* being set to *true*. After applying “base64url” encoding, the 5GMSd AS shall compare this with the value supplied in the URL *query* parameter whose name is *urlSignature.tokenName*. If the two values differ, the 5GMSd AS shall respond with a *403 (Forbidden)* error response message and terminate further processing of the M4d request.

4) Otherwise, the presented authentication token is valid. The 5GMSd AS shall either return the media resource in a *200 (OK)* response message (if it is able to serve that media resource), or else return an appropriate error response, such as *404 (Not Found)* or *503 (Service Unavailable).*

7.6.4.6 Geofencing

The 5GMSd Application Provider may wish to limit access to the media content it makes available at reference point M2d to UEs located in certain geographical zones. Geofencing is used to configure the zone from which content is accessible.

The *geoFencing.locatorType* shall be set to one of the controlled term identifiers in the first column of table B.1-1 of TS 26.510 [56] and each member of the *geoFencing.locators* array in the distribution configuration shall then be set as specified in the third column of that table.

7.6A Content Publishing Provisioning API

7.6A.1 Overview

The API used by the 5GMSu Application Provider at reference point M1u to create and manipulate the 5GMSu AS Content Publishing Configuration associated with a particular uplink media streaming Provisioning Session in the 5GMSu AF is specified in clause 8.9 of TS 26.510 [56].

7.7 Consumption Reporting Provisioning API

7.7.1 Overview

The API used by the 5GMSd Application Provider at reference point M1d to configure the Consumption Reporting Procedure associated with a particular downlink media streaming Provisioning Session in the 5GMSd AF is specified in clause 8.12 of TS 26.510 [56].

7.7.2 Void

7.7.3 Void

7.8 Metrics Reporting Provisioning API

7.8.1 Overview

The API used by the 5GMS Application Provider at reference point M1 to instantiate and manipulate Metrics Reporting Configurations associated with a particular downlink or uplink media streaming Provisioning Session in the 5GMS AF is specified in clause 8.11 of TS 25.510 [56].

In the case of downlink media streaming, the metrics scheme indicated in the *scheme* property of the Metrics Reporting Configuration shall be *urn:3GPP:ns:PSS:DASH:QM10* and the QoE metrics (if any) listed in the *metrics* property shall be term identifiers from the vocabulary specified in clause E.2.1.

Metrics related to virtual reality media, as specified in TS 26.118 [42] clause 9.3, may be listed in the *metrics* property of a metrics configuration when the *scheme* property indicates that metrics scheme. These shall be term identifiers from the vocabulary specified in clause E.2.2.

No standardised metrics schemes are defined in the present document for uplink media streaming.

7.8.2 Void

7.8.3 Void

7.9 Policy Templates Provisioning API

7.9.1 Overview

The API used by the 5GMS Application Provider at reference point M1 to instantiate and manipulate Policy Templates associated with a particular downlink or uplink media streaming Provisioning Session in the 5GMS AF is specified in clause 8.7 of TS 26.510 [56]. These Policy Template may subsequently be applied to downlink or uplink media streaming sessions belonging to that Application Provider using the Dynamic Policies API specified in clause 11.5. A Policy Template is used to specify the traffic shaping and charging policies to be applied to these media streaming sessions.

7.9.2 Void

7.9.3 Void

7.10 Edge Resources Provisioning API

7.10.1 General

The API used by the 5GMS Application Provider at reference point M1 to provision edge resource usage for media streaming sessions associated with a particular downlink or uplink media streaming Provisioning Session in the 5GMS AF is specified in clause 8.6 of TS 26.510 [56]. The information serves as a template to select or instantiate an appropriate 5GMS AS EAS instance that will support the media streaming session at reference point M4.

7.10.2 Void

7.10.3 Void

7.11 Event Data Processing Provisioning API

7.11.1 General

The API used by the 5GMS Application Provider at reference point M1 to instantiate and manipulate Event Data Processing Configurations associated with a particular downlink or uplink media streaming Provisioning Session in the Data Collection AF instantiated in the 5GMS AF is specified in clause 8.13 of TS 26.510 [56]. Each such configuration comprises processing rules and parameters expressed by Data Access Profiles each of which defines a level of access by Event consumers to the UE data collected by the Data Collection AF.

7.11.2 Void

7.11.3 Void

8 Media ingest and publish (M2) protocols

8.1 General

The set of content protocols supported by the 5GMS AS is listed in table 8.1-1 below:

Table 8.1-1: Supported content protocols

Description	Term identifier	Clause
Content ingest protocols at reference point M2d		
HTTP pull-based content ingest protocol	*urn:3gpp:5gms:content-protocol:http-pull* or *urn:3gpp:5gms:content-protocol:http-pull-ingest* (see NOTE)	8.2
DASH-IF push-based content ingest protocol	*http://dashif.org/ingest/v1.2/interface-1* or *http://dashif.org/ingest/v1.2/interface-2* or *urn:3gpp:5gms:content-protocol:dash-if-ingest* (see NOTE)	8.3
HTTP low-latency pull-based content ingest protocol	*urn:3gpp:5gms:content-protocol:http-ll-pull*	8.4
Content egest protocols at reference point M2u		
HTTP pull-based content egest protocol	*urn:3gpp:5gms:content-protocol:http-pull*	8.5
DASH-IF push-based content egest protocol	*http://dashif.org/ingest/v1.2/interface-1* or *http://dashif.org/ingest/v1.2/interface-2*	8.6
HTTP low-latency pull-based content egest protocol	*urn:3gpp:5gms:content-protocol:http-ll-pull*	8.7
NOTE: Term identifier deprecated in this version of the present document.		

8.2 HTTP pull-based content ingest protocol

The following provisions shall apply if *IngestConfiguration.protocol* is set to *urn:3gpp:5gms:content-protocol:http-pull* or to the deprecated value *urn:3gpp:5gms:content-protocol:http-pull* in the Content Hosting Configuration:

- Media resources shall be ingested by the 5GMSd AS from the 5GMSd Application Provider using HTTP [25].

NOTE 0: Any supported HTTP protocol version may be used for HTTP pull-based content ingest at reference point M2d.

- The *IngestConfiguration.mode* property shall be set to *PULL*, indicating that a pull-based protocol is used.
- The *IngestConfiguration.baseURL* property shall point at the 5GMSd Application Provider's origin server, as specified in table 8.8.3.1-1 of TS 26.510 [56], and may indicate the use of HTTPS [30].

When the 5GMSd AS receives a request for a media resource at reference point M4d that cannot be satisfied from its content cache, the request shall be transformed into a corresponding HTTP `GET` request directed to the 5GMSd Application Provider's origin server via interface M2d as follows:

1. The prefix of the request URL indicated in the *DistributionConfiguration.baseURL* of the applicable Content Hosting Configuration is replaced with that of the corresponding *IngestConfiguration.baseURL*.

NOTE 1: It is the responsibility of the 5GMSd AF to assign unique M4d base URLs to each provisioned Content Hosting Configuration so as to ensure that this substitution is unambiguous.

2. The path rewrite rules (if provisioned in *DistributionConfiguration.pathRewriteRules*) are applied in strict order to the remainder of the request URL (i.e., the path segments following *DistributionConfiguration.baseURL*). The *requestPathPattern* of the first matching path rewrite rule is replaced with the corresponding *mappedPath*.

In the case where the 5GMSd Application Provider's origin server issues an HTTP *3xx* redirect at reference point M2d pointing to another location, the 5GMSd AS shall issue an equivalent HTTP redirect to the Media Player via reference point M4d whose location is a dynamically generated M4d endpoint. Requests to this location shall be rewritten by the 5GMSd AS to the target location of the M2d redirection.

NOTE 2: This explicit handling of HTTP redirects received by the 5GMSd AS at reference point M2d ensures that it is not bypassed by the Media Player. The general concept underlying this is commonly referred to as a "reverse mapping rule" by HTTP reverse proxies.

8.3 DASH-IF push-based content ingest protocol

The following provisions shall apply if *IngestConfiguration.protocol* is set to *http://dashif.org/ingest/v1.2/interface-1* or *http://dashif.org/ingest/v1.2/interface-2* or to the deprecated value *urn:3gpp:5gms:content-protocol:dash-if-ingest* in the Content Hosting Configuration:

- Media resources shall be published by the 5GMSd Application Provider to the 5GMSd AS as specified by the DASH-IF Live Media Ingest specification [3].

NOTE: The protocol in [3] is specified for use with HTTP/1.1 [24] only.

- The *IngestConfiguration.mode* property shall be set to *PUSH*, indicating that a push-based protocol is used.
- The *IngestConfiguration.baseURL* property shall be set by the 5GMSd AF to the base URL that is to be used by the 5GMSd Application Provider to upload the DASH segments and MPD(s) to the 5GMSd AS at reference point M2d.

8.4 HTTP low-latency pull-based content ingest protocol

The provisions specified in clause 8.2 shall apply if *IngestConfiguration.protocol* is set to *urn:3gpp:5gms:content-protocol:http-ll-pull*.

In addition, if HTTP/1.1 [24] is used by at reference point M2d:

- The requesting 5GMSd AS shall make partially received media segments available immediately for retrieval by 5GMS Clients at reference point M4d instead of waiting until the full segment is received.
- The 5GMSd Application Provider should use HTTP chunked transfer coding as defined in section 7.1 of [24]. In this case, the requesting 5GMSd AS shall accept chunked HTTP/1.1 response messages and shall make partially received media segments (i.e., HTTP Chunks) available immediately for retrieval by 5GMS Clients at reference point M4d instead of waiting until the full segment is received.
- If the DASH-IF Low Latency mode as defined in [63] is used, then the content is packaged as a series of CMAF Segments [40]. Further, each CMAF Segment is typically subdivided into one or more multiple CMAF Chunks to support low-latency content generation. According to the DASH-IF Live Media Ingest specification [3], each HTTP Chunk should contain at most one CMAF Chunk in order to minimise the latency.

NOTE: Usage of HTTP/2.0 at reference point M2d is for future study.

8.5 HTTP pull-based content egest protocol

If *EgestConfiguration.protocol* is set to *urn:3gpp:5gms:content-protocol:http-pull-egest* in the Content Publishing Configuration, media resources shall be retrieved by the 5GMSu Application Provider from the 5GMSu AS at reference point M2u using HTTP [25]. Media segments contributed to the 5GMSu AS by the 5GMSu Client shall be processed according to the Content Preparation Template(s) specified in the corresponding Content Publishing Configuration (if any) prior to making them available at reference point M2u.

In this case:

- The *EgestConfiguration.mode* property shall be set to *PULL*, indicating that a pull-based protocol is used.
- The *EgestConfiguration.baseURL* property shall be set by the 5GMSu AF to the base URL on the 5GMSu AS where it will publish media segments, presentation manifests and metadata for retrieval by the 5GMSu Application Provider at reference point M2u.
- The *EgestConfiguration.entryPoint.relativePath* property shall point at a Media Entry Point document below this base URL, as specified in table 8.9.3.1-1 of TS 26.510 [56], and may indicate the use of HTTPS [30]. This document describes the location of media content and associated metadata exposed by the 5GMSu AS at reference point M2u which are expected to be pulled by the 5GMSu Application Provider.

In the absence of content preparation, the 5GMSu AS shall publish media resources by replacing the prefix *Contribution Configuration.baseURL* of its URL at M4u with that of the corresponding *EgestConfiguration.baseURL*.

8.6 DASH-IF push-based content egest protocol

If *EgestConfiguration.protocol* is set to *http://dashif.org/ingest/v1.2/interface-1* or *http://dashif.org/ingest/v1.2/interface-2* in the Content Publishing Configuration, media resources shall be published by the 5GMSu AS to the 5GMSu Application Provider at reference point M2u as specified in the DASH-IF Live Media Ingest specification [3]. Media segments contributed to the 5GMSu AS by the 5GMSu Client shall be processed according to the Content Preparation Template(s) specified in the corresponding Content Publishing Configuration (if any) prior to publishing them at reference point M2u.

NOTE 1: The protocol in [3] is specified for use with HTTP/1.1 [24] only.

NOTE 2: A 5GMSu AS implementation that advertises support for the egest of content at reference point M2u using interface 2 of the DASH-IF Live Media Ingest specification [3] is required to produce a suitable DASH presentation manifest.

In this case:

- The *EgestConfiguration.mode* property shall be set to *PUSH*, indicating that a push-based protocol is used.
- The *EgestConfiguration.baseURL* property shall be set by the 5GMSu Application Provider to the base URL that is to be used by the 5GMSu AS to upload media segments and presentation manifests to the 5GMSu Application Provider at reference point M2u.

If the 5GMSu Application Provider has provisioned an egest Media Entry Point, and if such document has been contributed to or produced by 5GMSu AS, the 5GMSu AS shall publish this document to the URL formed by the concatenation of *EgestConfiguration.baseURL* with *EgestConfiguration.entryPoint.relativePath*, as specified in table 8.9.3.1-1 of TS 26.510 [56]. This URL may indicate the use of HTTPS [30].

In the absence of any content preparation, each media resource uploaded at reference point M4u shall be published to the 5GMSu Application Provider at the URL formed by replacing the prefix *ContributionConfiguration.baseURL* of its URL at M4u with that of the corresponding *EgestConfiguration.baseURL*.

8.7 HTTP low-latency pull-based content egest protocol

The following provisions shall apply if *EgestConfiguration.protocol* is set to *urn:3gpp:5gms:content-protocol:http-ll-pull* the following provisions shall apply.

The content shall be packaged as a series of CMAF Segments [40]. Each CMAF Segment shall be subdivided into multiple one or more CMAF Chunks.

In addition:

- If HTTP/1.1 [24] is used at reference point M2u, partially available media segments may be accessed by the 5GMSu Application Provider using an HTTP byte range request, as specified in section 14 of RFC 9110 [25]. If the 5GMS Application Provider makes a byte-range request for a partially available media segment (the first media segment it retrieves) and the `first-pos` of that range is non-zero and the 5GMS Application Provider is expecting an aggregating response, then the 5GMS Application Provider should signal that expectation following the convention of IETF RFC 8673 [61]. Specifically, it should use a `last-pos` value of 9007199254740991. In this case, the 5GMSu AS is required to respond with a *206 (Partial Content)* HTTP response without a `Content-length` response header instead of waiting for the end of the segment and responding with a *200 (OK)* HTTP response code.

9 Application Server Configuration (M3) APIs

9.1 General

This clause defines the *Mas_Configuration* API invoked by a 5GMS AF on a 5GMS AS instance at reference point M3 to configure downlink or uplink 5G Media Streaming services in that 5GMS AS instance. The OpenAPI definitions for this API are specified in clause C.3A.

9.2 Server Certificates Configuration API

9.2.1 Overview

The Server Certificates Configuration API is used to configure X.509 [8] server certificates in a 5GMS AS instance that may then be referenced by a Content Hosting Configuration or by a Content Publishing Configuration in that 5GMS AS instance and subsequently presented by the 5GMS AS instance to 5GMS Clients connecting to it at reference point M4 using Transport Layer Security [30]. All Server Certificate resources are held by the 5GMS AS instance in a flat collection. The resource identifier for each Server Certificate resource is nominated by the 5GMS AF and need not be the same as that used at reference point M1.

9.2.2 Resource structure

The Server Certificates Configuration API is exposed by the 5GMS AS through the following URL base path:

{apiRoot}`/3gpp-mas-configuration/`*{apiVersion}*`/certificates/`

Table 9.2.2-1 specifies the operations and the corresponding HTTP methods that are supported by this API. In each case, the sub-resource path (if any) specified in the second column shall be appended to the URL base path.

Table 9.2.2-1: Operations supported by the Server Certificates Configuration API

Operation	Sub-resource path	Allowed HTTP method(s)	Description
Enumerate Server Certificates		`GET`	Used by the 5GMS AF to retrieve a list of Server Certificate resources currently configured in a 5GMS AS instance. The request message body shall be empty.
Create Server Certificate	*{afResourceId}*	`POST`	Used by the 5GMS AF to create a new Server Certificate resource in a 5GMS AS instance. The *{afResourceId}* is nominated by the 5GMS AF in this operation and shall be unique in the collection of Server Certificates in a given 5GMS AS instance. The request message body shall be a PEM-encoded X.509 certificate [8] bundle that includes the private key.
Update Server Certificate		`PUT`	Used by the 5GMS AF to replace an existing Server Certificate resource *{afResourceId}* in a 5GMS AS instance. The request message body shall be a replacement PEM-encoded X.509 certificate [8] bundle that includes the private key.
Destroy Server Certificate		`DELETE`	Removes the Server Certificate resource *{afResourceId}* from the collection. Attempting to destroy a Server Certificate resource that is referenced by a Content Hosting Configuration or Content Publishing Configuration is an error.
NOTE: The Server Certificate resource identifier *{certificateId}* differs from the serial number of the X.509 certificate.			

9.2.3 Data model

Server Certificate resource representations shall be PEM-encoded X.509 certificate [8] bundles including their private key.

9.3 Content Preparation Templates Configuration API

9.3.1 Overview

The Content Preparation Templates Configuration API is used to configure Content Preparation Template resources in a 5GMS AS instance that may then be referenced by a Content Hosting Configuration or Content Publishing Configuration in that 5GMS AS instance. All Content Preparation Template resources are held by the 5GMS AS instance in a flat collection. The resource identifier for each Content Preparation Template resource is nominated by the 5GMS AF and need not be the same as that used at reference point M1.

9.3.2 Resource structure

The Content Preparation Templates Configuration API is exposed by the 5GMS AS through the following URL base path:

{apiRoot}`/3gpp-mas-configuration/`*{apiVersion}*`/content-preparation-templates/`

Table 9.3.2-1 specifies the operations and the corresponding HTTP methods that are supported by this API. In each case, the sub-resource path (if any) specified in the second column shall be appended to the URL base path.

Table 9.3.2-1: Operations supported by the Content Preparation Templates Configuration API

Operation	Sub-resource path	Allowed HTTP method(s)	Description
Enumerate Content Preparation Templates		`GET`	Used by the 5GMS AF to retrieve a list of Content Preparation Template resources currently configured in a 5GMS AS instance. The request message body shall be empty.
Create Content Preparation Template	*{afResourceId}*	`POST`	Used by the 5GMS AF to create a new Content Preparation Template resource in a 5GMS AS instance. The *{afResourceId}* is nominated by the 5GMS AF in this operation and shall be unique in the collection of Content Preparation Templates in a given 5GMS AS instance. The request message body shall be a Content Preparation Template document.
Update Content Preparation Template		`PUT`	Used by the 5GMS AF to replace an existing Content Preparation Template resource *{afResourceId}* in a 5GMS AS instance. The request message body shall be a replacement Content Preparation Template document.
Destroy Content Preparation Template		`DELETE`	Removes the Content Preparation Template resource *{afResourceId}* from the collection. The request message body shall be empty. Attempting to destroy a Content Preparation Template resource that is referenced by a Content Hosting Configuration or Content Publishing Configuration is an error.

9.3.3 Data model

The representation of Content Preparation Template resources shall be the same as that specified in clause 8.5.3 of TS 26.510 [56].

9.4 Content Hosting Configuration API

9.4.1 Overview

The Content Hosting Configuration API is used to configure Content Hosting Configuration resources in a 5GMS AS instance. All Content Hosting Configuration resources are held by the 5GMS AS instance in a flat collection. The resource identifier for each Content Hosting Configuration resource is nominated by the 5GMS AF and need not be the same as that used at reference point M1.

9.4.2 Resource structure

The Content Hosting Configuration API is exposed by the 5GMS AS through the following URL base path:

{apiRoot}/3gpp-mas-configuration/*{apiVersion}*/content-hosting-configurations/

Table 9.4.2-1 specifies the operations and the corresponding HTTP methods that are supported by this API. In each case, the sub-resource path (if any) specified in the second column shall be appended to the URL base path.

Table 9.4.2-1: Operations supported by the Content Hosting Configuration API

Operation	Sub-resource path	Allowed HTTP method(s)	Description
Enumerate Content Hosting Configurations		GET	Used by the 5GMSd AF to retrieve a list of Content Hosting Configuration resources currently configured in a 5GMSd AS instance. The request message body shall be empty.
Create Content Hosting Configuration	*{afResourceId}*	POST	Used by the 5GMSd AF to create a new Content Hosting Configuration resource in a 5GMSd AS instance. The *{afResourceId}* is nominated by the 5GMSd AF in this operation and shall be unique in the collection of Content Hosting Configurations in a given 5GMSd AS instance. The request message body shall be a Content Hosting Configuration document.
Update Content Hosting Configuration		PUT	Used by the 5GMSd AF to replace an existing Content Hosting Configuration resource *{afResourceId}* in a 5GMSd AS instance. The request message body shall be a replacement Content Hosting Configuration document.
Destroy Content Hosting Configuration		DELETE	Used by the 5GMS AF to remove the Content Hosting Configuration resource *{afResourceId}* from the collection. The request message body shall be empty. Attempting to destroy a Content Hosting Configuration resource that is referenced by a Content Hosting Configuration or Content Publishing Configuration is an error.
(De)activate Content Hosting Configuration	*{afResourceId}*/active	POST	Used by the 5GMSd AF to (de)activate Content Hosting Configuration *{afResourceId}* in the 5GMSd AS instance.
Interrogate Content Hosting Configuration state		GET	Used by the 5GMSd AF to interrogate the state of Content Hosting Configuration *{afResourceId}* in the 5GMSd AS instance.
Purge Content Hosting cache	*{afResourceId}*/purge	POST	Used by the 5GMSd AF to purge one or more media resources associated with Content Hosting Configuration *{afResourceId}* from the 5GMSd AS content cache. The request message body shall specify the set of media resource URLs to be purged.

9.4.3 Data model

The representation of the Content Hosting Configuration resource shall be the same as that specified in clause 8.8.3.1 of TS 26.510 [56] except that *canonicalDomainName* and *baseURL* are read/write properties when used by the 5GMS AF to configure the 5GMS AS at reference point M3.

9.5 Content Publishing Configuration API

9.5.1 Overview

The Content Publishing Configuration API is used to configure Content Publishing Configuration resources in a 5GMS AS instance. All Content Publishing Configuration resources are held by the 5GMS AS instance in a flat collection. The resource identifier for each Content Publishing Configuration resource is nominated by the 5GMS AF and need not be the same as that used at reference point M1.

9.5.2 Resource structure

The Content Publishing Configuration API is exposed by the 5GMS AS through the following URL base path:

{apiRoot}/3gpp-mas-configuration/*{apiVersion}*/content-publishing-configurations/

Table 9.5.2-1 specifies the operations and the corresponding HTTP methods that are supported by this API. In each case, the sub-resource path (if any) specified in the second column shall be appended to the URL base path.

Table 9.5.2-1: Operations supported by the Content Publishing Configuration API

Operation	Sub-resource path	Allowed HTTP method(s)	Description
Enumerate Content Publishing Configurations		GET	Used by the 5GMSu AF to retrieve a list of Content Publishing Configuration resources currently configured in a 5GMSu AS instance. The request message body shall be empty.
Create Content Publishing Configuration	*{afResourceId}*	POST	Used by the 5GMSu AF to create a new Content Publishing Configuration resource in a 5GMSu AS instance. The *{afResourceId}* is nominated by the 5GMSu AF in this operation and shall be unique in the collection of Content Publishing Configurations in a given 5GMSu AS instance. The request message body shall be a Content Publishing Configuration document.
Update Content Publishing Configuration		PUT	Used by the 5GMSu AF to replace an existing Content Publishing Configuration resource *{afResourceId}* in a 5GMSu AS instance. The request message body shall be a replacement Content Publishing Configuration document.
Destroy Content Publishing Configuration		DELETE	Used by the 5GMSu AF to remove the Content Publishing Configuration resource *{afResourceId}* from the collection. The request message body shall be empty. Attempting to destroy a Content Publishing Configuration resource that is referenced by a Content Publishing Configuration or Content Publishing Configuration is an error.
(De)activate Content Publishing Configuration	*{afResourceId}*/active	POST	Used by the 5GMSd AF to (de)activate Content Publishing Configuration *{afResourceId}* in the 5GMSd AS instance.
Interrogate Content Publishing Configuration state		GET	Used by the 5GMSd AF to interrogate the state of Content Publishing Configuration *{afResourceId}* in the 5GMSd AS instance.
Purge Content Publishing cache	*{afResourceId}*/purge	POST	Used by the 5GMSu AF to purge one or more media resources associated with the Content Publishing Configuration *{afResourceId}* from the 5GMSu AS content cache. The request message body shall specify the set of media resource URLs to be purged.

9.5.3 Data model

The representation of the Content Publishing Configuration resource shall be the same as that specified in clause 8.9.3.1 of TS 26.510 [56] except that *canonicalDomainName* and *baseURL* are read/write properties when used by the 5GMS AF to configure the 5GMS AS at reference point M3.

10 Media Streaming (M4) interface

10.1 General

This clause specifies the interface for downlink and uplink media streaming at reference point M4 using different distribution formats and protocols. TS 26.511 [35] defines several media codecs and distribution formats for 5G Media Streaming. It also provides requirements and recommendations for the support of these media codecs and formats in profiles specific to 5G Media Streaming. However, 5GMS is not restricted to the media profiles and distribution formats defined in TS 26.511 [35]. For example, any CMAF media profile that integrates with the APIs specified in the present document may be used for media streaming at reference point M4.

10.1A Media delivery session identification

All media requests addressed by the Media Stream Handler (Media Player or Media Streamer) to the 5GMS AS at reference point M4 shall cite a media delivery session identifier using the HTTP header specified in clause 6.2.3.6. The value of this identifier shall be different for every media streaming session.

10.2 DASH distribution

In the case of DASH distribution, M4d is relevant for the distribution as shown in figure 10.2-1.

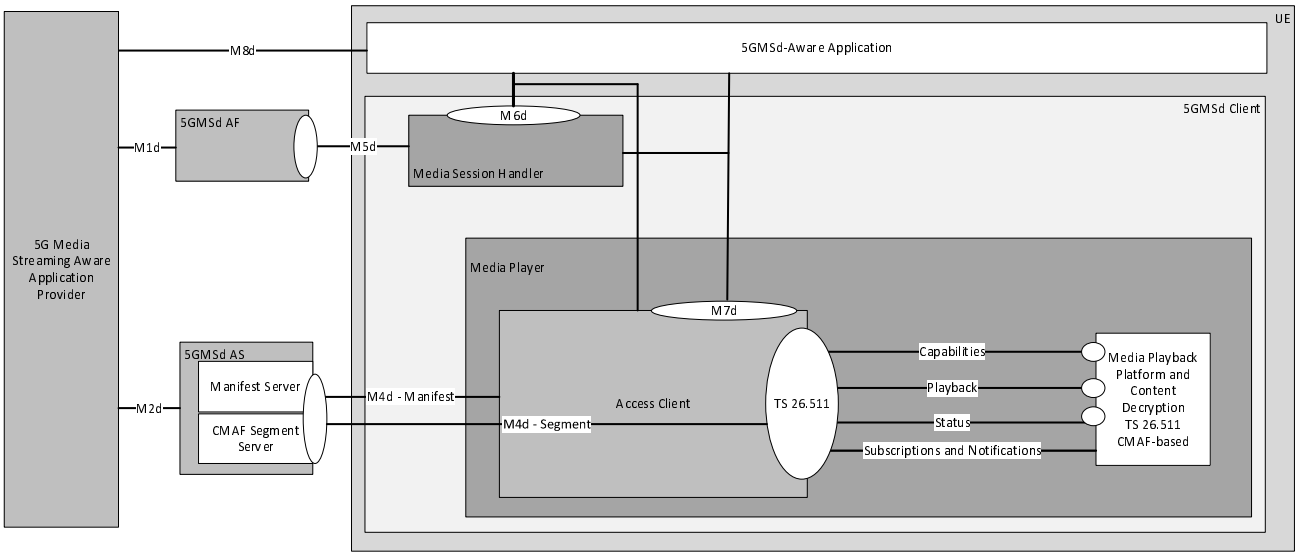

Figure 10.2-1: M4d usage for DASH distribution

For DASH-based distribution according to TS 26.247 [4] and ISO/IEC 23009-1 [32], two main formats are of relevance:

1) The Media Presentation Description (MPD) that is processed in the DASH Access Client.

2) The Segment formats that are passed through the DASH Access Client and processed in the Media Playback and Content Decryption Platform. Note that the DASH Access Client may parse Segments to extract, for example, In-band Events or producer reference times.

Other resources may be referenced in the MPD, for example DRM related information.

The Segment formats for DASH Streaming in the context of 5G Media Streaming are defined in TS 26.511 [35] based on the CMAF encapsulation. The DASH Access Client downloads the Segments from the 5GMSd AS based on the instructions in the MPD and the instructions from the 5GMSd-Aware Application through M7d (see clause 13 for details).

The interface between the DASH Access Client and the Media Playback and Content Decryption Platform as well as the 5GMSd Client requirements for media codecs are documented in TS 26.511 [35].

The following requirements apply at reference point M4d:

1) The Media Presentation Description (MPD) and Segments shall conform to an MPD according to ISO/IEC 23009-1 [32] or TS 26.247 [4].

2) The Segment formats should conform to CMAF addressable resources as well as to the requirements in TS 26.511 [35].

3) The Media Presentation should conform to the 5G Media Streaming DASH Interoperability Point as defined in clause 7.3.11 of TS 26.247 [4].

A 5GMSd Client shall support the 5G Media Streaming DASH Interoperability Point as defined in TS 26.247 [4], clause 7.3.11. A 5GMSd Client may support additional DASH profiles and interoperability points.

The MPD may contain a one or several **`ServiceDescription`** elements that include operational parameters. The MPD may also include multiple configurations for the media (different codecs, different content protection, different resolutions, etc.), for example for playback under different operating policies. The handling of this information is documented in clause 13.2.

If the media segment formats conform to CMAF addressable resources as defined ISO/IEC 23000-19 [27], the same CMAF content may then be provided for DASH and HLS. In order to support common deployment, the media segment content should conform to CTA-5005-A [62].

10.3 HTTP low-latency content distribution

When low-latency distribution of media content at reference point M4d is provisioned, then the following provisions shall apply:

- The 5GMSd AS shall make partially received media segments available immediately for retrieval by 5GMS Clients at reference point M4d instead of waiting until the full segment is received.

- the 5GMSd AS should use HTTP chunked transfer coding as defined in section 7.1 of [24]. In this case, the 5GMSd client shall accept chunked HTTP/1.1 response messages.

- If the DASH-IF Low Latency mode as defined in [63] is used as identified in the MPD by the profile indicator *http://www.dashif.org/guidelines/low-latency-live-v5*, then the content is packaged as a series of CMAF Segments [40]. Further, each CMAF Segment is typically subdivided into one or more multiple CMAF Chunks to support low-latency content generation. According to the DASH-IF Live Media Ingest specification [3], each HTTP Chunk should contain at most one CMAF Chunk in order to minimise the latency.

- At reference point M4d, the Media Player may access partially available media segments using an HTTP byte range request, as specified in section 14 of RFC 9110 [25]. (For details see for example [63] on Resynchronization Points.) If the Media Player makes a byte-range request for a partially available media segment (the first media segment it retrieves) and the `first-pos` of that range is non-zero and the Media Player is expecting an aggregating response, then the Media Player should signal that expectation following the convention of IETF RFC 8673 [61]. Specifically, it should use a `last-pos` value of 9007199254740991. In this case, the 5GMSd AS is required to respond with a *206 (Partial Content)* HTTP response without a `Content-length` response header instead of waiting for the end of the segment and responding with a *200 (OK)* HTTP response code.

10.4 Contribution protocols

10.4.1 General

The contribution protocols supported by the 5GMSu AS at reference point M4u are listed in table 10.4.1-1 below:

Table 10.4.1-1: Supported contribution protocols at reference point M4u

Description	Term identifier	Clause
DASH-IF push-based content ingest protocol	*http://dashif.org/ingest/v1.2/interface-1*	10.4.2

10.4.2 DASH-IF push-based contribution protocol

If *streamingAccess.entryPoints.protocol* is set to *http://dashif.org/ingest/v1.2/interface-1* in the Service Access Information, media resources shall be streamed to the 5GMSu AS as specified by the DASH-IF Live Media Ingest specification Interface-1 [3]. The content shall conform to at least one of the conformance profiles listed in *streamingAccess.profiles*, if any.

The content uploaded to the 5GMSu AS using this protocol is processed according to the Content Preparation Template(s) specified in the corresponding Content Publishing Configuration (if any), and the result is made available to the 5GMSu Application Service Provider at reference point M2u using the egest protocol indicated in *EgestConfiguration* as specified in clause 8.

11 Media Session Handling (M5) APIs

11.1 General

This clause defines the Media Session Handling APIs used by the Media Session Handler to access resources exposed by the 5GMS AF at interface M5.

NOTE: While the entirety of the Media Session Handling APIs apply to downlink media streaming, only a subset is applicable to uplink media streaming. Specifically, the Consumption Reporting API is not applicable to uplink media streaming.

11.2 Service Access Information API

11.2.1 General

The API used by the Media Session Handler to acquire Service Access Information from the 5GMS AF at reference point M5 is specified in clause 9.2 of TS 26.510 [56]. The Service Access Information enables the Media Session Handler to go on to use the other Media Session Handling APIs specified in clause 11.3 *et seq.*

11.2.2 Void

11.2.3 Void

11.3 Consumption Reporting API

11.3.1 General

The API used by the Media Session Handler to submit consumption reports to the 5GMS AF at reference point M5 is specified in clause 9.6 of TS 26.510 [56].

11.3.2 Void

11.3.3 Report format

11.3.3.1 ConsumptionReport data type

The *ConsumptionReport* data type is specified in clause 9.6.3.1 of TS 26.510 [56].

In the case of downlink media streaming with DASH [32]:

- The *mediaPlayerEntry* property shall be populated with the URL of the Media Player Entry (e.g., a MPD resource) at reference point M4d after following any HTTP redirects.
- A separate Consumption Reporting Unit shall be reported in the *consumptionReportingUnits* array for each DASH Adaptation Set currently selected for presentation by the Media Player.

For other types of media streaming, the content of these properties is undefined.

11.3.3.2 ConsumptionReportingUnit type

The *ConsumptionReport* data type is specified in clause 9.6.3.2 of TS 26.510 [56].

In the case of downlink media streaming with DASH [32]:

- The *mediaConsumed* property shall indicate which DASH Representation is currently selected by the Media Player for the DASH Adaptation Set in question by citing the value of its **`Representation`**`@id` from the DASH MPD.

For other types of media streaming, the content of this property is undefined.

11.4 Metrics Reporting API

11.4.1 General

The API used by the Media Session Handler to submit metrics reports to the 5GMS AF at reference point M5 is specified in clause 9.5 of TS 26.510 [56]. Metrics reports shall be submitted according to the metrics scheme indicated in each metrics reporting configuration described by the Service Access Information resource (see clause 11.2).

NOTE: Multiple metrics configurations may be active at the same time in the Service Access Information.

- In the case of downlink media streaming, metrics shall be reported according to the quality reporting scheme specified in clause 10.5 of TS 26.247 [7].
- If the metrics scheme specified in clause 9.3 of TS 26.118 [42] is indicated in the metrics reporting configuration, metrics related to virtual reality media shall be reported according to the extended quality reporting scheme as specified in clause 9.4 of [42].

11.4.2 Void

11.4.3 Report format

Metrics reports shall be submitted by the Media Session Handler in a format specified by the metrics reporting scheme in question. The `Content-Type` HTTP request header shall be set in accordance with the relevant metrics reporting scheme specification.

- For downlink media streaming, clauses 10.6.1 and 10.6.2 respectively of TS 26.247 [7] specify the required MIME content type and metrics report format for the 3GPP *urn:3GPP:ns:PSS:DASH:QM10* metrics reporting scheme.
- For virtual reality media the report format is further extended as defined in clause 9.4 of TS 26.118 [42].

In both cases, the **`ReceptionReport`**`@clientID` attribute should be populated with a GPSI value as defined by TS 23.003 [7], if present and available to the Media Session Handler. Otherwise, this attribute should be represented by a stable and globally unique string.

In both cases, the **`QoEReport`**`@recordingSessionId` attribute shall be populated with the media delivery session identifier.

11.5 Dynamic Policies API

11.5.1 Overview

The API used by the Media Session Handler at reference point M5 to request a specific policy and charging treatment to be applied to a particular application data flow of a downlink or uplink media streaming session by the 5GMS AF is specified in clause 9 of TS 26.510 [56].

11.5.2 Void

11.5.3 Void

11.5.4 Void

11.6 Network Assistance API

11.6.1 Overview

The API used by the Media Session Handler at reference point M5 to obtain bit rate recommendations from the 5GMS AF and to issue delivery boost requests to the 5GMS AF during an ongoing media streaming session is specified in clause 9.4 of TS 26.510 [56].

11.6.2 Void

11.6.3 Void

11.6.4 Void

12 UE Media Session Handling (M6/M11) APIs for uplink and downlink

12.1 General

This clause defines the client APIs for Media Session Handling to be used by other 5G System components such as a Media Player in a 5GMSd Client or the Media Streamer in a 5GMSu Client.

NOTE: Client-driven management of edge processing resources via reference point M6 or M11 is not specified in this release.

12.2 Media session handling for downlink media streaming – APIs and functions

12.2.1 Overview

In the following, it is assumed that the Media Session Handler for downlink media streaming adheres to a basic set of functionalities as shown in figure 12.2.1-1.

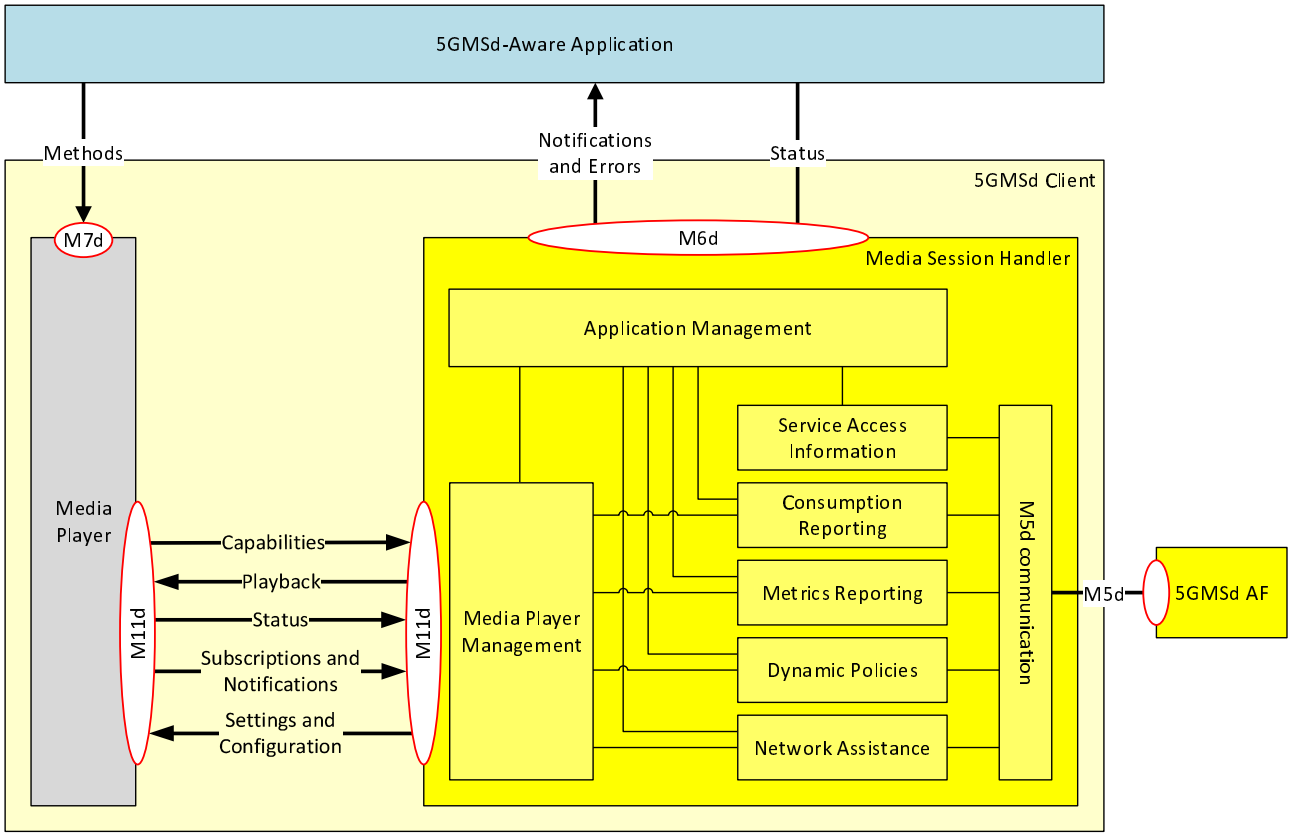

Figure 12.2.1-1: Usage of M6d in Media Downlink Streaming

The Media Session Handler is considered to run as a service in the background and is invoked for a media session once a media player in the 5GMSd streaming client is activated with an MPD URL of media MIME type `"application/dash+xml"`. Based on the MPD URL, the Media Session Handler may initiate communication with the 5GMSd AF through reference point M5d.

NOTE: The initiation of the Media Session Handler for other media types than DASH is for further study.

For an ongoing 5G Media Streaming session, the Media Session Handler is given the following authorizations:

1) The ability to query the status of the Media Player at reference point M11d. For details see clause 13.

2) The ability to process notifications and errors received from the Media Player at reference point M11d. For details see clause 13.

3) The ability to configure certain parameters on the Media Player using methods exposed at reference point M11d. For details see clause 13.

In addition, the Media Session Handler provides information to the 5GMS-Aware Application at reference point M6d, possibly delegated to Media Player at reference point M11d for each of the Media Session Handler functionalities, namely providing:

1) Notification and Error Events;

2) Status Information.

The client API used for downlink media session handling at reference point M6d by the 5GMSd-Aware Application and at reference point M11d by the Media Player in a 5GMSd Client is specified in clause 11 of TS 26.510 [56].

12.2.2 Void

12.2.3 Void

12.2.4 Void

12.2.5 Void

12.2.6 Void

12.2.7 Void

12.3 Media session handling for uplink Streaming – APIs and functions

The client API used for uplink media session handling at reference point M6u by the 5GMSu-Aware Application and at reference point M11u by the Media Streamer in a 5GMSu Client is specified in clause 11 of TS 26.510 [56].

12.4 3GPP Service URL for 5G Media Streaming

The 3GPP Service URL for 5G Media Streaming is based on the generic 3GPP Service URL defined in clause 6 of TS 26.510 [56].

If the service type discriminator *service* in the URL indicates `ms`, then the target service is a 5G Media Streaming service.

The parameters of the 3GPP Service URL for 5G Media Streaming are defined in table 12.4-1.

Table 12.4-1: 3GPP Service URL parameters for 5G Media Streaming

Path element	Cardinality	Description
service_id	1	An External Service Identifier that resolves to a Provisioning Session in the 5GMS System.
Query parameter	**Cardinality**	**Description**
af-host-address	0..*	The Fully Qualified Domain Name and optional port number of a 5GMS AF endpoint to be used by the Media Session Handler at reference point M5 with the format *hostname[:port]*. More than one occurrence of this parameter may be present in the Service URL to indicate alternative host endpoint addresses. Any of these may be used by the Media Session Handler at reference point M5. Supplied by the invoking 5GMS-Aware Application when the 5GMS AF is deployed in an External DN. The endpoint address(es) may, for example, have been passed to the 5GMS-Aware Application via reference point M8. If omitted, the Media Session Handler assumes the default 5GMS AF host endpoint address *ms.af.3gppservices.org:443* is to be used at reference point M5.
access-token	0..1	A token that is presented by the Media Session Handler to the 5GMS AF at reference point M5 that asserts its right to invoke the media session handling operations exposed by the 5GMS AF.
service-operation-point	0..1	A reference to the target Service Operation Point of the 5G Media Streaming session. Overrides any default Service Operation Point signalled in the resource pointed to by *media-entry-point*.
estimated-volume	0..1	An estimate of the volume of media data to be transferred between the 5GMS Client and the 5GMS AS at reference point M4 during the 5G Media Streaming session. Required if *service-operation-point* or *media-entry-point* refers to a Policy Template with an associated Background Data Transfer policy.
media-entry-point	0..1	A Media Entry Point reference expressed as a fully qualified URL per RFC 3986 [41], suitable for presentation to a Media AS at reference point M4. If supplied, used by the Media Session Handler to launch the Media Stream Handler (Media Player or Media Streamer) after successfully initiating media session handling.
content-type	0..*	A MIME content type string conforming to section 5 of RFC 2045 [57] identifying a type of Media Entry Point that is acceptable to the Media Stream Handler (Media Player or Media Streamer). More than one occurrence of this parameter may be present in the Service URL to indicate that more than one type of Media Entry Point is acceptable. Used by the Media Session Handler to eliminate unacceptable Media Entry Points from those listed in the Service Access Information. It is an error to supply this parameter if an explicit Media Entry Point is specified using *media-entry-point*.
profile	0..*	A fully-qualified term identifier from a controlled vocabulary specified outside the scope of the present document identifying a profile of Media Entry Point that is acceptable to the Media Stream Handler (Media Player or Media Streamer). The term identifier shall be formatted as a URI according to RFC 3986 [41]. More than one occurrence of this parameter may be present in the Service URL to indicate that more than one type of Media Entry Point is acceptable. Used by the Media Session Handler to eliminate unacceptable Media Entry Points from those listed in the Service Access Information.

		It is an error to supply this parameter if an explicit Media Entry Point is specified using *media-entry-point*.

The *service_id* path element, and the *af-host-address* and *access-token* query parameters correspond to the baseline Service Access Information for downlink media streaming specified in clause 4.2.3 of TS 26.501 [2] and the baseline parameters of the 3GPP Service URL for 5G Media Streaming defined in clause 4.10.2 of [2]. Together, they enable a full set of Service Access Information to be retrieved by the Media Session Handler from the 5GMS AF using the Service Access Information API at reference point M5 specified in clause 11.2 of the present document.

The *service-operation-point* parameter is used to support the procedure where the desired Service Operation Point is known *a priori* to the invoker and/or is not encoded in the Media Entry Point.

The *estimated-volume* parameter is used to support the procedure where the invoker intends the launched 5G Media Streaming session to be used for the purpose of Background Data Transfer.

The *media-entry-point* query parameter is used to support the procedure where the Media Session Handler launches media playback in the Media Stream Handler (Media Player or Media Streamer) after successfully retrieving a full set of Service Access Information via reference point M5 (if needed) and after successfully initiating media session handling.

The remaining query parameters are used for client-side filtering of Media Entry Point information provided in the Service Access Information and selection of one Media Entry Point by the Media Session Handler. (They are mutually exclusive with the *media-entry-point* parameter.) In this case, media playback by the Media Stream Handler (Media Player or Media Streamer) is launched by the Media Session Handler with its chosen Media Entry Point.

If the 5GMS-Aware Application prefers to launch media streaming itself (rather than have the Media Session Handler launch media streaming on its behalf), the *media-entry-point* query parameter and all client-side filtering parameters shall be omitted from the 3GPP Service URL. In this case, the Media Session Handler initiates only media session handling for the 5GMS Provisioning Session identified by the External Service Identifier.

13 UE Media Stream Handler (M7/M11) APIs

13.1 General

This clause defines a set of APIs and methods that permit a 5GMS-Aware Application at reference point M7 or a Media Session Handler at reference point M11 to communicate with a Media Stream Handler (Media Player or Media Streamer). The main focus of this clause is to formalize and harmonize commonly available proprietary APIs in order to support the usage of a Media Player or a Media Streamer in a 5G Media Streaming context.

The APIs specified in this clause are language- and runtime-independent. Implementations are expected to provide language bindings appropriate to the UE runtime environment.

13.2 DASH Media Player APIs and functions

13.2.1 Overview

In the following, it is assumed that the Media Player (in this case a DASH client) adheres to a basic set of functionalities as shown in figure 13.2-1. The DASH client downloads, processes and presents a DASH Media Presentation under the control of a 5GMSd-Aware Application via reference point M7d or of the Media Session Handler via reference point M11d.

The 5GMSd-Aware Application may, in addition, configure the presentation of the media, receive notifications on events, or query the internal status of the DASH Player, also supported through reference point M7d. Different functions of the DASH Access Client that are typically necessary to process a DASH Media Presentation, are shown in figure 13.2-1. Additional functions may be available as well.

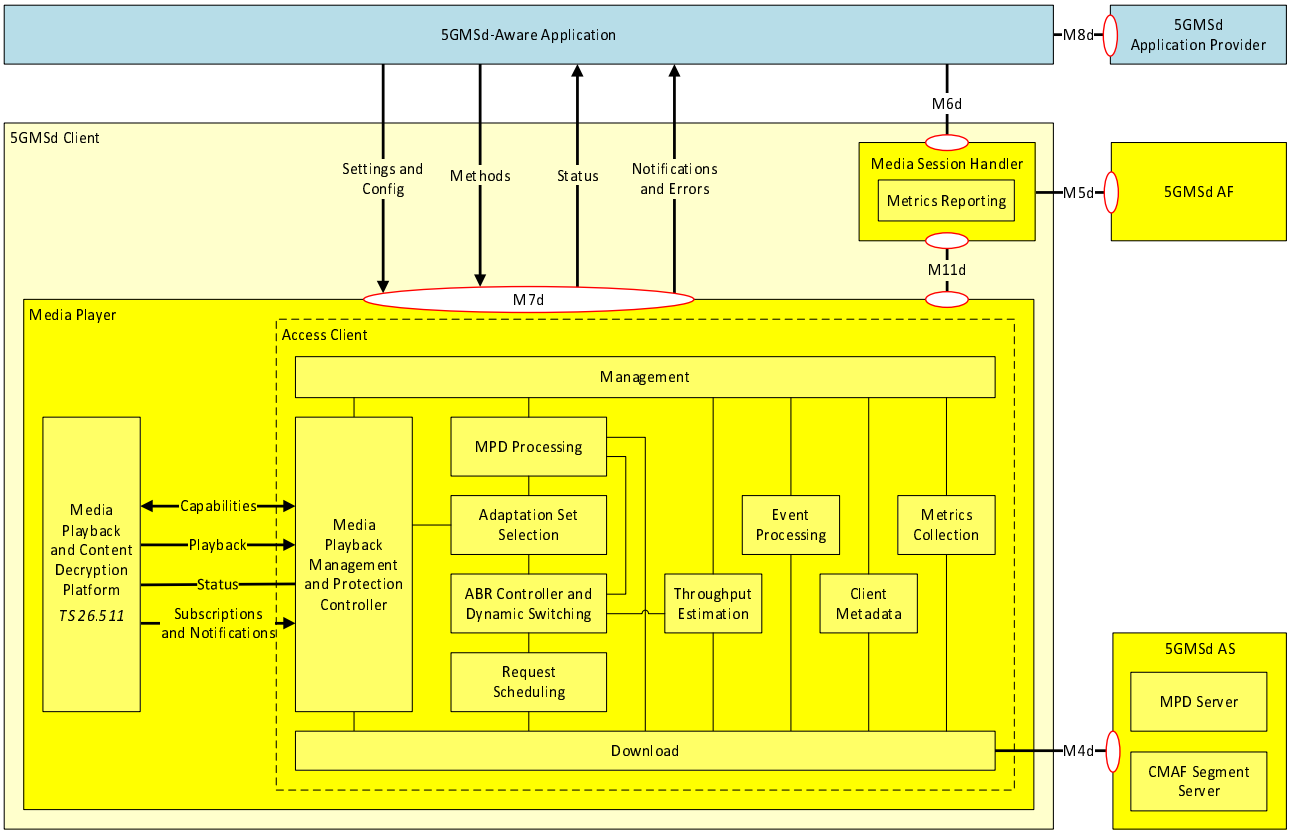

Figure 13.2.1-1: Architecture of DASH-based 5GMSd Client

The key functionalities of each of the functions as shown in figure 13.2-1 are summarized in the following:

- *5GMSd-Aware Application:* Application that makes use of the DASH-based Media Player to play back a DASH Media Presentation using the APIs defined in this clause.
- *Media Player:* A complete player for the playback of a Media Presentation, including the Media Playback and Content Decryption Platform as defined in TS 26.511 [35].
- *Access Client:* A part of the DASH Player that accesses and downloads of the resources and provides the downloaded resources to the Media Playback Platform and Content Decryption for the playback of DASH content.
- *Management:* Controls all internal processes and the communication with the 5GMSd-aware application. In particular this includes the handling of service descriptions and operation points.
- *MPD Processing:* parses and processes the MPD and extracts the relevant information.
- *Adaptation Set Selection:* selects the Adaptation Set based on user, application and/or device capability information. Information provided through M7d may be used.
- *ABR Controller and Dynamic Switching:* runs adaptive bit rate logic and triggers adaptive switching of Representations. Information provided to the DASH client through M7d may be used.
- *Throughput Estimation:* estimates the throughput from the 5GMSd Application Server.
- *Metrics Logging:* logs relevant low-level metrics and provides those to the metrics aggregation and reporting functions in the Media Session Handler.
- *Media Playback Management and Protection Controller:* manages the media playback by moving downloaded information into media playback platform and also addresses handling of protection and DRM related information.

- *Media Playback and Content Decryption Platform:* plays back CMAF-based media content according to the playback requirements in TS 26.511 [35]. It also provides status information as well as events that maybe be provided through M7d.
- *Event Processing:* Processes DASH events and provides information to the 5GMSd-Aware Application as defined in TS 26.247 [4].

This clause focuses on interactions with the Media Player through reference point M7d. In particular, the following aspects of the API are defined:

1) Methods to interact with the Media Player at this reference point are defined in clause 13.2.3.
2) Notification and Error Events raised by the Media Player at this reference point are defined in clause 13.2.4.
3) Configuration and Settings of the Media Player at this reference point are defined in clause 13.2.5.
4) Status Information exposed by the Media Player at this reference point is defined in clause 13.2.6.

Communication between the Access Client and the media playback platform of the Media Player is defined in TS 26.511 [35].

A 5GMSd Client for DASH distribution shall support the APIs defined in this clause 13.

NOTE: The initial APIs have largely been designed based on the dash.js APIs documented here: http://cdn.dashjs.org/latest/jsdoc.

13.2.2 Media Player model

Figure 13.2.2-1 provides an informative client state model in order to appropriately describe the messages on the Media streaming service API. The different states are defined in table 13.2.2-1.

State changes may happen based on:

- Calls from application.
- Information provided in the Media Presentation Description (MPD).

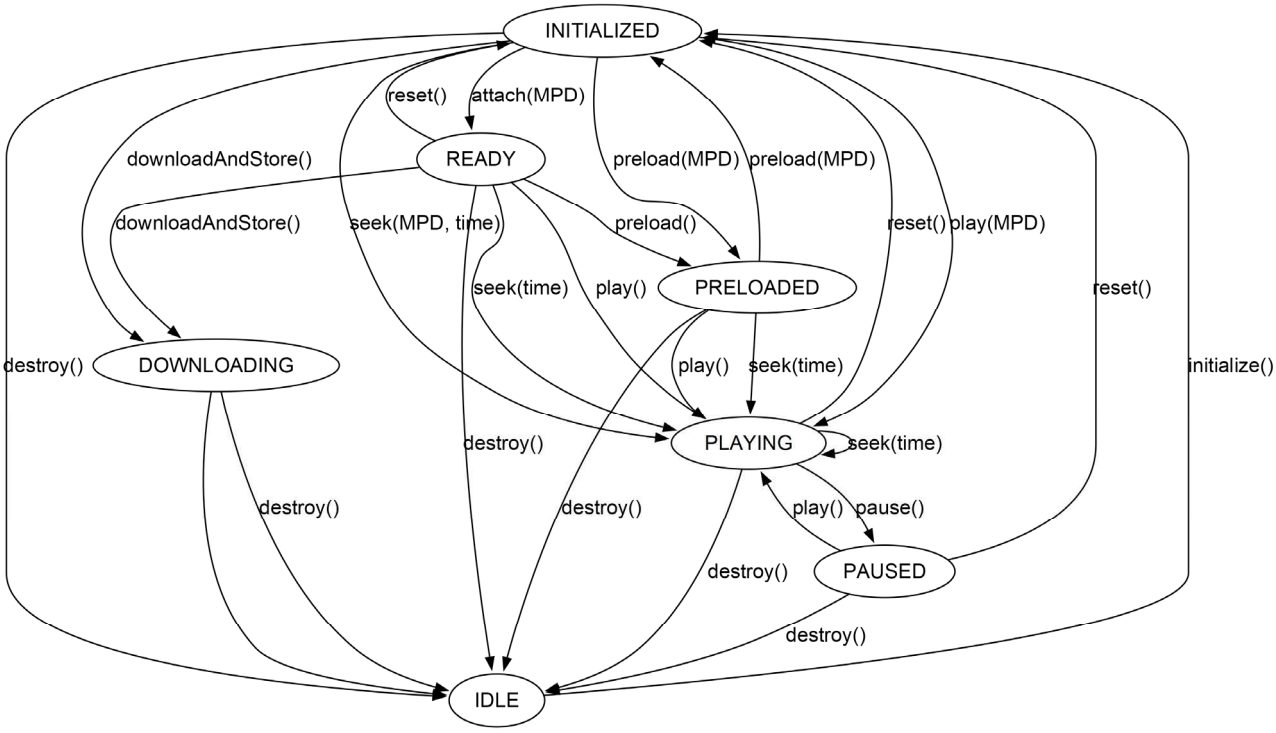

Figure 13.2.2-1: State diagram for Media Player

Table 13.2.2-1 defines states for the Media Player. Detailed descriptions are provided in the following clauses.

Table 13.2.2-1: States of Media Player

States	Definition
IDLE	The Media Player is not associated with any application.
INITIALIZED	The Media Player is associated with an application and the M7d API communication is established.
READY	The Media Player has loaded an MPD and is able to playback the media in this Media Presentation. It also updates the MPD according to the MPD update mechanism.
PRELOADED	The Media Player has pre-loaded all media information in order to start playback instantaneously. It also updates the MPD according to the MPD update mechanism.
PLAYING	The Media Player is playing the Media Presentation. It also updates the MPD according to the MPD update mechanism.
DOWNLOADING	The Media Player is downloading the Media Presentation and storing it in the Media Player for later playback.
PAUSED	The playback of the Media Presentation is paused. It also updates the MPD according to the MPD update mechanism.

It is assumed that the DASH Access Client manages the playback of at most one CMAF track for each media type, namely one for video, one for audio and one for subtitles as defined in TS 26.511 [35]. Playback of multiple CMAF tracks of the same media type is not excluded by the present document, but details are for further study.

13.2.3 Media Player methods

13.2.3.1 General

Based on the state model in clause 13.2.2, this clause introduces relevant procedures and API calls exposed by the Media Player to the 5GMSd-Aware Application at reference point M7d and to the Media Session Handler at reference point M11d.

Table 13.2.3.1-1 provides an overview over the methods defined for the DASH-based streaming API. Note that in implementations, additional methods may be supported.

Table 13.2.3.1-1: Methods defined for DASH Streaming API

Method	State after success	Brief description	Clause
`initialize()`	*INITIALIZED*	The Media Player is created.	13.2.3.2
`attach()`	*READY*	Sets a source URL to an MPD file or a previously downloaded and parsed MPD.	13.2.3.3
`preload()`	*PRELOADED*	Streaming the media is initiated.	13.2.3.4
`play()`	*PLAYING*	Playback of the media is initiated.	13.2.3.5
`pause()`	*PAUSED*	Playback of the media is paused.	13.2.3.6
`seek()`	*PLAYING*	The playback time of the media is altered.	13.2.3.7
`downloadAndStore()`	*DOWNLOADING*	Download a media presentation and store it locally for later playback.	13.2.3.7A
`reset()`	*INITIALIZED*	All media related information is reset.	13.2.3.8
`destroy()`	*IDLE*	All media player related information is reset and API communication is stopped.	13.2.3.9

13.2.3.2 Initialize

This clause defines the `initialize()` method.

No pre-conditions apply.

This method is invoked to create a new Media Player instance. A media delivery session identifier may be assigned to the media delivery session by the Media Player and returned if a value is not supplied by the invoker of the method.

The input parameters of this method are specified in table 13.2.3.2-1.

Table 13.2.3.2-1: Input parameters of `initialize()` method

Name	Type	O	Description
serviceId	`string`	M	An external service identifier, as specified in clause 5.4.2.1 of TS 26.510 [56].
sessionId	`string`	C	A media delivery session identifier nominated by the Media Session Handler, as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document. This parameter shall be included when the method is invoked by the Media Session Handler at reference point M6d; it shall be omitted when the method is invoked by a 5GMSd-Aware Application at reference point M7d.

The following functions are initialized:

- Media Playback Management in order to enable API-based communication through M7d and/or M11d. In particular, the *Notifications and Errors API* (see clause 13.2.5) and the *Status Information* (see clause 13.2.6) are established.

If the *sessionId* parameter is provided by the Media Session Handler at reference point M11d, the newly created Media Player instance shall use this value in its further interactions, in particular the *Notifications and Errors API* (see clause 13.2.5) and the *Status Information* (see clause 13.2.6).

If the *sessionId* parameter is omitted when the method is invoked by the 5GMSd-Aware Application at reference point M6d, the newly created Media Player instance shall rely on the Media Session Handler assigning a media delivery session identifier as a side-effect of invoking the method specified in clause 11.2.2.1 of TS 26.510 [56] at reference point M11d. The Media Player shall then use this value in its further interactions, in particular the *Notifications and Errors API* (see clause 13.2.5) and the *Status Information* (see clause 13.2.6).

The return value of the method is specified in table 13.2.3.2-2.

Table 13.2.3.2-2: Return value of `initialize()` method

Type	Description
`string`	A media delivery session identifier as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document.

The remaining Media Player methods specified below require the media delivery session identifier to be cited as an input parameter.

13.2.3.3 Attach

This clause defines the `attach()` method.

The following pre-conditions apply:

- The Media Player transitions to the *INITIALIZED* state.

The `attachMPD()` method is invoked on a Media Player instance to set a source URL to an MPD file or a previously downloaded and parsed MPD.

The input parameters of the method are specified in table 13.2.3.3-1.

Table 13.2.3.3-1: Input parameters of `attachMPD()` method

Name	Type	Description
sessionId	`string`	The media delivery session identifier (as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document) of an initialised downlink media streaming session.
urlOrMPD	`string | Object`	A URL to a valid MPD or a valid MPD as defined in ISO/IEC 23009-1 [32] or TS 26.247 [4]. The URL may be augmented by MPD Anchors as defined in clause C.4 of ISO/IEC 23009-1 [32].

The following Media Player Actions are expected:

- The *Request Scheduling* and *Download* functions are established.
- If the input is a URL, the Media Player requests the MPD at the corresponding URL through reference point M4d.
- If the MPD is not found after multiple retries, an error *ERROR_MPD_NOT_FOUND* is returned and the process is terminated.
- The *MPD Processing* function is established and the MPD parsed.
- If the MPD is not valid, an error *ERROR_MPD_NOT_VALID* is returned and the process is terminated.
- If the DASH Player does not support the profiles as indicated in the MPD, an error *ERROR_PROFILE_NOT_SUPPORTED* is returned and the process is terminated.
- Depending on the type of the MPD, possibly present anchors as well as the wall-clock time, the Media Player selects the Period in the content that is expected to be played next.
- The *Media Playback Management and Protection Controller* is established.
- The MPD is parsed for available Service Descriptions (including Media Subsets and Adaptation Sets). By using capability mechanisms defined in TS 26.511 [35] as well as using other information (language settings, output capabilities, accessibility settings), the Media Player identifies a set of permissible Service Descriptions including Media Subsets and Adaptation Sets. If no Adaptation Sets are capable to be played, an error *ERROR_MEDIA_NOT_SUPPORTED* is returned and the process is terminated.
- The available Service Descriptions including included Adaptation Sets are provided to the 5GMS-Aware Application through reference point M7d.
- The application may select a Service Description instance as well as Adaptation Sets. Additional Service Descriptions parameters may be configured by the 5GMSd-Aware Application through reference point M7d.
- Based on the service description parameters and selected Adaptation Sets:
  - the Operation Point parameters are set.
  - the *Media Playback Platform and Content Decryption* is established using the methods defined in TS 26.511 [35].
  - The selected Adaptation Sets are initialized by downloading the relevant Initialization Segments/CMAF Headers through M4d in the Media Playback Platform as in TS 26.511 [35] establishing a track buffer for each selected media type.
- Depending on the MPD information and/or M7d configuration, one or more of the following functions may be established:
  - Metrics Logging and Collection
  - Event Processing and Notification

- Client Metadata handling

- The Media Player transitions to the *READY* state.

An application may use this method to load an MPD and in order to prepare playback. In case of errors notifications, it is up to the application to initiate appropriate actions.

13.2.3.4 Pre-load

This clause defines the `preload()` method.

The following pre-conditions apply:

- The Media Player is in *INITIALIZED* or *READY* state.

The `preload()` method is invoked on a Media Player instance to cause it to begin streaming the media as set by the `attach()` method (see clause 13.2.3.3) in preparation for playing.

The input parameters of the method are specified in table 13.2.3.4-1.

Table 13.2.3.4-1: Input parameters of `preload()` method

Name	Type	Description
sessionId	`string`	The media delivery session identifier (as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document) of an initialised downlink media streaming session.
urlOrMPD	`string | Object`	A URL to a valid MPD or a valid MPD as defined in ISO/IEC 23009-1 [32] or TS 26.247 [4]. The URL may be augmented by MPD Anchors as defined in clause C.4 of ISO/IEC 23009-1 [32].

The following Media Player Actions are expected:

- If in *INITIALIZED* state, the `attach()` method is invoked with the value of the *urlOrMPD* input parameter.

- Depending on the type of the MPD, possibly present anchors as well as the wall-clock time, and other MPD information, the earliest media time span for pre-loading is identified.

- The Access Client schedules and generates requests for the relevant media segments based on the ABR Controller information, as well as the throughput estimation and downloads this media.

- The segments are downloaded from the corresponding URLs through reference point M4d no earlier than the segment availability start time of the Segments.

- The downloaded segments are appropriately appended to the track buffers as established according to *Media Playback Platform and Content Decryption* APIs, following the description in TS 26.511 [35] for playback requirements.

- Configuration and service description parameters are taken into account, for example the content is continuously loaded to remain at the live edge following the latency requirements provided in the service description setting. Content not at the live edge is removed. For static services, the content is loaded from the beginning up to a suitable buffer duration, possibly as configured, and then downloading is stopped.

- The Media Player transitions to the *PRELOADED* state.

- Appropriate notifications and error messages are generated. For details, refer to clause 13.2.5.

- Appropriate Status Information is generated. For details, refer to clause 13.2.6.

An application may use this method to preload media into the player in order minimize the start-up time.

13.2.3.5 Play

This clause defines the `play()` method.

The following pre-conditions apply:

- The Media Player is in *INITIALIZED* or *READY* or *PRELOADED* or *PAUSED* state.

The `play()` method is invoked on a Media Player instance to cause it to begin playback of the media as set by the `attach()` method (see clause 13.2.3.3).

The input parameters of the method are defined in table 13.2.3.5-1.

Table 13.2.3.5-1: Input parameters of `play()` method

Name	Type	Description
sessionId	`string`	The media delivery session identifier (as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document) of an initialised downlink media streaming session.
urlOrMPD	`string | Object`	A URL to a valid MPD or a valid MPD as defined in ISO/IEC 23009-1 [32] or TS 26.247 [4]. The URL may be augmented by MPD Anchors as defined in clause C.4 of ISO/IEC 23009-1 [32].

The following Media Player Actions are expected:

- If in *INITIALIZED* state, the `attach()` method (see clause 13.2.3.3) is invoked internally, passing the value of the *urlOrMPD* input parameter.
- If in *PAUSED* state, the earliest media time is *MEDIA_TIME* (for details see clause 13.2.3.6), else, depending on the type of the MPD, possibly present anchors as well as the wall-clock time, and other MPD information, the earliest media time for start-up is identified.
- The Access Client checks the available buffer state of media in the Media Playback Platform. Based on this, the Access Client schedules and generates requests for the relevant media segments based on the ABR Controller information, as well as the throughput estimation and downloads this media.
- Media segments are acquired from their corresponding URLs (through M4d or, if already downloaded and stored, from local storage) earliest at the segment availability start times.
- The media is appropriately appended to the *Media Playback Platform and Content Decryption* APIs, following the description in TS 26.511 [35] for playback requirements.
- Once a threshold for sufficient buffering is reached, the Media Playback platform is initiated to be started, i.e. a playback is initiated, following the description in TS 26.511 [35] for playback requirements.
- The content is continuously streamed, downloaded and played back.
- The Media Player transitions to the *PLAYING* state.
- Appropriate notifications and error messages are generated. For details, refer to clause 13.2.5.
- Appropriate Status Information is generated. For details, refer to clause 13.2.6.

An application may use this method to initiate playback of media.

13.2.3.6 Pause

This clause defines `pause()` method.

The following pre-conditions apply:

- The Media Player is in *PLAYING* state.

The `pause()` method is invoked on a Media Player instance to cause the Media Playback Platform to pause playback.

The input parameters of the method are specified in table 13.2.3.6-1.

Table 13.2.3.6-1: Input parameters of `pause()` method

Name	Type	Description
sessionId	`string`	The media delivery session identifier (as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document) of an initialised downlink media streaming session.

The following Media Player Actions are expected:

- The playback on the playback platform is paused and the media time is maintained as *MEDIA_TIME*.
- The Access Client checks the available buffer state of media in the Media Playback Platform. Based on this, the Access Client schedules and generates requests for the relevant media segments based on the ABR Controller information, as well as the throughput estimation and downloads this media.
- The media is downloaded from the corresponding URL through reference point M4d earliest at the segment availability start time of the media.
- The media is appropriately appended to the *Media Playback Platform and Content Decryption* APIs, following the description in TS 26.511 [35] for playback requirements.
- Once the buffers are sufficiently filled, the client stops downloading.
- The Media Player transitions to the *PAUSED* state.
- Appropriate notifications and error messages are generated. For details, refer to clause 13.2.5.
- Appropriate Status Information is generated. For details, refer to clause 13.2.6.

An application may use this method to play back media.

13.2.3.7 Seek

This clause defines `seek()` method.

The following pre-conditions apply:

- The Media Player is in *INITIALIZED*, *READY*, *PRELOADED* or *PAUSED* state.

The `seek()` method is invoked on a Media Player instance to cause it to go to a specific media time.

The input parameters of the method are specified in table 13.2.3.7-1.

Table 13.2.3.7-1: Input parameters of `seek()` method

Name	Type	Description
sessionId	`string`	The media delivery session identifier (as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document) of an initialised downlink media streaming session.
urlOrMPD	`string | Object`	A URL to a valid MPD or a valid MPD. The URL may be augmented by MPD Anchors as defined in clause C.4 of ISO/IEC 23009-1 [32].
mediaTime	`Unsigned integer`	The media time in milliseconds for playback.

The following Media Player actions are expected:

- If in *INITIALIZED* state, the `attach()` method (see clause 13.2.3.3) is invoked internally, passing the value of the *urlOrMPD* input parameter.
- If the `mediaTime` is not accessible, an *ERROR_MEDIA_TIME_NOT_ACCESSIBLE* event is issued (see clause 13.2.5) and the following actions are not carried out.
- The earliest media time is set to the value of the `mediaTime` input parameter.

- The Media Player transitions to the *PAUSED* state.
- The `play()` method (see clause 13.2.3.5) is invoked internally.

An application may use this method to initiate playback of media.

13.2.3.7A Download and store

This clause defines the `downloadAndStore()` method.

The following pre-conditions apply:

- The Media Player is in *INITIALIZED* or *READY* state.

The `downloadAndStore()` is invoked on a Media Player instance to cause it to download and store the media as set by the `attach()` method (see clause 13.2.3.3).

The input parameters of the method are specified in table 13.2.3.5A-1.

Table 13.2.3.7A-1: Input parameters of `downloadAndStore()` method

Name	Type	Description
sessionId	`string`	The media delivery session identifier (as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document) of an initialised downlink media streaming session.
url	`string`	The URL of a Media Entry Point which may be a valid MPD as defined in ISO/IEC 23009-1 [32] or TS 26.247 [4].
serviceComponents	`array(string)`	A list of MPEG-DASH Adaptation Set and Representation identifiers to be downloaded. If omitted or empty, all Representations are downloaded.
background	`boolean`	If true, the content is required to be acquired using a Background Data Transfer.
deadline	`dateTime`	An optional date–time by which content acquisition is required to be complete. If this deadline is missed, any resources downloaded already are removed from the Media Player.
expiry	`dateTime`	A date–time by which any download resources are required to be removed from the 5GMS Client. The value of this parameter shall be after *deadline*, if present.

The anonymous output parameter of the method is specified in table 13.2.3.7A-2.

Table 13.2.3.7A-2: Output parameter of `downloadAndStore()` method

Name	Type	Description
—	`string`	The URL of a Media Entry Point in local storage which may be a valid MPD as defined in ISO/IEC 23009-1 [32] or TS 26.247 [4]. The downloaded media asset can be played back by passing this URL to the methods specified in clauses 13.2.3.4 and/or 13.2.3.5.

The following Media Player Actions are expected:

- If in *INITIALIZED* state, the `attach()` method (see clause 13.2.3.3) is invoked internally, passing the value of the *urlOrMPD* input parameter.
- The downloaded Media Entry Point is stored locally in the 5GMS Client for later playback. In the case where the Media Entry Point is a presentation manifest, such as an MPD, Base URLs may be modified to suit offline playback of the media resources it references.
- Depending on the type of the Media Entry Point, possibly present anchors as well as the wall-clock time, and other information, the earliest media time span for pre-loading is identified.

- The Access Client schedules and generates requests for the relevant media resources referenced by the Media Entry Point.
- The media resources are downloaded through reference point M4d at the earliest available opportunity. In the case where the Media Entry Point is a presentation manifest, such as an MPD, they are downloaded no earlier than the availability start time indicated in the presentation manifest.
- The downloaded media resources are stored locally in the 5GMS Client for later playback.
- The Media Player transitions to the *DOWNLOADING* state.
- Appropriate notifications and error messages are generated. For details, refer to clause 13.2.5.
- Appropriate Status Information is generated. For details, refer to clause 13.2.6.
- When the download completes (either successfully or unsuccessfully) the Media Player transitions to the *IDLE* state.

An application may use this method to preload media into the player in order minimize the start-up time.

13.2.3.8 Reset

This clause defines the `reset()` method.

The following pre-conditions apply:

- The Media Player may be in any state.

The `reset()` method is invoked on a Media Player instance to reset all information related to the media. As a side-effect, the Media Presentation described by the MPD is terminated.

The input parameters of the method are specified in table 13.2.3.8-1.

Table 13.2.3.8-1: Input parameters of `reset()` method

Name	Type	Description
sessionId	`string`	The media delivery session identifier (as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document) of an initialised downlink media streaming session.

The following Media Player Actions are expected:

- The playback on the playback platform terminated.
- All open requests are cancelled.
- All scheduled requests are deleted.
- The current MPD is removed.
- Any media downloaded and stored in the 5GMSd Client by this Media Player instance is discarded.
- The Media Player transitions to the *INITIALIZED* state.

An application may use this method to terminate the playback of any media.

13.2.3.9 Destroy

This clause defines `destroy()` method.

The following pre-conditions apply:

- The Media Player may be in any state.

The `destroy()` method is invoked on a Media Player instance to reset all information related to the media and the network.

The input parameters of the method are specified in table 13.2.3.9-1.

Table 13.2.3.9-1: Input parameters of `destroy()` method

Name	Type	Description
sessionId	`string`	The media delivery session identifier (as specified in clause 7.3.2 of TS 26.510 [56] and in clause 10.1A of the present document) of an initialised downlink media streaming session.

The following Media Player actions are expected:

- The playback on the playback platform terminated.
- All open download requests are cancelled.
- All scheduled download requests are deleted.
- All network information is history is cleared.
- Any unexpired media downloaded and stored in the 5GMSd Client by this Media Player instance is retained.
- The Media Player transitions to the *IDLE* state.

An application may use this method to terminate the playback of any media clear and download related information.

If successful, the Media Player instance no longer exists once control has passed back from this method to the invoker.

13.2.4 Configurations and settings API

DASH streaming for a particular downlink media delivery session may be configured by the 5GMSd-Aware Application at reference point M7d or by the Media Session Handler at reference point M11d with the parameters provided in table 13.2.4-1. Note that these parameters may be set and they may also be observed.

Table 13.2.4-1: Media Player Configuration API

Status	Type	Definition
sessionId	`string`	A media delivery session identifier for the downlink media streaming session that has been initialised using the method specified in clause 13.2.3.2.
source	`Object`	Provides the MPD and all contained information.
consumptionMode	`Enum`	Defines two modes: *live*: in this case the target latency is maintained, if specified in the service description, according to the parameters *vod*: in this case the latency is set by the application, and the latency settings are ignored.
maxBufferTime	`Integer`	Maximum buffer time in milliseconds for the service.
serviceDescriptionId	`id`	Selects a service description by selecting an identifier.
serviceDescriptions[]	`Service description parameters`	Configures a service description as defined in annex K of ISO/IEC 23009-1 [32]. This allows the application to define additional service descriptions beyond those defined in the MPD.
id	`id`	Sets a service description identifier different from the ones available in the service descriptions in the MPD or modifies existing service descriptions.
serviceLatency	`Object`	Sets service description parameters for the service latency, as defined in table K.1 of ISO/IEC 23009-1 [32].
playBackRate	`Object`	Sets service description parameters for the playback rate, as defined in table K.2 of ISO/IEC 23009-1 [32] when the service is consumed in live mode.
operatingQuality	`Object`	Sets service description parameters for the operating quality, as defined in table K.3 of ISO/IEC 23009-1 [32].
operatingBandwidth	`Object`	Sets service description parameters for the operating bandwidth, as defined in table K.4 of ISO/IEC 23009-1 [32].
mediaSettings[]	Media type `audio`, `video`, `subtitle`	Sets the selected Adaptation Set based on the available Adaptation Sets for each media type.
metricsConfiguration[ ]	`Object`	Zero or more sets of settings for collecting metrics in relation to the downlink media streaming session.

13.2.5 Notifications and error events

Table 13.2.5-1 provides a list of notification events that are provided by the Media Player to 5GMSd-Aware Applications at reference point M7d and to the Media Session Handler at reference point M11d. Every notification and error event is disambiguated by a media delivery session identifier.

Table 13.2.5-1: Media Player Notification events

Status	Definition	Payload
AST_IN_FUTURE	Triggered when playback will not start yet as the MPD's *availabilityStartTime* is in the future.	Media delivery session identifier, Time before playback will start.
AVAILABLE_MEDIA_CHANGED	The list of available media has changed.	Media delivery session identifier, Media type: - video - audio - subtitle - all
BUFFER_EMPTY	Triggered when the media playback platform's buffer state changes to stalled.	Media delivery session identifier, Media Type
BUFFER_LOADED	Triggered when the media playback platform's buffer state changes to loaded.	Media delivery session identifier, Media Type
CAN_PLAY	Sent when enough data is available that the media can be played.	Media delivery session identifier
MANIFEST_LOADED	Triggered when the manifest load is complete	Media delivery session identifier
METRIC_ADDED	Triggered every time a new metric is added.	Media delivery session identifier
METRIC_CHANGED	Triggered every time a metric value changes.	Media delivery session identifier, Metric identifier
METRIC_UPDATED	Triggered when the configuration of a metric is updated.	Media delivery session identifier, Metric identifier
METRICS_CHANGED	Triggered whenever there is a change to the overall metrics.	Media delivery session identifier
OPERATION_POINT_CHANGED	Triggered whenever there is a change of a Service Operation Point parameter.	Media delivery session identifier, External reference identifier of currently selected Service Operation Point.
PLAYBACK_ENDED	Sent when media playback completes normally.	Media delivery session identifier
PLAYBACK_ERROR	Sent when an error occurs during media playback. The element's error attribute contains more information.	Media delivery session identifier, Error reason (see table 13.2.5-2).
PLAYBACK_PAUSED	Sent when media playback is paused.	Media delivery session identifier
PLAYBACK_PLAYING	Sent when the media begins to play (either for the first time, after having been paused, or after ending and then restarting).	Media delivery session identifier
PLAYBACK_SEEKED	Sent when a media playback seek operation completes.	Media delivery session identifier
PLAYBACK_SEEKING	Sent when a media playback seek operation begins.	Media delivery session identifier
PLAYBACK_STALLED	Sent when the media playback platform reports stalled.	Media delivery session identifier

PLAYBACK_STARTED	Sent when playback of the media starts after having been paused; that is, when playback is resumed after a prior pause event.	Media delivery session identifier
PLAYBACK_WAITING	Sent when the media playback has stopped because of a temporary lack of data.	Media delivery session identifier
SERVICE_DESCRIPTION_SELECTED	sent when the DASH client has selected a service description.	Media delivery session identifier
SERVICE_DESCRIPTION_CHANGED	Sent when the DASH client has changed a service description.	Media delivery session identifier
SERVICE_DESCRIPTION_VIOLATED	Provides notification that the service description parameters are currently not met.	Media delivery session identifier, Parameters of service description that are not met
SOURCE_INITIALIZED	Triggered when the source is set up and ready.	Media delivery session identifier
DOWNLOAD_STARTED	Sent when a non-real-time content download begins.	Media delivery session identifier
DOWNLOAD_COMPLETED	Sent when a non-real-time content download is complete.	Media delivery session identifier
DOWNLOAD_ERROR	Send when an error occurs during non-real-time content download	Media delivery session identifier, Error reason (see table 13.2.5-2).

Table 13.2.5-2 provides a list of error reasons that are indicated for notifications of type *PLAYBACK_ERROR* and *DOWNLOAD_ERROR*.

Table 13.2.5-2: Media Player Error reasons

Error reason	Definition
ERROR_MEDIA_ENTRY_NOT_FOUND	The Media Entry Point resource requested by the Media Player could not be located.
ERROR_CONTENT_NOT_FOUND	Other content requested by the Media Player could not be located.
ERROR_MEDIA_PLAYBACK	There is an error from the media playback platform buffer.
ERROR_INVALID_MEDIA_ENTRY	The Media Entry Point resource supplied is not syntactically valid.
ERROR_INACCESSIBLE_MEDIA_TIME	The media time requested in a seek operation is not accessible in the current media presentation.
ERROR_UNSUPPORTED_PROFILE	The profile of the media presentation described by the Media Entry Point resource is not supported by the media playback platform.
ERROR_DOWNLOAD_DEADLINE_MISSED	The download of content did not complete before the requested deadline and the incomplete download has been discarded.

13.2.6 Dynamic Status Information

Table 13.2.6-1 provides a list of dynamically changing status information that can be obtained from the Media Player via reference point M7d or M11d. A separate set of Dynamic Status Information is provided for each active downlink media streaming session, indexed by its media delivery session identifier initialised per clause 13.2.3.2.

Table 13.2.6-1: Media Player Dynamic Status information

Status	Type	Parameter	Definition
state	Enumeration		An enumerated value from table 13.2.2-1 indicating the current state of the Media Player.
averageThroughput	`float`	none	Current average throughput computed in the ABR logic in bit/s.
bufferLength	`float`	`MediaType` "video", "audio" and "subtitle"	Current length of the buffer for a given media type, in seconds. If no type is passed in, then the minimum of video, audio and subtitle buffer length is returned. NaN is returned if an invalid type is requested, the presentation does not contain that type, or if no arguments are passed and the presentation does not include any adaption sets of valid media type.
liveLatency	`float`	none	Current live stream latency in seconds based on the latency measurement.
mediaSetting[ ]	`MPDAdaptationSet`	`MediaType` "video", "audio" and "subtitle"	Current media settings for each media type based on the CMAF Header and the MPD information based on the selected Adaptation Set for this media type.
mediaTime	`float`	None	Current media playback time from media playback platform. The media time is in seconds and is relative to the start of the playback and provides the media that is actually rendered.
playbackRate	`float`	None	The current rate of playback. For a video that is playing twice as fast as the default playback, the *playbackRate* value should be 2.00.
availableServiceDescriptions[ ]	Array of service descriptions		Provides the list of available selectable service descriptions with an id to select from. Those are either configured ones or the ones in the MPD.
availableMediaOptions[ ]	List of Adaptation Set or Preselection ids	`MediaType` "video", "audio" "subtitle" "all"	Provides the list of available media options that can be selected by the application based on the capability discovery and the subset information.
serviceOperationPoints	`array(Service OperationPoint)`		The set of Service Operation Points declared in the presentation manifest (e.g. DASH MPD) of the current media presentation.
operativeServiceOperation Point	`integer`		A zero-based index into the *service OperationPoints* array indicating the Service Operation Point currently operative in the playback session. Set to -1 if the array is empty.
metrics[ ][ ]	`Metrics`		A data blob of metrics for each configured metrics collecting scheme.

Table 13.2.6-2 provides a list of configured operation point information that can be obtained from the client. Any change to a parameter below shall be announced with a notification *OPERATION_POINT_CHANGED* as specified in table 13.2.5-1.

Table 13.2.6-2: Media Player Service Operation Point Information

Parameter	Type	Definition
ServiceOperationPoint	`Object`	The currently configured Service Operation Point parameters according to which the DASH client is operating.
externalIdentifier	`String`	The external identifier uniquely identifying this Service Operation Point in the presentation manifest (e.g. DASH MPD).
mode	`Enum`	The following operation modes are defined: *live*: The DASH client operates to maintain configured target latencies using playback rate adjustments and possibly resync. *vod*: The DASH client operates without latency requirements and rebuffering may result in additional latencies
maxBufferTime	`Integer`	maximum buffer time in milliseconds for the service.
switchBufferTime	`Integer`	buffer time threshold below which the DASH clients attempt to switch Representations.
latency	`Object`	Defines the latency parameters used by the DASH client when operating in live mode.
target	`Integer`	The target latency for the service in milliseconds.
max	`Integer`	The maximum latency for the service in milliseconds.
min	`Integer`	The maximum latency for the service in milliseconds.
playbackRate	`MediaType` *audio*, *video*, *all*	Defines the playback rate parameters used by the DASH client for catchup mode and deceleration to avoid buffer underruns and maintaining target latencies.
max	`Real`	The maximum playback rate for the purposes of automatically adjusting playback latency and buffer occupancy during normal playback, where 1.0 is normal playback speed.
min	`Real`	The minimum playback rate for the purposes of automatically adjusting playback latency and buffer occupancy during normal playback, where 1.0 is normal playback speed.
bitRate		Defines the operating bit rate parameters used by the DASH client used for a specific media type or aggregated. The values are on IP level.
target	`Integer`	The target bit rate for the service in bit/s that the client is configured to consume.
max	`Integer`	The maximum bit rate for the service in bit/s that the client is configured to consume.
min	`Integer`	The minimum bit rate for the service in bit/s that the client is configured to consume.
playerSpecificParameters		Player-specific parameters may be provided, for example about the used algorithm, etc.

13.2.7 Usage of Media Player information by Media Session Handler

The Media Session Handler may use the notifications, errors and status information provided by the Media Player at reference point M11 to execute relevant tasks, such as compiling QoE metrics reports.

14 Application (M8) APIs for uplink and downlink

APIs of this reference point are not specified within this release.

15 Miscellaneous UE-internal APIs

15.1 General

The use of UE modem APIs by the Media Session Handler to support ANBR-based Network Assistance and ANBR-based metrics reporting is specified in clause 5.6 of TS 26.510 [56].

15.2 Void

15.3 Void

16 Usage of 5GC interfaces and APIs

16.1 General

The use of 5GC APIs by the 5GMS AF is specified in clause 5.5 of TS 26.510 [56].

16.2 Void

16.3 Void

17 Media Streaming data reporting at R4

17.1 General

The following record types shall be used with the *Ndcaf_DataReporting_Report* service operation specified in clause 7.2.3.4.1 of TS 26.532 [47]. In each case, one or more records are included in a *DataReport*, as specified in clause 7.3.3.2.1 of [47].

The OpenAPI definitions of the record types are found in clause C.5.1 of the present document.

17.2 MediaStreamingAccessRecord type

As specified in clause 4.11.3, the *MediaStreamingAccessRecord* type shall be used by the 5GMS AS to report media streaming access. This data type is defined in clause C.5.1 as the combination of:

- *BaseRecord*, as defined in clause B.4 of TS 26.532 [49], which provides a record timestamp for the data report and which also cites the set of reporting context identifiers that gave rise to the data report, as specified in clause 4.1 of [49].
- *MediaStreamingBaseReportingRecord*, as defined in clause 6.4.3.9A of the present document, which enables the network slice and/or Data Network of the media streaming session at the time of the media streaming access to be reported by the 5GMS AS, as well as the location of the UE when the media streaming access was made.
- *MediaStreamingSessionIdentification*, as defined in clause 6.4.3.10 of the present document.

  If a media streaming session identifier is not explicitly provided by the 5GMS Client at reference point M4, the 5GMS AS should instead synthesise a value for the *sessionId* property, for example a one-way hash of the transport connection identifier (if available from the underlying transport protocol) or a one-way hash of the 5-tuple formed from the Media Stream Handler and 5GMSd AS endpoint addresses and a transport protocol identifier, combined with a randomly chosen salt to prevent reverse engineering of the original values.
- *MediaStreamingAccess*, as defined in clause 6.4.3.11 of the present document. These properties shall be populated by the 5GMS AS.

17A Data reporting at R2

17A.1 General

The following record types shall be used with the *Ndcaf_DataReporting_Report* service operation specified in clause 7.2.3.4.1 of TS 26.532 [49]. In each case, one or more records are included in a *DataReport*, as specified in clause 7.3.2.3 of [49].

The OpenAPI definitions of the record types are found in clause C.5.2 of the present document.

17A.2 ANBRNetworkAssistanceInvocationRecord type

As specified in clause 7.3.2.3 of TS 26.532 [49], the *ANBRNetworkAssistanceInvocationRecords* type shall be used by the Media Session Handler to report ANBR-based Network Assistance invocations at reference point R2.

The *ANBRNetworkAssistanceInvocationRecords* type structure is defined in clause C.5.2 as the combination of:

- *BaseRecord*, as defined in clause B.4 of [49], which provides a record timestamp for the data report and which also cites the set of reporting context identifiers that gave rise to the data report, as specified in clause 4.1 of [49].
- *MediaStreamingBaseReportingRecord*, as defined in clause 6.4.3.9A of the present document, which enables the network slice and/or Data Network of the media streaming session on which ANBR-based Network Assistance was invoked to be reported by the Media Session Handler, as well as the location of the UE when the ANBR-based Network Assistance was invoked.
- *MediaStreamingSessionIdentification*, as defined in clause 6.4.3.10 of the present document.
- *NetworkAssistanceInvocation*, as defined in clause 6.4.3.12 of the present document.

18 Event exposure at R5 and R6

18.1 General

The *Naf_EventExposure* service specified in TS 29.517 [46] shall be used by event consumers to subscribe to the following types of 5G Media Streaming event notifications, identified by their respective Event IDs, from the Data Collection AF instantiated in the 5GMS AF, and subsequently to receive such notifications in the form of *AfEventNotification* objects as specified in table 5.6.2.6-1 of [46] and as further specified in this clause:

1. Media Streaming QoE Event notifications, as specified in clause 18.3, comprising
   a) 3GPP-defined QoE metrics information, and
   b) non-3GPP-defined QoE metrics information.
2. Media Streaming Consumption Event notifications, as specified in clause 18.4.
3. Media Streaming Network Assistance Invocation Event notifications, as specified in clause 18.5.
4. Media Streaming Dynamic Policy Invocation Event notifications, as specified in clause 18.6.
5. Media Streaming Access Event notifications, as specified in clause 18.7.

OpenAPI data types for these event notifications are found in clause C.6.

In this release, eligible event consumer subscribers to the *Naf_EventExposure* service as specified in [46] are the following:

- The NWDAF defined in TS 23.288 [47].
- The Event Consumer AF defined in TS 26.531 [46] when it is deployed in the Trusted DN.
- The NEF defined in TS 23.501 [2] when it is used to expose the *Naf_EventExposure* service to functions outside the Trusted DN via the *Nnef_EventExposure* service defined in TS 23.502 [45] and specified in TS 29.591 [55].

Implementations of the Data Collection AF instantiated the 5GMS AF shall support negotiation of the optional features relating to 5G Media Streaming specified in table 5.8-1 of TS 29.517 [46]. Feature negotiation by event consumers is achieved as specified in clause 5.8 of [46].

18.2 Common data types for event exposure

18.2.1 BaseEventCollection data type

BaseEventCollection is an abstract base data type for describing a collection of media streaming event records. It is combined with other collection data types to form concrete collections. As such, this data type shall not be exposed by the Data Collection AF instantiated in the 5GMS AF.

Table 18.2.1-1: BaseEventCollection data type

Property name	Data Type	Cardinality	Description
collectionTimestamp	`DateTime`	1..1	The date–time at which this collection was exposed by the Data Collection AF as an event to its subscribed event consumers.
startTimestamp	`DateTime`	1..1	Date–time of earliest data sample included in or summarised by this collection.
endTimestamp	`DateTime`	1..1	Date–time of latest data sample included in or summarised by this collection.
sampleCount	`integer`	1..1	The number of data samples included in or summarised by this collection.
streamingDirection	`Provisioning SessionType`	1..1	Indicates whether the collection concerns a downlink media streaming session or an uplink media streaming session.
summarisations	`array(Data Aggregation Function Type)`	1..1	A set of one or more data aggregation functions (see TS 26.532 [49]) that have been applied to the UE data to produce summary records present in this collection.
records	`array()`	1..1	A set of zero or more records, the type of which is specified in subsequent clauses. Empty when the *summarisations* property indicates that this collection describes only a count of UE data samples.

18.2.2 BaseEventRecord data type

BaseEventRecord data type is an abstract base data type for describing a single UE data record or summarising a summarising a set of UE data records. It is combined with other collection data types to form concrete collections. As such, this data type shall not be exposed by the Data Collection AF instantiated in the 5GMS AF.

Table 18.2.2-1: BaseEventRecord data type

Property name	Data Type	Cardinality	Description
recordType	`EventRecordType`	1..1	The type of this record. See table 18.2.2-2.
recordTimestamp	`DateTime`	1..1	Date–time at which the UE data carried in this record was sampled or summarised.
appId	`ApplicationId`	1..1	Identifying the application (see table 5.4.2-1 of TS 29.571 [12]) to which the UE data carried in this record pertains.
provisioningSessionId	`ResourceId`	0..1	The identifier of the Provisioning Session to which this record pertains. Present only for individual data sample *recordType*.
sessionId	`MediaDelivery SessionId`	0..1	A value that uniquely identifies the media streaming session to which this record pertains. Present only for individual data sample *recordType*.
ueIdentification	`string`	0..1	GPSI of the requesting UE or a stable globally unique string identifying the requesting Media Session Handler. Present only for individual data sample *recordType* and only when exposure is permitted by the data exposure restrictions in force for the event type in question.
dataNetworkName	`Dnn`	0..1	Identifying the Data Network of the M4 media streaming session. Present only for individual data sample *recordType*.
sliceId	`Snssai`	0..1	The S-NSSAI identifying the Network Slice of the M4 media streaming session.

Property name	Data Type	Cardinality	Description
			Present only for individual data sample *recordType*.
ueLocations	`array(LocationArea5G)`	0..1	The location(s) of the UE when the data described by this record was sampled. Present only for individual data sample *recordType* and only when exposure is permitted by the data exposure restrictions in force for the event in question.

Table 18.2.2-2: EventRecordType enumeration

Enumeration value	Description
INDIVIDUAL_SAMPLE	The event record is an individual UE data sample.
SUMMARY_MEAN	The event record summarises the mean average value over the period indicated by the parent collection.
SUMMARY_MINIMUM	The event record summarises the minimum value over the period indicated by the parent collection.
SUMMARY_MAXIMUM	The event record summarises the maximum value over the period indicated by the parent collection.
SUMMARY_SUM	The event record summarises the sum over the period indicated by the parent collection.

18.3 QoE metrics event notifications

18.3.1 QoEMetricsCollection data type

QoEMetricsCollection is a concrete data type describing a collection of QoE Metrics Event records.

Table 18.3.1-1: QoEMetricsCollection data type

Property name	Data Type	Cardinality	Description
collectionTimestamp	`DateTime`	1..1	The date–time at which this collection was exposed by the Data Collection AF as an event to its subscribed event consumers.
startTimestamp	`DateTime`	1..1	Date–time of earliest QoE metrics report included in or summarised by this collection.
endTimestamp	`DateTime`	1..1	Date–time of latest QoE metrics report included in or summarised by this collection.
sampleCount	`integer`	1..1	The number of QoE metrics reports included in or summarised by this collection. (Where summary records are included in the collection, the number of records in the collection differs from this number.)
streamingDirection	`Provisioning SessionType`	1..1	Collections of QoE metrics records only apply to downlink media streaming.
summarisations	`array(Data Aggregation Function Type)`	1..1	One or more of the following data aggregation functions (see clause 6.3.3.2 of TS 26.532 [49]) that have been applied to the UE data to produce summary records present in this collection with the semantics indicated in table 4.7.4.4-1 of TS 26.501 [2]: - *NULL* - *COUNT* - *MEAN* - *MINIMMUM* - *MAXIMUM* - *SUM*
records	`array(QoE Metrics Event)`	1..1	A set of zero or more QoE Metrics Event records, each one describing a QoE metrics report or summarising a set of QoE metrics reports. Empty when the *summarisations* property indicates that this collection describes only a count of UE data samples.

18.3.2 QoEMetricsEvent data type

QoEMetricsEvent is a concrete data type describing a set of, or summaries of, QoE metric samples of the same type.

Table 18.3.2-1: QoEMetricsEvent data type

Property name	Data Type	Cardinality	Description
recordType	`EventRecordType`	1..1	One of the following: - *INDIVIDUAL_SAMPLE* - *SUMMARY_MEAN* - *SUMMARY_MINIMMUM* - *SUMMARY_MAXIMUM* - *SUMMARY_SUM*
recordTimestamp	`DateTime`	1..1	For individual records, the date–time at which the parent QoE metrics report was generated by the Media Session Handler. Otherwise, the date–time at which the summary record was generated by the Data Collection AF instantiated in the 5GMS AF.

Property name	Data Type	Cardinality	Description
appId	ApplicationId	1..1	Identifying the application (see table 5.4.2-1 of TS 29.571 [12]) to which the UE data carried in this record pertains.
provisioningSessionId	ResourceId	0..1	The identifier of the Provisioning Session to which this record pertains. Present only for individual data sample *recordType*.
sessionId	MediaDeliverySessionId	0..1	A value that uniquely identifies the media streaming session to which this record pertains. Present only for individual data sample *recordType*.
ueIdentification	string	0..1	GPSI of the requesting UE or a stable globally unique string identifying the requesting Media Session Handler. Present only for individual data sample *recordType* and only when exposure is permitted by the data exposure restrictions in force.
dataNetworkName	Dnn	0..1	Identifying the Data Network of the M4 media streaming session. Present only for individual data sample *recordType*.
sliceId	Snssai	0..1	The S-NSSAI identifying the Network Slice of the M4 media streaming session. Present only for individual data sample *recordType*.
ueLocations	array(LocationArea5G)	0..1	The location(s) of the UE when the data described by this record was sampled. Present only for individual data sample *recordType* and only when exposure is permitted by the data exposure restrictions in force.
metricType	Uri	1..1	A fully-qualified term identifier that uniquely identifies the QoE metrics reporting scheme and the type of QoE metric included this record, as specified in clause E.2, up to but excluding the first hierarchical separator. For example, *urn:3GPP:ns:PSS:DASH:QM10#AvgThroughput*.
samples	array(object)	1..1	An ordered list of one or more samples of type *metricType* derived from a single QoE metrics report.
sampleTimestamp	DateTime	0..1	Where applicable for the metric indicated by *metricType*, the moment in time at which this QoE metric was sampled.
sampleDuration	Duration	0..1	Where applicable for the metric indicated by *metricType*, the time duration over which this QoE metric was sampled.
mediaTimestamp	Duration	0..1	Where applicable for the metric indicated by *metricType*, the time point (expressed relative to the start of the media streaming presentation) at which this QoE metric was sampled.
metrics	array(object)	1..1	A set of key–value pairs for the sampled metrics associated with this QoE metric sample.
key	string	1..1	A token that uniquely identifies metric subtype within the scope of the QoE metric type. For example: *numbytes*. There shall be at most one instance of this property's value in the parent array.
value	{}	0..1	A value (of any type) associated with the metric indicated by *key*.

18.4 Consumption reporting event notifications

18.4.1 ConsumptionReportingUnitsCollection data type

ConsumptionReportingUnitsCollection is a concrete data type describing a collection of consumption reporting event records.

Table 18.4.1-1: ConsumptionReportingUnitsCollection data type

Property name	Data Type	Cardinality	Description
collectionTimestamp	DateTime	1..1	The date–time at which this collection was exposed by the Data Collection AF as an event to its subscribed event consumers.
startTimestamp	DateTime	1..1	Date–time of earliest consumption reporting unit included in or summarised by this collection.
endTimestamp	DateTime	1..1	Date–time of latest consumption reporting unit included in or summarised by this collection.
sampleCount	integer	1..1	The number of consumption reporting units included in or summarised by this collection. (Where summary records are included in the collection, the number of records in the collection differs from this number.)
streamingDirection	ProvisioningSessionType	1..1	Collections of consumption reporting event records only apply to downlink media streaming.
summarisations	array(DataAggregationFunctionType)	1..1	One or more of the following data aggregation functions (see clause 6.3.3.2 of TS 26.532 [49]) that have been applied to the UE data to produce summary records present in this collection with the semantics indicated in table 4.7.4.5-1 of TS 26.501 [2]: - *NULL* - *COUNT*
records	array(ConsumptionReportingEvent)	1..1	A set of zero or more consumption reporting event records.

18.4.2 ConsumptionReportingEvent data type

ConsumptionReportingEvent is a concrete data type corresponding to a single consumption reporting unit.

Table 18.4.2-1: ConsumptionReportingEvent data type

Property name	Data Type	Cardinality	Description
recordType	EventRecordType	1..1	One of the following: - *INDIVIDUAL_SAMPLE*
recordTimestamp	DateTime	1..1	The date–time at which this consumption reporting unit began.
appId	ApplicationId	1..1	Identifying the application (see table 5.4.2-1 of TS 29.571 [12]) to which the UE data carried in this record pertains.
provisioningSessionId	ResourceId	1..1	The identifier of the Provisioning Session to which this record pertains.
sessionId	MediaDeliverySessionId	1..1	A value that uniquely identifies the media streaming session to which this record pertains.
ueIdentification	string	0..1	GPSI of the requesting UE or a stable globally unique string identifying the requesting Media Session Handler. Present only when exposure is permitted by the data exposure restrictions in force.
dataNetworkName	Dnn	1..1	Identifying the Data Network of the M4 media streaming session.
sliceId	Snssai	1..1	The S-NSSAI identifying the Network Slice of the M4 media streaming session.

Property name	Data Type	Cardinality	Description
ueLocations	array(Location Area5G)	0..1	The location(s) of the UE when the data described by this record was sampled. Present only when exposure is permitted by the data exposure restrictions in force.
unitDuration	Duration	1..1	The duration of this consumption reporting unit.
clientEndpoint Address	EndpointAddress	0..1	The endpoint address of the UE that consumed media. Present only if access reporting is enabled in the Consumption Reporting Configuration.
serverEndpoint Address	EndpointAddress	0..1	The endpoint address of the 5GMS AS from which media was consumed. Present only if access reporting is enabled in the Consumption Reporting Configuration.
mediaPlayerEntryUrl	AbsoluteUrl	1..1	The Media Player Entry URL to which this consumption reporting unit pertains.
mediaComponent Identifier	string	1..1	A token (e.g., an MPEG-DASH representation identifier) identifying the media component of the Media Player Entry that was consumed during this consumption reporting unit.

18.5 Network Assistance invocation event notifications

18.5.1 NetworkAssistanceInvocationsCollection data type

NetworkAssistanceInvocationsCollection is a concrete data type describing a collection of Network Assistance Invocation Event records.

Table 18.5.1-1: NetworkAssistanceInvocationsCollection data type

Property name	Data Type	Cardinality	Description
collectionTimestamp	DateTime	1..1	The date–time at which this collection was exposed by the Data Collection AF as an event to its subscribed event consumers.
startTimestamp	DateTime	1..1	Date–time of earliest Network Assistance invocation included in or summarised by this collection.
endTimestamp	DateTime	1..1	Date–time of latest Network Assistance invocation included in or summarised by this collection.
sampleCount	integer	1..1	The number of Network Assistance invocations included in or summarised by this collection. (Where summary records are included in the collection, the number of records in the collection differs from this number.)
streamingDirection	ProvisioningSessionType	1..1	Indicating whether this collection of Network assistance invocation records relates to downlink media streaming sessions or to uplink media streaming sessions.
summarisations	array(DataAggregationFunctionType)	1..1	One or more of the following data aggregation functions (see clause 6.3.3.2 of TS 26.532 [49]) that have been applied to the UE data to produce summary records present in this collection with the semantics indicated in table 4.7.4.7-1 of TS 26.501 [2]: - *NULL* - *COUNT* - *MEAN* - *MINIMMUM* - *MAXIMUM*
records	array(NetworkAssistanceInvocationEvent)	1..1	A set of zero or more Network Assistance invocation records.

18.5.2 NetworkAssistanceInvocationEvent data type

NetworkAssistanceInvocationEvent is a concrete data type describing a single invocation of the Network Assistance API (see clause 11.6).

Table 18.5.2-1: NetworkAssistanceInvocationEvent data type

Property name	Data Type	Cardinality	Description
recordType	`EventRecordType`	1..1	One of the following: - *INDIVIDUAL_SAMPLE* - *SUMMARY_MEAN* - *SUMMARY_MINIMMUM* - *SUMMARY_MAXIMUM*
recordTimestamp	`DateTime`	1..1	For individual records, the date–time at which Network Assistance was invoked by the Media Session Handler. Otherwise, the date–time at which the summary record was generated by the Data Collection AF instantiated in the 5GMS AF.
appId	`ApplicationId`	1..1	Identifying the application (see table 5.4.2-1 of TS 29.571 [12]) to which the UE data carried in this record pertains.
provisioningSessionId	`ResourceId`	0..1	The identifier of the Provisioning Session to which this record pertains. Present only for individual data sample *recordType*.
sessionId	`MediaDelivery SessionId`	0..1	A value that uniquely identifies the media streaming session to which this record pertains. Present only for individual data sample *recordType*.
ueIdentification	`string`	0..1	GPSI of the requesting UE or a stable globally unique string identifying the requesting Media Session Handler. Present only for individual data sample *recordType* and only when exposure is permitted by the data exposure restrictions in force.
dataNetworkName	`Dnn`	0..1	Identifying the Data Network of the M4 media streaming session. Present only for individual data sample *recordType*.
sliceId	`Snssai`	0..1	The S-NSSAI identifying the Network Slice of the M4 media streaming session. Present only for individual data sample *recordType*.
ueLocations	`array(Location Area5G)`	0..1	The location of the UE when Network Assistance was sought. If present, the array shall contain exactly one location for the Network Assistance invocation. Present only for individual data sample *recordType* and only when exposure is permitted by the data exposure restrictions in force.

Property name	Data Type	Cardinality	Description
networkAssistance Type	`Network AssistanceType`	1..1	The type of Network Assistance solicited by the Media Session Handler (see table 18.5.2-2).
policyTemplateId	`ResourceId`	0..1	Identifying the Policy Template (if any) referenced by the Media Session Handler in the parent Network Assistance Session.
serviceDataFlow Descriptions	`array(Service DataFlow Description)`	0..1	If present, a set of one or more Service Data Flow Descriptions (see clause 6.4.3.1) to which the Network Assistance session has been applied. Present only for individual data sample *recordType* and only when exposure is permitted by the data exposure restrictions in force.
requestedQoS	`Unidirectional QoSSpecification`	0..1	The network QoS parameters (if any) requested by the Media Session Handler from the 5GMS AF in the parent Network Assistance Session or from the RAN (see clause 6.4.3.13).
recommendedQoS	`object`	0..1	The network QoS parameters (if any) recommended to the Media Session Handler by the 5GMS AF in the parent Network Assistance Session or by the RAN.
maximumBitRate	`BitRate`	1..1	The maximum recommended bit rate.
minimumBitRate	`BitRate`	1..1	The minimum recommended bit rate.

Table 18.5.2-2: NetworkAssistanceType enumeration

Enumeration value	Description
AF_THROUGHPUT_ESTIMATION	Throughput estimation (bit rate recommendation) sought from the 5GMS AF.
AF_DELIVERY_BOOST	Delivery boost sought from the 5GMS AF.
ANBR_THROUGHPUT_ESTIMATION	Throughput estimation (bit rate recommendation) sought from the RAN.
ANBR_DELIVERY_BOOST	Delivery boost sought from the RAN.

18.6 Dynamic policy invocation event notifications

18.6.1 DynamicPolicyInvocationsCollection data type

DynamicPolicyInvocationsCollection is a concrete data type describing a collection of Dynamic Policy Invocation records.

Table 18.6.1-1: DynamicPolicyInvocationsCollection data type

Property name	Data Type	Cardinality	Description
collectionTimestamp	DateTime	1..1	The date–time at which this collection was exposed by the Data Collection AF as an event to its subscribed event consumers.
startTimestamp	DateTime	1..1	Date–time of earliest dynamic policy invocation included in or summarised by this collection.
endTimestamp	DateTime	1..1	Date–time of latest dynamic policy invocation included in or summarised by this collection.
sampleCount	integer	1..1	The number of dynamic policy invocations included in or summarised by this collection. (Where summary records are included in the collection, the number of records in the collection differs from this number.)
streamingDirection	ProvisioningSessionType	1..1	Indicating whether this collection of dynamic policy invocation records relates to downlink media streaming sessions or to uplink media streaming sessions.
summarisations	array(DataAggregationFunctionType)	1..1	One or more of the following data aggregation functions (see clause 6.3.3.2 of TS 26.532 [49]) that have been applied to the UE data to produce summary records present in this collection with the semantics indicated in table 4.7.4.6-1 of TS 26.501 [2]: - *NULL* - *COUNT*
records	array(DynamicPolicyInvocationEvent)	1..1	A set of zero or more dynamic policy invocation event records.

18.6.2 DynamicPolicyInvocationEvent data type

DynamicPolicyInvocationEvent is a concrete data type describing a single invocation of the Dynamic Policies API (see clause 11.5).

Table 18.6.2-1: DynamicPolicyInvocationEvent data type

Property name	Data Type	Cardinality	Description
recordType	EventRecordType	1..1	One of the following: - *INDIVIDUAL_SAMPLE*
recordTimestamp	DateTime	1..1	The date–time at which the dynamic policy was invoked by the Media Session Handler.
appId	ApplicationId	1..1	Identifying the application (see table 5.4.2-1 of TS 29.571 [12]) to which the UE data carried in this record pertains.
provisioningSessionId	ResourceId	1..1	The identifier of the Provisioning Session to which this record pertains.
sessionId	MediaDeliverySessionId	1..1	A value that uniquely identifies the media streaming session to which this record pertains.
ueIdentification	string	0..1	GPSI of the requesting UE or a stable globally unique string identifying the requesting Media Session Handler. Present only when exposure is permitted by the data exposure restrictions in force.

Property name	Data Type	Cardinality	Description
dataNetworkName	Dnn	1..1	Identifying the Data Network of the M4 media streaming session.
sliceId	Snssai	1..1	The S-NSSAI identifying the Network Slice of the M4 media streaming session.
ueLocations	array(Location Area5G)	0..1	The location of the UE when the dynamic policy was invoked. If present, the array shall contain exactly one location for the dynamic policy invocation. Present only when exposure is permitted by the data exposure restrictions in force.
policyTemplateId	ResourceId	1..1	Identifying the Policy Template instantiated by the Media Session Handler.
applicationFlow Descriptions	array(ApplicationFlow Description)	0..1	If present, a set of one or more Application Flow Descriptions (see clause 7.3.3.2 of TS 26.510 [56]) to which the dynamic policy has been applied. Present only when exposure is permitted by the data exposure restrictions in force.
requestedQoS	Unidirectional QoSSpecification	0..1	The network QoS parameters (if any) requested by the Media Session Handler when instantiating the Policy Template (see clause 6.4.3.13).
enforcementMethod	string	1..1	The policy enforcement method indicated by the 5GMS AF.
enforcementBitRate	BitRate	1..1	The enforcement bit rate indicated by the 5GMS AF.

18.7 Media streaming access event notifications

18.7.1 MediaStreamingAccessesCollection data type

MediaStreamingAccessesCollection is a concrete data type describing a collection of Media Streaming Access Event records.

Table 18.7.1-1: MediaStreamingAccessesCollection data type

Property name	Data Type	Cardinality	Description
collectionTimestamp	DateTime	1..1	The date–time at which this collection was exposed by the Data Collection AF as an event to its subscribed event consumers.
startTimestamp	DateTime	1..1	Date–time of earliest media streaming access event record included in or summarised by this collection.
endTimestamp	DateTime	1..1	Date–time of latest media streaming access event record included in or summarised by this collection.
sampleCount	integer	1..1	The number of media streaming access event records included in or summarised by this collection.
streamingDirection	Provisioning SessionType	1..1	Indicating whether this collection of media streaming access event records relates to downlink media streaming sessions or to uplink media streaming sessions.
summarisations	array(Data Aggregation Function Type)	1..1	One or more of the following data aggregation functions (see clause 6.3.3.2 of TS 26.532 [49]) that have been applied to the UE data to produce summary records present in this collection with the semantics indicated in table 4.7.4.8-1 of TS 26.501 [2]: - *NULL* - *COUNT*
records	array(Media Streaming AccessEvent)	1..1	A set of zero or more media streaming access event records.

18.7.2 MediaStreamingAccessEvent data type

MediaStreamingAccessEvent is a concrete data type describing a single media access by a Media Stream Handler.

Table 18.7.2-1: MediaStreamingAccessEvent data type

Property name	Data Type	Cardinality	Description
recordType	`EventRecordType`	1..1	One of the following: - *INDIVIDUAL_SAMPLE*
recordTimestamp	`DateTime`	1..1	The date–time at which media was accessed by the Media Stream Handler (Media Player or Media Streamer).
appId	`ApplicationId`	1..1	Identifying the application (see table 5.4.2-1 of TS 29.571 [12]) to which the UE data carried in this record pertains.
provisioningSessionId	`ResourceId`	1..1	The identifier of the Provisioning Session to which this record pertains.
sessionId	`MediaDelivery SessionId`	1..1	A value that uniquely identifies the media streaming session to which this record pertains.
ueIdentification	`string`	0..1	GPSI of the requesting UE or a stable globally unique string identifying the requesting Media Session Handler. Present only when exposure is permitted by the data exposure restrictions in force.
dataNetworkName	`Dnn`	1..1	Identifying the Data Network of the M4 media streaming session.
sliceId	`Snssai`	1..1	The S-NSSAI identifying the Network Slice of the M4 media streaming session.
ueLocations	`array(Location Area5G)`	0..1	The location of the UE when the media was accessed. If present, the array shall contain exactly one location for the media streaming access. Present only when exposure is permitted by the data exposure restrictions in force.
mediaStreamHandler EndpointAddress	`EndpointAddress`	1..1	The endpoint address of the Media Stream Handler accessing the 5GMS AS. (See clause 6.4.3.8.)
applicationServer EndpointAddress	`EndpointAddress`	1..1	The service endpoint on the 5GMS AS to which the Media Stream Handler is connected. (See clause 6.4.3.8.)
requestMessage	`Object`	1..1	Details of the HTTP request message submitted to the 5GMS AS by the Media Stream Handler for this media access.
method	`string`	1..1	The request method.
url	`AbsoluteUrl`	1..1	The request URL. (See table 6.4.2-1.)
protocolVersion	`string`	1..1	The HTTP protocol version, e.g., "HTTP/1.1".
range	`string`	0..1	The value of the `Range` request header, if present.
size	`Uinteger`	1..1	The total number of bytes in the request message.
bodySize	`Uinteger`	1..1	The number of bytes supplied by the Media Stream Handler in the HTTP request message body. Zero if there is no request body.
contentType	`string`	0..1	The MIME content type of the request message, if any.
userAgent	`string`	0..1	A string describing the requesting Media Stream Handler, if it supplies a `User-Agent` request header.
userIdentity	`String`	0..1	A string identifying the user that made the access, if supplied.
referer	`AbsoluteUrl`	0..1	The URL that the Media Player reports being referred from, if the `Referer` request header is supplied. (See table 6.4.2-1.)

Property name	Data Type	Cardinality	Description
cacheStatus	CacheStatus	0..1	An indication of whether the 5GMS AS is able to serve an object corresponding to *requestMessage,url* from cache (*HIT*) or whether there is a stale object cached (*EXPIRED*) or the requested object is not present in cache (*MISS*). (See table 6.4.4.4.) For non-caching implementations of the 5GMS AS, the property shall be omitted.
responseMessage	Object	1..1	Details of the HTTP response message returned by the 5GMS AS to the Media Stream Handler for this media access.
responseCode	Uinteger	1..1	The HTTP response code.
size	Uinteger	1..1	The total number of bytes in the response message.
bodySize	Uinteger	1..1	The number of bytes in the HTTP response message body.
contentType	string	0..1	The MIME content type of response message, if any.
processingLatency	Float	1..1	The time, expressed in milliseconds, taken by the 5GMS AS to respond to the Media Stream Handler request, measured from the first byte of the HTTP request being processed by the 5GMS AS to the last byte of the response being sent.
connectionMetrics	Object	0..1	Metrics about the performance of the transport connection underlying the HTTP session serving this media access.
meanNetwork RoundTripTime	Float	1..1	A rolling mean average, expressed in milliseconds, of the network round-trip time for the HTTP session.
networkRoundTrip TimeVariation	Float	1..1	The variation in *meanNetworkRoundTripTime*, expressed in milliseconds, during the averaging period.
congestion WindowSize	Uinteger	1..1	The current size (in bytes) of the congestion window for the transport connection underlying the HTTP session.

Annex A (informative): 5GMS Parameter propagation for DASH Streaming

A.1 End-to-end model

Figure A.1-1 below depicts an end-to-end model for the 5GMS parameter propagation for DASH streaming with dynamic policy. The arrows indicate the main information flow. The interfaces specified in TS 26.501 [2] are used throughout. However, there are additional interfaces (i.e. P1 or U1), which are not in the 5GMS Architecture.

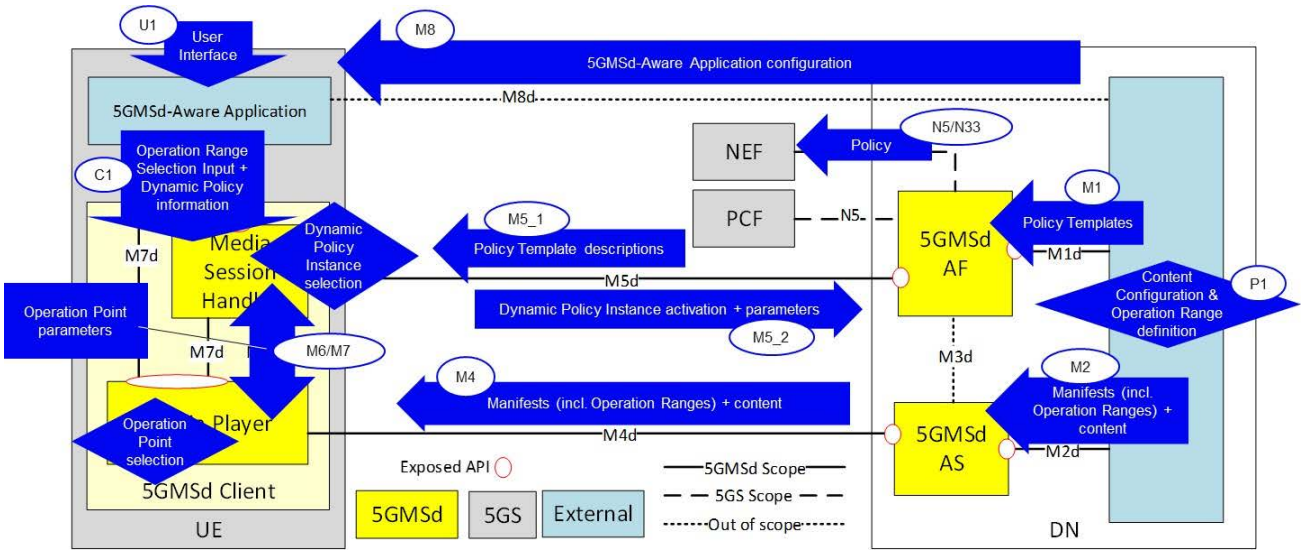

Figure A.1-1: End-to-end model for dynamic policy parameter propagation

The interfaces involved and their roles in this feature are as follows:

- M1: Provisioning interface between the 5GMS Application Provider and the 5GMS AF.
- P1: The 5GMS Application Provider provisions the DASH MPD generator, e.g. by annotating the MPD with Service Descriptions.
- U1: User Interface to the 5GMS-Aware Application.

NOTE: The 5GMS Application Provider controls the application, i.e. controls the GUI choices.

- M8: Non-standardized input from the 5GMS Application Provider to the 5GMS-Aware Application, such as country-specific application behaviours (languages, on-demand catalogue, etc).
  - Input on subscriptions (e.g. 4K subscription versus SD subscription).
  - Device-specific content selection rules (e.g. Smartphone versus Smart TV).
  - Additional service offering features (e.g. background download possible).
- C1 (one of M6 or M7): Information from the 5GMS-Aware Application to the 5GMS Client, e.g. user content selections.
- M6: Information flow from the DASH Player to the Media Session Handler.
- M7: Information flow from the Media Session Handler to the DASH Player.
- M5_1: Information flow into the Media Session Handler for parameter provisioning (Policy Descriptions, which originate from 5GMS AF and 5GMS Application Provider). The Policy Descriptions contain or reference the detailed Service Access Information, i.e. URLs to activate a certain policy.

- M5_2: Information flow from the Media Session Handler to the 5GMS AF. This includes:
  - input to create the Service Data Flow Templates (see TS 23.503 [33]) for identifying the application data flows within a PDU Session,
  - an identifier for the Dynamic Policy instance (e.g. QoS, Conditional Zero-rating, charging, etc) and
  - optionally, Network Assistance information, e.g. bit rate recommendations.

In its Annex K, the DASH standard [32] specifies so-called "Service Descriptions". The purpose of Service Descriptions is to provide additional information to a DASH player to influence its "Selection Logic", e.g. a DASH player should prefer a certain set of representations within an adaptation set. It is assumed in the following that the DASH MPD can be annotated using Service Descriptions to give hints for subscription models and different device types.

The 5G System specifies a number of different means to detect application flows. When activating a Dynamic Policy, the Media Session Handler provides a Service Data Flow Template to the 5GMS System, which identifies the application flow(s) of interest. It is assumed here that multiple applications are executing simultaneously on a given UE and that each application may independently access the network. Therefore, the Media Session Handler needs to provide (and update) these Service Data Flow Templates in order that the application traffic can be treated according to the corresponding Dynamic Policy.

In the following clauses, the parameter propagation for a number of different use cases is described.

A.2 Premium QoS dynamic policy

A.2.1 General

To realise a Premium QoS service offering, the 5GMS Client should activate a QoS Flow with characteristics matching the service needs. It is assumed that the DASH content is prepared for different subscription levels, e.g. 4K, HDR or SD, and for different target device types, e.g. SmartPhone or SmartTV. When commencing playback of a DASH presentation according to a particular subscription level (e.g. 4K), the 5GMS Client needs to activate a QoS Flow with a matching bit rate setting.

NOTE: The 5GMS Client may choose to activate a QoS Flow with a lower bit rate than the maximum supported by the 5G System, e.g. a small screen Smartphone may select different QoS settings from a large screen device.

The per-title quality and the subscription levels of an example on-demand catalogue are illustrated in the figure below. The subscription levels in this example are 4K, FullHD, HD, SD and 480p. Only devices entitled to activate a 4K quality should actually select the according representations from the MPDs. In this example, all titles are available in SD and HD quality. Often, not all titles are available in 4K quality. Thus, a device with a 4K subscription can only activate reception of the HD or SD representations.

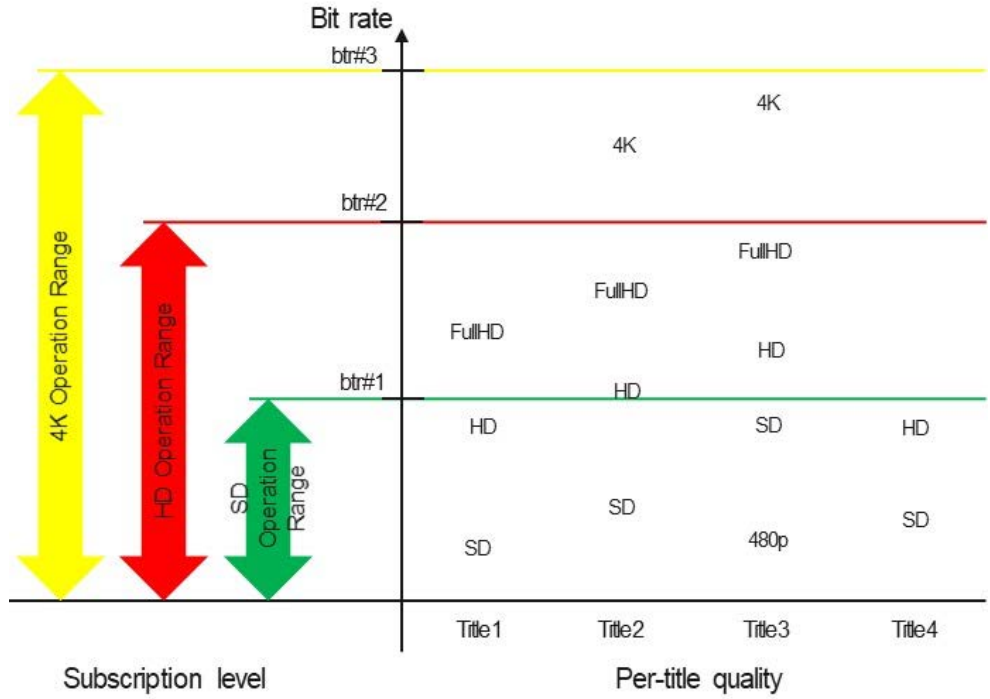

Figure A.2.1-1: Subscription Levels for Premium QoS

The bit rate required to sustain a certain quality varies from title to title. In the figure, the bit rate needed for *Title4* in HD is in the same range as SD quality of *Title3*.

The various consumer-facing Network Subscription Levels define a set of bounded Operation Ranges, as illustrated on the right side of the figure. Each such Operation Range is conveniently modelled in the 5GMS architecture as a Policy Template. The Policy Template for SD subscription level (*SD Operation Range*) is authorized to activate a maximal bit rate of *btr#1*. The Policy Template for 4K subscription level is authorized to activate between any low bit rate and a maximal bit rate of *btr#3*.

When activating a Dynamic Policy instance, the 5GMSd Client provides a desired bit rate for the selected title. The desired bit rate can be smaller than the maximal bit rate allowed by the Policy Template. The 5GMSd Client always activates a Dynamic Policy instance from its assigned Network Subscription Level, even when the desired bit rate justifies a different Policy Template.

When activating a QoS Flow for a certain subscription level and title, the 5GMSd Client should preferably select a desired bit rate matching the quality needed. For example, a device with an *HD Operation Range* subscription needs a higher desired bit rate when consuming *Title3* in HD quality and a lower desired bit rate when consuming *Title4* in HD quality.

In some cases, the system rejects a requested QoS Flow or drops an established QoS Flow due to insufficient available network resource. The 5GMSd Client can then try to activate a different QoS Flow with a lower desired bit rate.

A.2.2 Procedure

The procedure for activating a Premium QoS dynamic policy is illustrated in figure A.2.2-1 below.

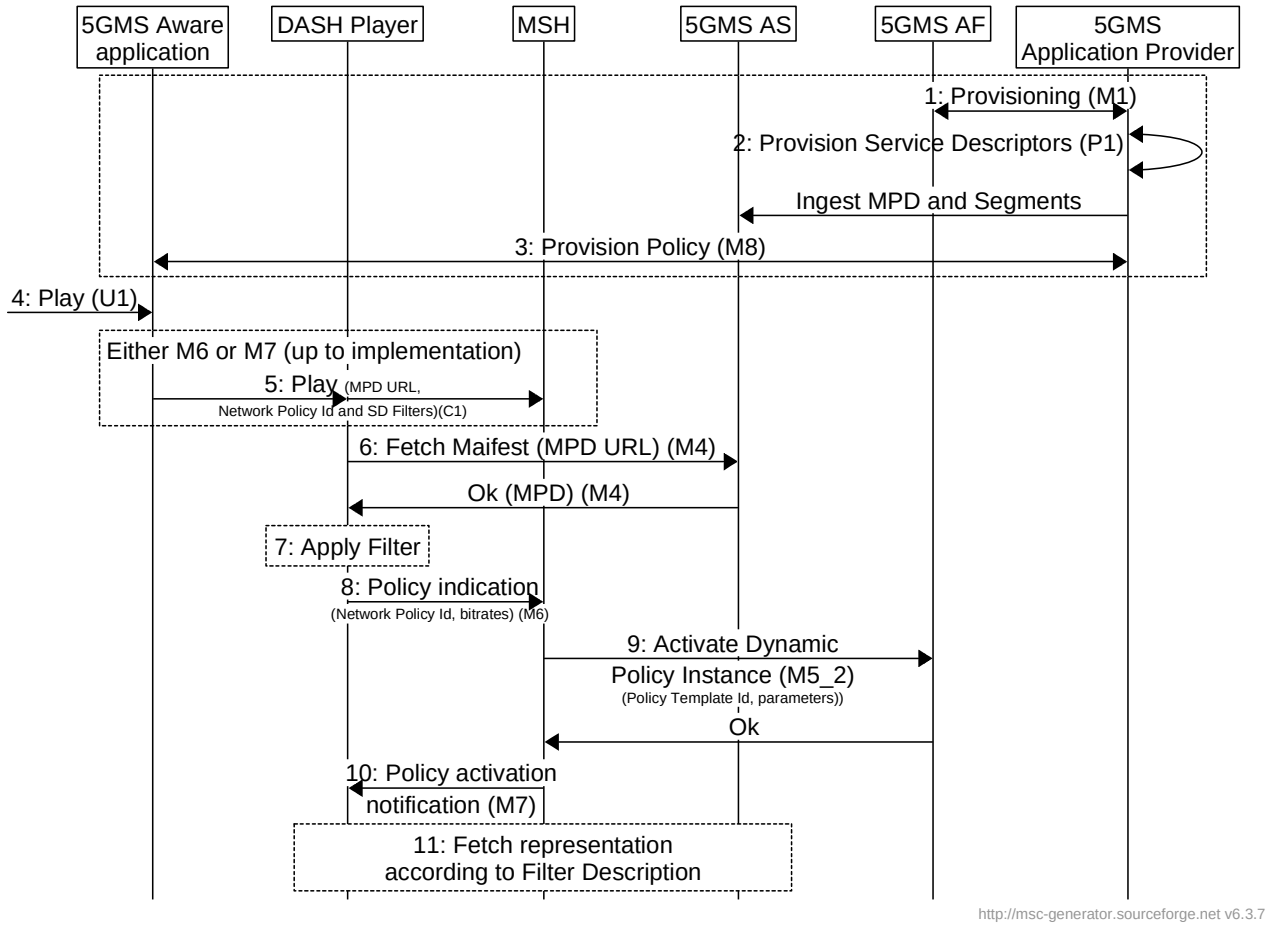

Figure A.2.2-1: Procedure for activating Premium QoS dynamic policy

Steps:

1. The 5GMS Application Provider interacts with the 5GMS AF to set up one or more Policy Templates (using M1). Each Policy Template is identified by a Policy Template identifier and contains information about how to activate the corresponding policy within the 5G System (e.g. N5 URLs and parameters).

2. The 5GMS Application Provider interacts with its DASH content generation function (e.g. an MPD provider) to annotate the DASH MPD with Service Descriptions (using P1). The Service Descriptions define the Operational Ranges within the Media Player should operate. The DASH MPD and the DASH Media Segments are then ingested by the 5GMS AS.

3. The 5GMS-Aware Application is configured via M8 (step 3) with information about the available content catalogue (e.g. resolving MPD URLs), the available subscription identifiers (e.g. the user has a 4K subscription or the user has an SD subscription), device type identifiers and network policy identifiers.

   The subscription identifiers and the device type identifiers are collectively referred to as Service Description Filters in the following.

NOTE 1: It is for further study whether network policy identifiers are embedded in the MPD Service Descriptions or derived from the Service Descriptions.

NOTE 2: The network policy identifier can be equal to a Policy Template identifier when the 5GMS-Aware Application is aware about its usage (e.g. for QoS streaming or background download). It is assumed here, that a unique Network Policy identifier is assigned to each subscription level.

4. When the user selects an item via the User Interface (U1), the 5GMS-Aware Application translates the input to the needed 5GMSd API calls.

5. The 5GMS-Aware Application provides input (via C1) on the selected presentation entry (i.e. MPD URL) together with a Network Policy Identifier (the value indicates here a "HD Premium QoS" policy (alternative Network Policy Identifiers can refer to e.g. 4K quality), i.e. make the Media Session Handler request a QoS Flow) and Service Description Filters. The Service Description Filter is used by the Media Player to identify the usable Service Descriptions from the MPD. The Network Policy Identifier is used by the Media Session Handler to find the according Policy Description containing information on the Dynamic Policy instantiation method (i.e. procedure and parameters such as Policy Template identifier).

6. The DASH player fetches the MPD.

7. The Media Player selects the Service Description and applies the Service Description Filter.

8. The DASH player indicates to the Media Session Handler (M6) that a "HD Premium QoS" network service should be activated (value of the Network Policy Identifier). The DASH player provides input on bit rate ranges (which may depend on the device type and the title quality). The Media Session Handler has received one or more Policy Descriptions together with matching Service Access Information (via M5_1). When the Media Session Handler has received the policy indication, the Media Session Handler uses the Network Policy Identifier to find the procedure and the parameters to activate the Dynamic Policy instance (i.e. find the matching Policy Description). The Media Session Handler activates a Dynamic Policy instance in the 5GMS AF, providing Service Data Flow Templates identifying the DASH media flows (audio, video, etc) and to provide the desired bit rate of the video.

9. The Media Session Handler activates a Dynamic Policy instance with the 5GMS AF. The 5GMS AF uses the Policy Template identifier to look up the matching Policy Template in order to create the PCF or NEF API invocation. As result, the Media Session Handler receives the enforcement bit rate in the 5GMS AF response. The 5GMS Client should not exceed this bit rate threshold.

   The Service Access Information (via M5_1) includes a list of recommended traffic detection methods. The Media Session Handler selects a Service Data Flow description method (e.g. 5-Tuples). When the Media Session Handler selects:

   - 5-Tuples: For each new TCP connection, the Media Session Handler updates the Dynamic Policy instances and adds a new 5-Tuple. For each closed TCP connection, the Media Session Handler updates the Dynamic Policy instances and removes the 5-Tuple of the closed TCP connection.

   - TOS or Traffic Class: The Media Session Handler sets the TOS or Traffic Class for each new TCP connection.

   - Domain name: The Media Session Handler provides the domain name with the Dynamic Policy Instance.

A.2.3 Example parameters

Table A.2.3-1: M5_1 parameters for Policy Descriptions (used by the Media Session Handler)

Parameter	Type	Purpose	Example Values
Policy Description	Object		
Network Policy Identifier	String	Identifies the Policy Description.	"4K Premium QoS", "HD Premium QoS".
Service Access Information URL	URL	References the associated Service Access Information.	

Table A.2.3-2: M5_1 parameters for Service Access Information

Parameter	Type	Purpose	
Service Access Information	Object		
Policy Template identifier	String	Identifies the Policy Template.	"HD QoS".
5GMS AF URL	URL	Used to invoke the 5GMS AF.	
Mandatory Request M5 information	List	Desired bit rate, which should be provided by the network for the application.	Policy Template identifier, Desired Bit Rate, Packet Detection Filters.
M5 Response information	List	Information to the Media Session Handler on the response parameters.	OK (requested bit rate is accepted), Proposed Lower Bit rate (requested bit rate cannot be provided).
sdfMethod	[String]	Indicates which Service Data Flow Description methods are recommended to be used by the Media Session Handler.	"5-Tuple", "domainName", "TOS=xx", etc.

A.3 (Conditional) Zero Rating dynamic policy

A.3.1 General

In the case of (Conditional) Zero Rating, the quality of a video streaming service should not exceed a certain bit rate threshold (called the policy threshold). This can be realized by deploying a traffic shaper in the network (e.g. a policing function in the UPF) or by instructing the DASH Player not to exceed a certain policy threshold bit rate. The policy threshold may be network-specific, i.e. depending on the 5G System. The following realization assumes the latter, i.e. the DASH Player is not exceeding the bit rate policy and the UPF is just monitoring the compliance of the application flows (one or more TCP and/or UDP flows). The MPD is annotated using DASH Service Descriptions in such a way that the DASH Player can identify which maximal representation bit rates still comply with the policy threshold.

Figure A.3.1-1 below illustrates the per-title quality and the policy threshold. For *Title1* and *Title2*, the 5GMSd Client can activate the SD and HD representations. For *Title3*, the 5GMSd Client can activate the 480p and the SD representations. For *Title4*, the 5GMSd Client can activate all available representations (i.e. SD and HD).

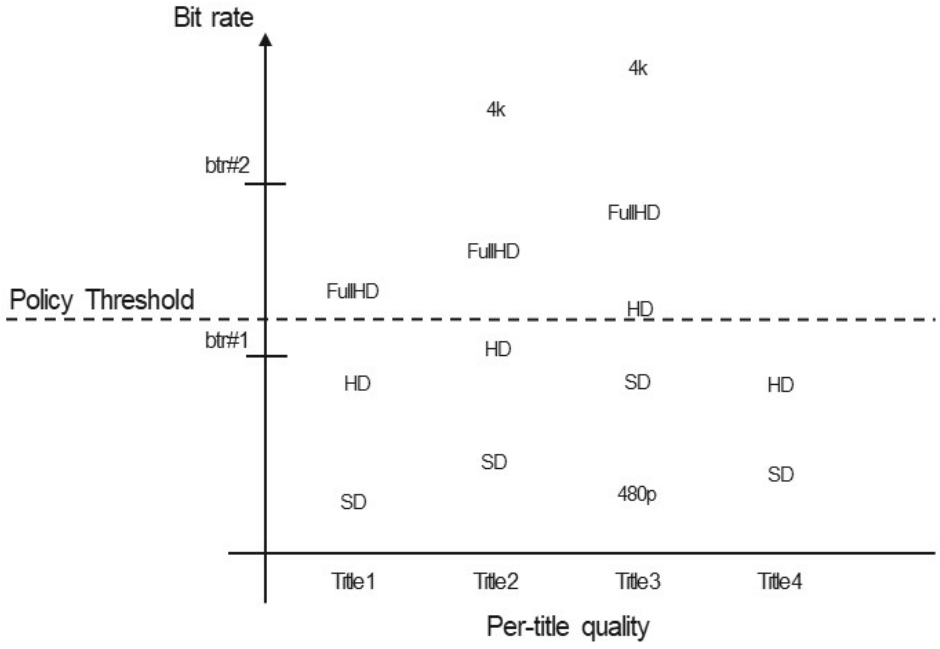

Figure A.3.1-1: Policy threshold versus quality

When the 5GMSd Client receives the bit rate of the policy threshold from the network, the 5GMSd Client filters the MPD for policy-compliant representations (i.e. those that lie at or below the policy threshold).

A.3.2 Procedure

The procedure for activating a (Conditional) Zero Rating dynamic policy is illustrated in figure A.3.2-1 below.

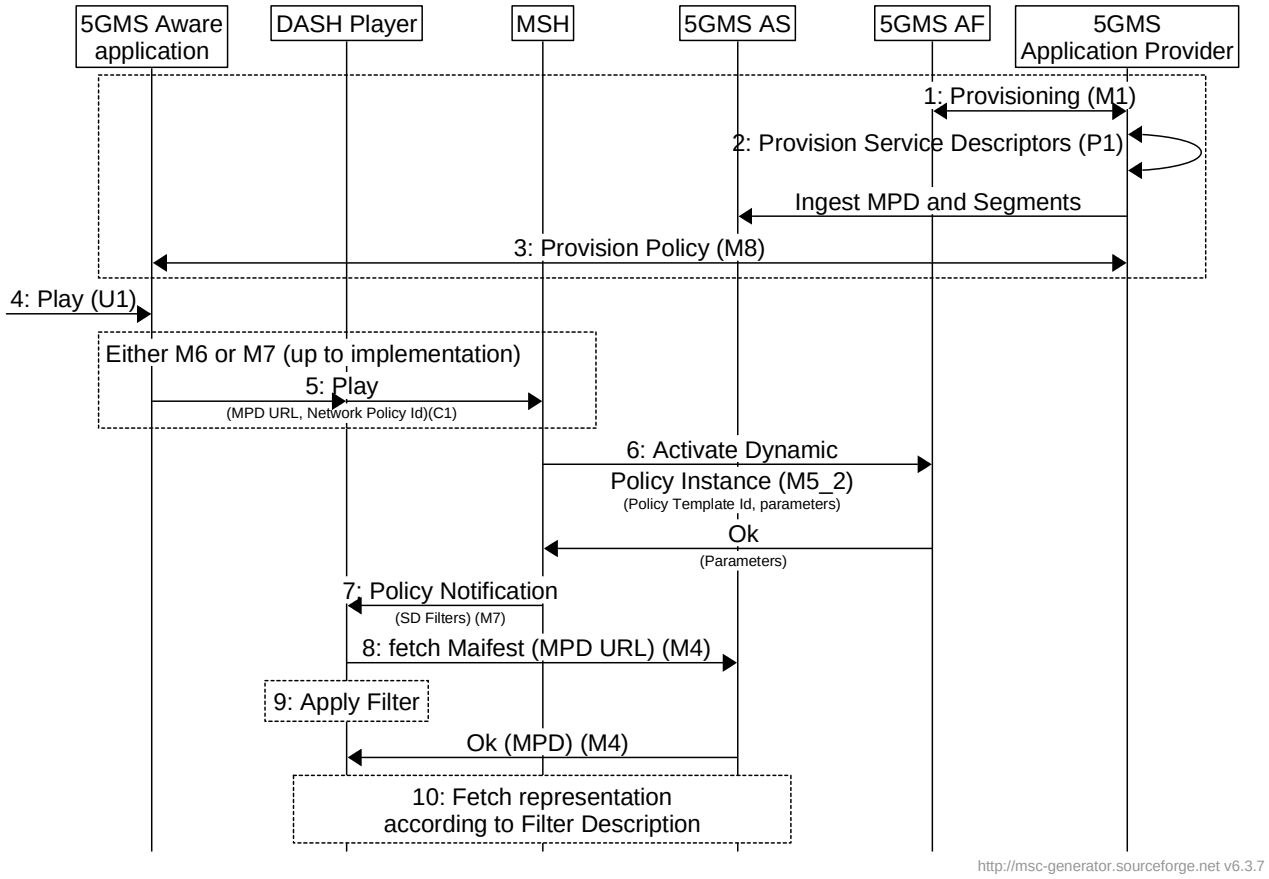

Figure A.3.2-1: Procedure for activating (Conditional) Zero Rating dynamic policy

Steps:

1. The 5GMS Application Provider interacts with the 5GMS AF to set up one or more Policy Templates. Each Policy Template is identified by a Policy Template identifier and contains information about how to activate the corresponding policy within the 5G System (e.g. N5 URLs and parameters).

2. The 5GMS Application Provider interacts with its DASH content generation function (e.g. an MPD provider) to annotate the DASH MPD with Service Descriptions (step 2). The intention of the Service Descriptions here is that the DASH Player can identify those representation combinations which do not exceed the bit rate requirement.

3. The 5GMSAware Application is configured via M8 with information about the available content catalogue (e.g. resolving MPD URLs), the available subscription identifiers (e.g. the user has a 4K content subscription or the user has an SD subscription), device type identifiers.

   The 5GMSd-Aware Application is configured via M8 about the available (Conditional) Zero Rating policy. This includes the Network Policy Ids.

4. When a user selects an item via the User Interface (U1), the 5GMS-Aware Application translates the input to the needed 5GMSd API calls.

5. The 5GMS Aware Application provides input (via C1) on the selected presentation entry (i.e. MPD URL) and also on the Network Policy Id (the value in this case indicates a (Conditional) Zero-Rating policy, i.e. make the Media Session Handler request the policy threshold parameter from the network).

NOTE: C1 is an abstract interface and indicates that the 5GMS-Aware Application may either first use M6 or M7 for the interactions with the 5GMS Client.

6. The Media Session Handler uses the Network Policy Identifier to find the procedure and the parameters to activate the Dynamic Policy Instance (here a (Conditional) Zero Rating policy). The Media Session Handler has received one or more Policy Descriptions together with matching Service Access Information (via M5_1). The Media Session Handler uses the Network Policy Identifier as a key to find the correct Policy Description. Here, the Network Policy Identifier indicates a (Conditional) Zero Rating policy. The Media Session Handler should activate a dynamic policy in the 5GMS AF, providing Service Data Flow Template information about the DASH media flows (audio, video, etc.) and retrieving the bit rate threshold, which cannot be exceeded to comply with the policy. The Media Session Handler receives (as result of the Dynamic Policy activation) some information on the policy enforcement (*enforcementMethod* and/or *enforcementBitrate*), so that the representation selection logic (bit rate adaptation function) in the DASH Player can consider the effects of the enforcement scheme.

7. The Media Session Handler activates the Dynamic Policy instance on M5, providing a Policy Template identifier. Upon positive response, the Media Session Handler notifies the DASH Player, providing Service Descriptor Filters. The Media Session Handler may receive these Service Descriptor Filters with the response, or it may look up the Service Descriptor Filter values by a response value. Alternatively, the Media Session Handler receives a maximum bit rate with the response and the Media Session Handler derives the Service Descriptor Filter. The Media Session Handler may also receive information about Policy Enforcement, e.g. what type of traffic shaper will throttle the bit rate.

   The Media Session Handler may need to update the Dynamic Policy instance, depending on the selected traffic detection method. For example, when the Media Session Handler uses 5-Tuples, the Media Session Handler needs to update the Dynamic Policy instance with every newly opened and every closed TCP connection.

8. The DASH Player fetches the MPD of the selected content.

9.The Service Descriptor Filter is used by the DASH Player to filter policy-compliant Service Descriptions from the MPD. The DASH Access Engine or Selection Logic (see ISO/IEC 23009-1 [32] figure K.1) selects only adaptation sets and representations according to the filter. Here, the DASH Player fetches the MPD after the notification from the Media Session Handler.

A.3.3 Example parameters

Table A.3.3-1: M5_1 parameters for Policy Descriptions (used by the Media Session Handler)

Parameter	Type	Purpose	Example Values
Policy Description	Object		
Network Policy Id	String	Identifies the Policy Description.	"(Conditional) Zero Rating".
Service Access Information URL	URL	References the associated Service Access Information.	

Table A.3.3.-2: M5_1 parameters for Service Access Information

Parameter	Type	Purpose	
Service Access Information	Object		
Policy Template Id	String	Identifies the Policy Template.	"not exceed bit rate"
5GMS AF URL	URL	Used to invoke the 5GMS AF.	
sdfMethods	[String]	Indicates which Service Data Flow Description methods are recommended for use by the Media Session Handler.	"5-Tuple", "domainName", "TOS=xx", etc.
Mandatory M5 Request information	List		Policy Template identifier, Service Data Flow Template.
M5 Response information	List	Information to the Media Session Handler on the response parameters.	Bit rate Policy Threshold (upper bit rate bound, which should not be exceeded).

A.4 Background Download

A.4.1 General

In the case of Background Download, the asset is acquired in the background, prior to viewing. Many application services offer the capability of acquiring a VoD item for later consumption. The 5GMS-Aware Application triggers the Media Session Handler to acquire the item, providing a background download network policy id.

NOTE: Here, the DASH Player is handling the acquisition, since the DASH Player contains the MPD processing and the DASH Access engine parts. Other realizations would use a separate background download agent, which is not even try to decode and render the video.

Figure A.4.1-1 below illustrates the representation marking for background download. The MPD may be annotated with Service Descriptions clearly identifying representations intended for download. Here, *Title1* should be downloaded in Full HD quality and all other titles in regular HD quality.

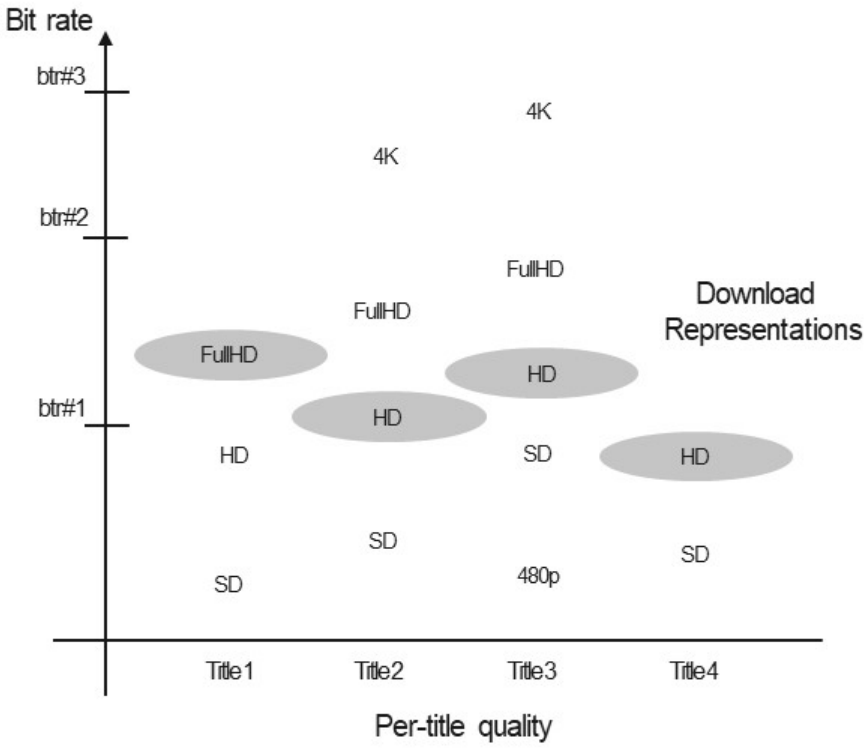

Figure A.4.1-1: Background Download Representations

A.4.2 Procedure

The procedure for activating a Background Download dynamic policy is illustrated in figure A.3.2-1 below.

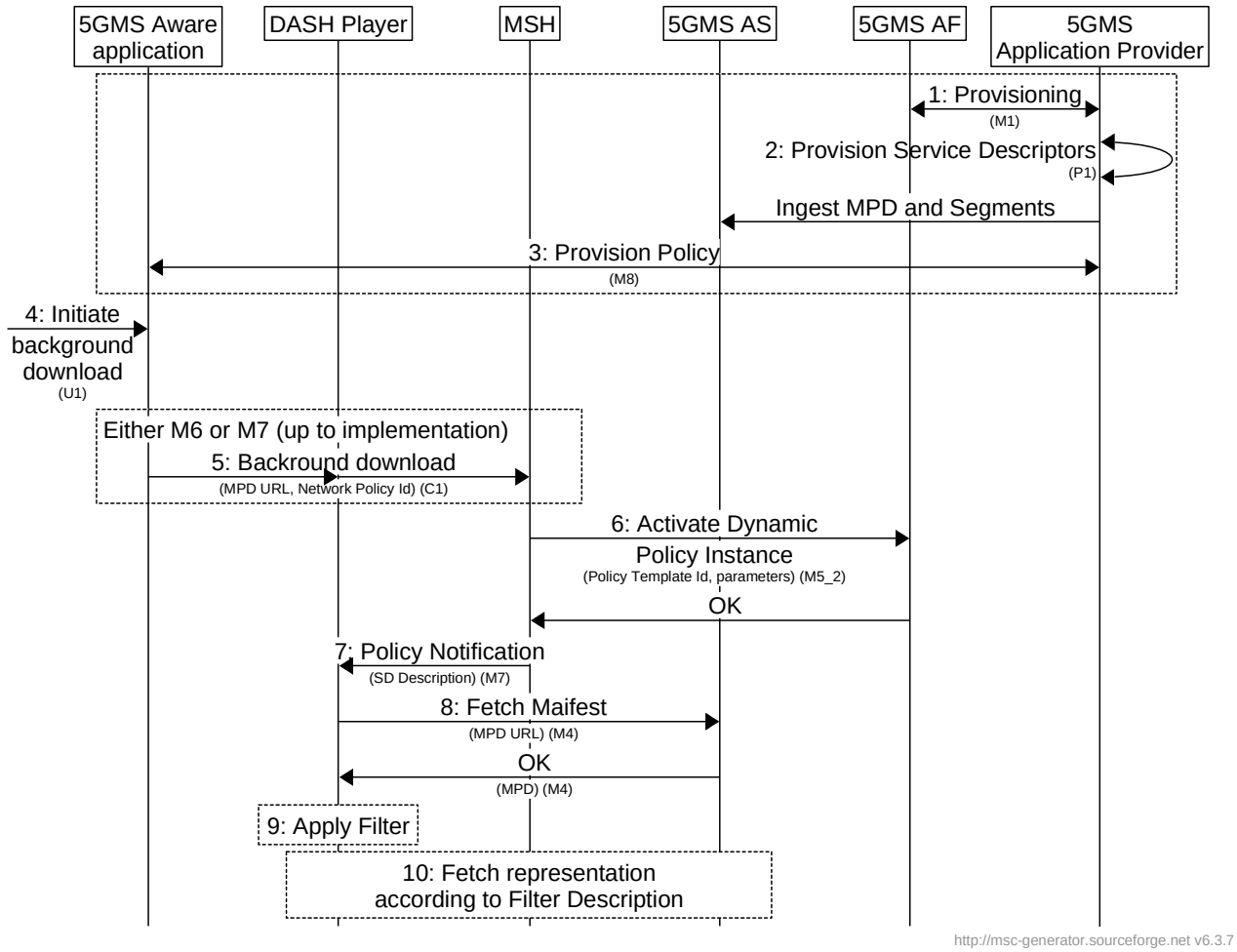

Figure A.3.2-1: Procedure for activating Background Download dynamic policy

Steps:

1. The 5GMS Application Provider interacts with the 5GMS AF to set up one or more Policy Templates (M1). Each Policy Template is identified by a Policy Template identifier and contains information about how to activate the according policy within the 5G System (e.g. N5 URLs and parameters).

2. The 5GMS Application Provider also interacts with its DASH content generation function (e.g. an MPD provider) to annotate the DASH MPD with Service Descriptions, e.g. to identify, which representation is intended for background download.

3. The 5GMS-Aware Application is configured via M8 with information about the available content catalogue (e.g. resolving MPD URLs), the available subscription identifiers (e.g. the user has a 4K subscription or the user has an SD subscription), device type identifiers.

   The 5GMSd-Aware Application is configured via M8 about the available background download policy. This includes the Network Policy Id which hints a background download policy.

4. When a user selects an item via the User Interface (U1) for Background Download the 5GMS-Aware Application translates the input to the needed 5GMSd API calls.

5. The 5GMS-Aware Application provides input (via C1) on the selected presentation entry (i.e. MPD URL) and also on the Network Policy Identifier (indicating a background download policy, i.e. make the Media Session Handler request a bearer suitable for Background Download).

NOTE: C1 is an abstract interface and indicates that the 5GMS-Aware Application may either first use M6 or M7 for the interactions with the 5GMS Client.

6. The Media Session Handler uses the Network Policy Identifier to find the procedure and the parameters to activate the Dynamic Policy Instance (here a Background Download policy). The Media Session Handler has received one or more Policy Descriptions together with matching Service Access Information (via M5_1). The Media Session Handler uses the Network Policy Identifier as a key to find the correct Policy Description. The Media Session Handler should activate a Dynamic Policy in the 5GMS AF, providing Service Data Flow Template information of the media flows (audio, video, etc). The Media Session Handler can also receive information on a bit rate policing (*enforcementMethod* and/or *enforcementBitrate*), e.g. that the bit rate is actively limited.

7. The Media Session Handler activates the Dynamic Policy instance on M5, providing the Policy Template identifier and additional parameters. Upon positive response, the Media Session handler notifies the DASH Player to start the Background Download. The notification contains a Service Descriptor Filters, which is used by the DASH Player to filter policy-compliant Service Descriptions from the MPD. The Media Session Handler may receive the Service Descriptor Filters with the response or may look up the Service Descriptor Filter values by a response value (e.g. derived from a maximum bit rate indication).

   The Media Session Handler may need to update the Dynamic Policy instance, depending on the selected traffic detection method. For example, when the Media Session Handler uses 5-Tuples, it needs to update the Dynamic Policy instance with every newly opened and every closed TCP connection.

8. The DASH Player fetches the MPD of the selected content.

9. The DASH Access Engine / Selection Logic (see ISO 23009-1 [32] figure K.1) selects only adaptation sets and representations according to the filter (i.e. suitable for Background Download). Here, the DASH Player fetches the MPD after the notification from the Media Session Handler.

A.4.3 Example parameters

Table A.4.3-1: M5_1 Parameters for Policy Descriptions (used by the Media Session Handler)

Parameter	Type	Purpose	Example Values
Policy Description	Object		
Network Policy Id	String	Identifies the Policy Description.	"Background Download".
Service Access Information URL	URL	References the associated Service Access Information.	

Table A.4.3-2: M5_1 Parameters for Service Access Information

Parameter	Type		
Service Access Information	Object		
Policy Template Id	String	Identifies the Policy Template.	"backgrounddata".
5GMS AF URL	URL	Used to invoke the 5GMS AF.	
sdfMethods	[String]	Indication, which Service Data Flow Description methods are recommended to use by the media session handler.	"5-Tuple", "domainName", "TOS=xx", etc.
Mandatory M5 Request information	List	Desired bit rate, to be provided by the network for the application.	Policy Template Id, Average Bit rate, Service Data Flow Template.
M5 Response information	List	Information to the Media Session Handler on the response parameters.	

Annex B (informative): Content Hosting Configuration examples

B.1 Pull-based content ingest example

B.1.1 Overview

1. The 5GMSd Client on the UE requests a media resource via M4d.
2. The 5GMSd AS determines that it does not have a cached copy of the requested media resource.
3. The 5GMSd AS transforms the M4d request URL into a request to the 5GMSd Application Provider's origin server via M2d.

B.1.2 Desired URL mapping

In the example shown in table B.1.2-1 below, media resources for the Provisioning Session with external identifier `com.provider.service` are exposed at M4d from a default canonical domain `com-provider-service.ms.as.3gppservices.org` determined by the 5GMSd System operator, and also from a custom domain name alias `5gms.provider.com` that has been configured by the 5GMSd Application Provider.

Table B.1.2-1: Example URL mapping for pull-based ingest

M4d request from 5GMSd Client	Mapped M2d request to origin server on 5GMSd AS cache miss
https://**com-provider-service.ms.as.3gppservices.org**/**asset123456**/**video1**/segment1000.mp4	https://origin.provider.com/media/**asset123456**/**video1**/segment1000.mp4
https://**5gms.provider.com**/**asset123456**/**video1**/segment1000.mp4	
https://**com-provider-service.ms.as.3gppservices.org**/**asset123456**/**video2**/segment1000.mp4	https://origin.provider.com/media/**asset123456**/**video2**/segment1000.mp4
https://**5gms.provider.com**/**asset123456**/**video2**/segment1000.mp4	
https://**com-provider-service.ms.as.3gppservices.org**/**asset123456**/**audio1**/segment1000.mp4	https://origin.provider.com/media/**asset123456**/**audio1**/segment1000.mp4
https://**5gms.provider.com**/**asset123456**/**audio1**/segment1000.mp4	

B.1.3 Content Hosting Configuration

Table B.1.3-1 below shows the relevant Content Hosting Configuration parameters needed to achieve the example mapping described in table B.1.2-1 above.

Table B.1.3-1: Content Hosting Configuration properties relevant to pull-based ingest

Property	Example value	Set by
ProvisioningSession		
externalServiceId	com.provider.service	5GMSd Application Provider *(M1d request)*
IngestConfiguration		
protocol	urn:3gpp:5gms:content-protocol:**http-pull**	5GMSd Application Provider *(M1d request)*
mode	*PULL*	
baseURL	https://origin.provider.com/media	
DistributionConfiguration		
canonicalDomainName	com-provider-service.ms.as.3gppservices.org	5GMSd AF *(M1d response)*
domainNameAlias	5gms.provider.com	5GMSd Application Provider *(M1d request)*
baseURL	https://5gms.provider.com/	5GMSd AF *(M1d response)*

B.2 Push-based content ingest example

B.2.0 Overview

1. The 5GMSd Application Provider uploads content to the 5GMSd AS via M2d.
2. The 5GMSd AS rewrites the M2d upload URL to an M4d downlink URL that is exposed to the 5GMSd Client on the UE.

B.2.1 Desired URL mapping

In the example shown in table B.2.1-1, media resources for the Provisioning Session with external identifier `com.provider.service` are pushed into the 5GMSd AS at M2d by the 5GMSd Application Provider and exposed to the 5GMSd Client at M4d using the canonical name of the 5GMSd AS `com-provider-service.ms.as.3gppservices.org` and an additional domain name alias `mno-cdn.5gmsd-ap.com` configured by the 5GMSd Application Provider.

Table B.2.1-1: Example URL mapping for push-based ingest

M2d ingest URL pushed to 5GMSd AS	M4d URL exposed to 5GMSd Client
https://5gmsd-as.mno.net/com-provider-service/**asset123456/video1**/segment1000.mp4	https://**com-provider-service.ms.as.3gppservices.org**/**asset123456/video1**/segment1000.mp4
	https://**5gms.provider.com**/**asset123456/video1**/segment1000.mp4
https://5gmsd-as.mno.net/com-provider-service/**asset123456/video2**/segment1000.mp4	https://**com-provider-service.ms.as.3gppservices.org**/**asset123456/video2**/segment1000.mp4
	https://**5gms.provider.com**/**asset123456/video2**/segment1000.mp4
https://5gmsd-as.mno.net/com-provider-service/**asset123456/audio1**/segment1000.mp4	https://**com-provider-service.ms.as.3gppservices.org**/**asset123456/audio1**/segment1000.mp4
	https://**5gms.provider.com**/**asset123456/audio1**/segment1000.mp4

B.2.2 Content Hosting Configuration

Table B.2.2-1 below shows the relevant Content Hosting Configuration parameters needed to achieve the example mapping described in table B.2.1-1 above.

Table B.2.2-1: Content Hosting Configuration properties relevant to push-based ingest

Property	Example value	Set by
ProvisioningSession		
externalServiceId	com.provider.service	5GMSd Application Provider *(M1d request)*
IngestConfiguration		
protocol	http://dashif.org/ingest/v1.2/interface-1	5GMSd Application Provider *(M1d request)*
mode	*PUSH*	
baseURL	https://5gmsd-as.mno.net/com-provider-service	5GMSd AF *(M1d response)*
DistributionConfiguration		
canonicalDomainName	com-provider-service.ms.as.3gppservices.org	5GMSd AF *(M1d response)*
domainNameAlias	5gms.provider.com	5GMSd Application Provider *(M1d request)*
baseURL	https://5gms.provider.com/	5GMSd AF *(M1d response)*

Annex C (normative): OpenAPI representation of the 5GMS HTTP REST APIs

C.1 General

This annex is based on the OpenAPI 3.0.0 specification [23] and provides corresponding representations of all APIs defined in the present document.

NOTE 1: An OpenAPIs representation embeds JSON Schema representations of HTTP message bodies.

This Annex shall take precedence when being discrepant to other parts of the present document with respect to the encoding of information elements and methods within the API(s).

NOTE 2: The semantics and procedures, as well as conditions, e.g. for the applicability and allowed combinations of attributes or values, not expressed in the OpenAPI definitions but defined in other parts of the specification also apply.

C.2 Data Types applicable to several APIs

For the purpose of referencing entities defined in this clause, it shall be assumed that the OpenAPI definitions below are contained in a physical file named "TS26512_CommonData.yaml".

```yaml
openapi: 3.0.0
info:
  title: 5GMS Common Data Types
  version: 3.1.1
  description: |
    5GMS Common Data Types
    © 2025, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.
tags:
  - name: 5GMS Common Data Types
    description: '5G Media Streaming: Common Data Types'
externalDocs:
  description: 'TS 26.512 V18.6.0; 5G Media Streaming (5GMS); Protocols'
  url: 'https://www.3gpp.org/ftp/Specs/archive/26_series/26.512/'
paths: {}
components:
  schemas:
    ################################
    # Clause 6.4.2: Simple data types
    ################################

    ####################################
    # Clause 6.4.3: Structured data types
    ####################################
    MediaStreamingBaseReportingRecord:
      type: object
      properties:
        sliceInfo:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
        dataNetworkName:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnn'
        location:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/TypedLocation'

    MediaStreamingSessionIdentification:
      type: object
      required:
        - sessionId
      properties:
        sessionId:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/MediaDeliverySessionId'

    MediaStreamingAccess:
      type: object
      description: Common properties of a single media access by the Media Stream Handler.
```

```
      required:
        - mediaStreamHandlerEndpointAddress
        - applicationServerEndpointAddress
        - requestMessage
        - responseMessage
        - processingLatency
      properties:
        mediaStreamHandlerEndpointAddress:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/EndpointAddress'
        applicationServerEndpointAddress:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/EndpointAddress'
        requestMessage:
          type: object
          required:
            - method
            - url
            - protocolVersion
            - size
            - bodySize
          properties:
            method:
              type: string
            url:
              $ref: 'TS26510_CommonData.yaml#/components/schemas/AbsoluteUrl'
            protocolVersion:
              type: string
            range:
              type: string
            size:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
            bodySize:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
            contentType:
              type: string
            userAgent:
              type: string
            userIdentity:
              type: string
            referer:
              $ref: 'TS26510_CommonData.yaml#/components/schemas/AbsoluteUrl'
        cacheStatus:
          $ref: '#/components/schemas/CacheStatus'
        responseMessage:
          type: object
          required:
            - responseCode
            - size
            - bodySize
          properties:
            responseCode:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
            size:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
            bodySize:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
            contentType:
              type: string
        processingLatency:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
        connectionMetrics:
          type: object
          required:
            - meanNetworkRoundTripTime
            - networkRoundTripTimeVariation
            - congestionWindowSize
          properties:
            meanNetworkRoundTripTime:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
            networkRoundTripTimeVariation:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/Float'
            congestionWindowSize:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'

    NetworkAssistanceInvocation:
      description: Common properties of a single Network Assistance invocation.
      type: object
      properties:
        policyTemplateId:
```

```
          $ref: 'TS26510_CommonData.yaml#/components/schemas/ResourceId'
        applicationFlowDescriptions:
          type: array
          minItems: 1
          items:
            $ref: 'TS26510_CommonData.yaml#/components/schemas/ApplicationFlowDescription'
        requestedQoS:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/UnidirectionalQoSSpecification'
        # The network QoS parameters (if any) requested by the Media Session Handler.
        recommendedQoS:
          type: object
          description: The network QoS parameters (if any) recommended to the Media Session
Handler.
          required:
            - maximumBitRate
            - minimumBitRate
          properties:
            maximumBitRate:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
            minimumBitRate:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'

    ######################################
    # Clause 6.4.4: Enumerated data types
    ######################################
    CacheStatus:
      anyOf:
        - type: string
          enum:
            - HIT
            - MISS
            - EXPIRED
        - type: string
          description: >
            This string provides forward-compatibility with future
            extensions to the enumeration but is not used to encode
            content defined in the present version of this API.
```

C.3 OpenAPI representation of the M1 APIs

C.3.0 Maf_Provisioning API

The normative code specifying the APIs defined in this clause, including JSON Schema representations of HTTP message bodies to be used with these APIs, is published on 3GPP Forge according to the OpenAPI 3.0.0 specification [23]. The YAML files corresponding to this version of the present document shall be published to the following location:

`https://forge.3gpp.org/rep/all/5G_APIs/-/tags/TSG108-Rel18`

Informative copies of these YAML files shall be distributed with the present document for convenience only. Where any discrepancy exisits, the version on 3GPP Forge shall be considered definitive.

For the purpose of referencing entities specified in this clause, it shall be assumed that the OpenAPI definitions are contained in a physical file named "TS26512_Maf_Provisioning.yaml".

C.3.1 Void

C.3.2 Void

C.3.3 Void

C.3.4 Void

C.3.5 Void

C.3.6 Void

C.3.7 Void

C.3.8 Void

C.3.9 Void

C.3.10 Void

C.3A OpenAPI representation of the M3 APIs

C.3A.0 Mas_Configuration API

The normative code specifying the APIs defined in this clause, including JSON Schema representations of HTTP message bodies to be used with these APIs, is published on 3GPP Forge according to the OpenAPI 3.0.0 specification [23]. The YAML files corresponding to this version of the present document shall be published to the following location:

`https://forge.3gpp.org/rep/all/5G_APIs/-/tags/TSG108-Rel18`

Informative copies of these YAML files shall be distributed with the present document for the convenience only. Where any discrepancy exisits, the version on 3GPP Forge shall be considered definitive.

For the purpose of referencing entities specified in this clause, it shall be assumed that the OpenAPI definitions are contained in a physical file named "TS26512_Mas_Configuration.yaml".

C.3A.1 Mas_Configuration_ServerCertificates API

For the purpose of referencing entities specified in this clause, it shall be assumed that the OpenAPI definitions are contained in a physical file named "TS26512_Mas_Configuration_ServerCertificates.yaml".

C.3A.2 Mas_Configuration_ContentPreparationTemplates API

For the purpose of referencing entities specified in this clause, it shall be assumed that the OpenAPI definitions are contained in a physical file named "TS26512_Mas_Configuration_ContentPreparationTemplates.yaml".

C.3A.3 Mas_Configuration_ContentHosting API

For the purpose of referencing entities specified in this clause, it shall be assumed that the OpenAPI definitions are contained in a physical file named "TS26512_Mas_Configuration_ContentHosting.yaml".

C.3A.4 Mas_Configuration_ContentPublishing API

For the purpose of referencing entities specified in this clause, it shall be assumed that the OpenAPI definitions are contained in a physical file named "TS26512_Mas_Configuration_ContentPublishing.yaml".

C.4 OpenAPI representation of the M5 APIs

C.4.0 Maf_SessionHandling API

The normative code specifying the APIs defined in this clause, including JSON Schema representations of HTTP message bodies to be used with these APIs, is published on 3GPP Forge according to the OpenAPI 3.0.0 specification [23]. The YAML files corresponding to this version of the present document shall be published to the following location:

`https://forge.3gpp.org/rep/all/5G_APIs/-/tags/TSG108-Rel18`

Informative copies of these YAML files shall be distributed with the present document for convenience only. Where any discrepancy exisits, the version on 3GPP Forge shall be considered definitive.

For the purpose of referencing entities specified in this clause, it shall be assumed that the OpenAPI definitions are contained in a physical file named "TS26512_Maf_SessionHandling.yaml".

C.4.1 Void

C.4.2 Void

C.4.3 Void

C.4.4 M5_DynamicPolicies API

This file is specified for the sole purpose of maintaining backwards compatibility for Release 17 of TS 29.517 [46]. The data types it specifies are deprecated and shall not be used in the present release.

```
openapi: 3.0.0

info:
  title: M5_DynamicPolicies (deprecated)
  version: 3.0.3
  description: |
    5GMS AF M5 Dynamic Policy API
    © 2025, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

tags:
  - name: M5_DynamicPolicies
    description: '5G Media Streaming: Media Session Handling (M5) APIs: Dynamic Policies
(deprecated)'

externalDocs:
  description: 'TS 26.512 V18.6.0; 5G Media Streaming (5GMS); Protocols'
  url: 'https://www.3gpp.org/ftp/Specs/archive/26_series/26.512/'

paths: {}
```

```
components:
  schemas:
    DynamicPolicy:
      deprecated: true
      description: "A representation of a Dynamic Policy resource."
      type: object
      required:
        - dynamicPolicyId
        - policyTemplateId
        - serviceDataFlowDescriptions
        - provisioningSessionId
      properties:
        dynamicPolicyId:
          readOnly: true
          allOf:
            - $ref: 'TS26510_CommonData.yaml#/components/schemas/ResourceId'
        policyTemplateId:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/ResourceId'
        serviceDataFlowDescriptions:
          type: array
          items:
            $ref: 'TS26510_CommonData.yaml#/components/schemas/ApplicationFlowDescription'
        mediaType:
          $ref: 'TS29514_Npcf_PolicyAuthorization.yaml#/components/schemas/MediaType'
        provisioningSessionId:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/ResourceId'
        qosSpecification:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/ClientQosSpecification'
        enforcementMethod:
          readOnly: true
          type: string
        enforcementBitRate:
          readOnly: true
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Uinteger'
```

C.4.5 M5_NetworkAssistance API

This file is specified for the sole purpose of maintaining backwards compatibility for Release 17 of TS 29.517 [46]. The data types it specifies are deprecated and shall not be used in the present release.

```
openapi: 3.0.0

info:
  title: M5_NetworkAssistance (deprecated)
  version: 3.0.3
  description: |
    5GMS AF M5 Network Assistance API
    © 2025, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

tags:
  - name: M5_NetworkAssistance
    description: '5G Media Streaming: Media Session Handling (M5) APIs: Network Assistance
(deprecated)'

externalDocs:
  description: 'TS 26.512 V18.6.0; 5G Media Streaming (5GMS); Protocols'
  url: 'https://www.3gpp.org/ftp/Specs/archive/26_series/26.512/'

paths: {}

components:
  schemas:
    NetworkAssistanceSession:
      deprecated: true
      description: "A representation of a Network Assistance Session resource."
      type: object
      required:
        - naSessionId
        - provisioningSessionId
        - serviceDataFlowDescriptions
      properties:
        naSessionId:
```

```
          readOnly: true
          allOf:
            - $ref: 'TS26510_CommonData.yaml#/components/schemas/ResourceId'
        provisioningSessionId:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/ResourceId'
        serviceDataFlowDescriptions:
          type: array
          items:
            $ref: 'TS26510_CommonData.yaml#/components/schemas/ApplicationFlowDescription'
          minItems: 1
        mediaType:
          $ref: 'TS29514_Npcf_PolicyAuthorization.yaml#/components/schemas/MediaType'
        policyTemplateId:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/ResourceId'
        requestedQoS:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/ClientQosSpecification'
        recommendedQoS:
          readOnly: true
          allOf:
            - $ref: 'TS26510_CommonData.yaml#/components/schemas/ClientQosSpecification'
        notficationURL:
          readOnly: true
          allOf:
            - $ref: 'TS26510_CommonData.yaml#/components/schemas/AbsoluteUrl'
```

C.5 OpenAPI representation of data reporting records

C.5.1 R4 data reporting records

For the purpose of referencing entities defined in this clause, it shall be assumed that the OpenAPI definitions below are contained in a physical file named "TS26512_R4_DataReporting.yaml".

```
openapi: 3.0.0

info:
  title: 5GMS R4 Data Reporting data types
  version: 2.0.1
  description: |
    5GMS R4 Data Reporting data types
    © 2024, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

tags:
  - name: 5GMS R4 Data Reporting data types
    description: '5G Media Streaming: R4 Data Reporting data types'

externalDocs:
  description: 'TS 26.512 V18.2.0; 5G Media Streaming (5GMS); Protocols'
  url: 'https://www.3gpp.org/ftp/Specs/archive/26_series/26.512/'

paths: {}

components:
  schemas:
    MediaStreamingAccessRecord:
      description: "An R4 data reporting record describing a single media access by the Media
Stream Handler."
      allOf:
        - $ref: 'TS26532_Ndcaf_DataReporting.yaml#/components/schemas/BaseRecord'
        - $ref: 'TS26512_CommonData.yaml#/components/schemas/MediaStreamingBaseReportingRecord'
        - $ref: 'TS26512_CommonData.yaml#/components/schemas/MediaStreamingSessionIdentification'
        - $ref: 'TS26512_CommonData.yaml#/components/schemas/MediaStreamingAccess'
```

C.5.2 R2 data reporting records

For the purpose of referencing entities defined in this clause, it shall be assumed that the OpenAPI definitions below are contained in a physical file named "TS26512_R2_DataReporting.yaml".

```
openapi: 3.0.0

info:
  title: 5GMS Data Reporting data types
  version: 1.0.1
  description: |
    5GMS Data Reporting data types
    © 2024, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

tags:
  - name: 5GMS Data Reporting data types
    description: '5G Media Streaming: Data Reporting data types'

externalDocs:
  description: 'TS 26.512 V18.2.0; 5G Media Streaming (5GMS); Protocols'
  url: 'https://www.3gpp.org/ftp/Specs/archive/26_series/26.512/'

paths: {}

components:
  schemas:
    ANBRNetworkAssistanceInvocationRecord:
      description: "An R2 data reporting record describing a single ANBR-based Network Assistance
invocation by the Media Stream Handler."
      allOf:
        - $ref: 'TS26532_Ndcaf_DataReporting.yaml#/components/schemas/BaseRecord'
        - $ref: 'TS26512_CommonData.yaml#/components/schemas/MediaStreamingBaseReportingRecord'
        - $ref: 'TS26512_CommonData.yaml#/components/schemas/MediaStreamingSessionIdentification'
        - $ref: 'TS26512_CommonData.yaml#/components/schemas/NetworkAssistanceInvocation'
```

C.6 OpenAPI representation of event exposure data types

For the purpose of referencing entities defined in this clause, it shall be assumed that the OpenAPI definitions below are contained in a physical file named "TS26512_EventExposure.yaml".

```
openapi: 3.0.0

info:
  title: 5GMS Event Exposure
  version: 1.1.1
  description: |
    5GMS Event Exposure syntax
    © 2025, 3GPP Organizational Partners (ARIB, ATIS, CCSA, ETSI, TSDSI, TTA, TTC).
    All rights reserved.

tags:
  - name: 5GMS Event Exposure
    description: '5G Media Streaming: Event Exposure'

externalDocs:
  description: 'TS 26.512 V18.6.0; 5G Media Streaming (5GMS); Protocols'
  url: 'https://www.3gpp.org/ftp/Specs/archive/26_series/26.512/'

paths: {}

components:
  schemas:
    BaseEventCollection:
      type: object
      description: Abstract base data type describing a collection of event records
      required:
        - collectionTimestamp
        - startTimestamp
```

```
        - endTimestamp
        - sampleCount
        - streamingDirection
        - summarisations
        - records
      properties:
        collectionTimestamp:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
          # The date-time at which this collection was exposed by the Data Collection AF as an
event to its subscribed event consumers.
        startTimestamp:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
          # Date-time of earliest data sample included in or summarised by this collection.
        endTimestamp:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
          # Date-time of latest data sample included in or summarised by this collection.
        sampleCount:
          type: integer
          minimum: 1
          description: The number of data samples included in or summarised by this collection.
        streamingDirection:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/ProvisioningSessionType'
        summarisations:
          type: array
          minItems: 1
          items:
            $ref:
'TS26532_Ndcaf_DataReportingProvisioning.yaml#/components/schemas/DataAggregationFunctionType'
          description: One or more data aggregation functions that have been applied to the UE
data to produce summary records present in this collection.
        records:
          type: array
          minItems: 0
          items: {}
          description: Type of record is defined by concrete data type.

    BaseEventRecord:
      type: object
      description: Abstract base data type describing a single UE data record or summarising a set
of UE data records.
      required:
        - recordType
        - recordTimestamp
        - appId
      properties:
        recordType:
          $ref: '#/components/schemas/EventRecordType'
        recordTimestamp:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
          # The date-time at which the UE data carried in this record was sampled or summarised.
        appId:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/ApplicationId'
          # Identifying the application to which the UE data carried in this record pertains.
        provisioningSessionId:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/ResourceId'
          # The identifier of the Provisioning Session to which this record pertains. Present only
for individual data sample record type.
        sessionId:
          $ref: 'TS26510_CommonData.yaml#/components/schemas/MediaDeliverySessionId'
          # A value synthesised by the 5GMS System that uniquely identifies the media streaming
session to which this record pertains. Present only for individual data sample record type.
        ueIdentification:
          type: string
          description: GPSI of the requesting UE or a stable globally unique string identifying
the requesting Media Session Handler. Present only for individual data sample record type and only
when exposure is permitted by the data exposure restrictions in force for the event type in
question.
        dataNetworkName:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Dnn'
          # Identifying the Data Network of the M4 media streaming session. Present only for
individual data sample record type.
        sliceId:
          $ref: 'TS29571_CommonData.yaml#/components/schemas/Snssai'
          # The S-NSSAI identifying the Network Slice of the M4 media streaming session. Present
only for individual data sample record type.
        ueLocations:
          type: array
          minItems: 0
```

```
          items:
            $ref: 'TS29122_CommonData.yaml#/components/schemas/LocationArea5G'
          description: The location of the UE when the data described by this record was sampled.
Present only for individual data sample record type and only when exposure is permitted by the
data exposure restrictions in force for the event in question.

    EventRecordType:
      description: Enumeration of event record types.
      anyOf:
        - type: string
          enum:
            - INDIVIDUAL_SAMPLE
            - SUMMARY_MEAN
            - SUMMARY_MINIMUM
            - SUMMARY_MAXIMUM
            - SUMMARY_SUM
        - type: string
          description: >
            This string provides forward-compatibility with future
            extensions to the enumeration but is not used to encode
            content defined in the present version of this API.

    QoEMetricsCollection:
      description: A collection of QoE Metrics Event records.
      allOf:
        - $ref: '#/components/schemas/BaseEventCollection'
        - type: object
          required:
            - records
          properties:
            records:
              type: array
              minItems: 0
              items:
                $ref: '#/components/schemas/QoEMetricsEvent'
              description: A set of QoE Metrics Event records, each one describing a QoE metrics
report or summarising a set of QoE metrics reports.

    QoEMetricsEvent:
      description: A QoE Metrics Event record.
      allOf:
        - $ref: '#/components/schemas/BaseEventRecord'
        - type: object
          required:
            - metricType
          properties:
            metricType:
              $ref: 'TS29122_CommonData.yaml#/components/schemas/Uri'
              # A fully-qualified term identifier that uniquely identifies the QoE metrics
reporting scheme and the type of QoE metric included in this record, as specified in clause E.2,
up to but excluding the first hierarchical separator.
            samples:
              type: array
              minItems: 1
              items:
                type: object
                required:
                  - metrics
                properties:
                  sampleTimestamp:
                    $ref: 'TS29571_CommonData.yaml#/components/schemas/DateTime'
                    # The moment in time at which this QoE metric was sampled.
                  sampleDuration:
                    $ref: 'TS26510_CommonData.yaml#/components/schemas/Duration'
                    # The time duration over which this QoE metric was sampled.
                  mediaTimestamp:
                    $ref: 'TS26510_CommonData.yaml#/components/schemas/Duration'
                    # The time point in the media at which this QoE metric was sampled.
                  metrics:
                    type: array
                    minItems: 1
                    description: A set of key–value pairs for the samples metrics associated with
this QoE metric sample.
                    items:
                      type: object
                      description: A name and optional value for a QoE metric within a QoE metric
sample.
                      required:
```

```
                        - key
                      properties:
                        key:
                          type: string
                          description: A token that uniquely identifies the type of metric within
the scope of the event type.
                        value: {}

    ConsumptionReportingUnitsCollection:
      description: A collection of Consumption Reporting Event records.
      allOf:
        - $ref: '#/components/schemas/BaseEventCollection'
        - type: object
          required:
            - records
          properties:
            records:
              type: array
              minItems: 0
              items:
                $ref: '#/components/schemas/ConsumptionReportingEvent'
              description: A set of records, each one describing a Consumption Reporting Unit.

    ConsumptionReportingEvent:
      description: A Consumption Reporting Event record, corresponding to a Consumption Reporting
Unit.
      allOf:
        - $ref: '#/components/schemas/BaseEventRecord'
        - type: object
          required:
            - unitDuration
            - mediaPlayerEntryUrl
            - mediaComponentIdentifier
          properties:
            unitDuration:
              $ref: 'TS26510_CommonData.yaml#/components/schemas/Duration'
              # The duration of this consumption reporting unit.
            clientEndpointAddress:
              $ref: 'TS26510_CommonData.yaml#/components/schemas/EndpointAddress'
              # The endpoint address of the UE that consumed media.
            serverEndpointAddress:
              $ref: 'TS26510_CommonData.yaml#/components/schemas/EndpointAddress'
              # The endpoint address of the 5GMS AS from which media was consumed.
            mediaPlayerEntryUrl:
              $ref: 'TS26510_CommonData.yaml#/components/schemas/AbsoluteUrl'
              # The Media Player Entry URL to which this consumption reporting unit pertains.
            mediaComponentIdentifier:
              type: string
              description: A token (e.g., an MPEG DASH representation identifier) identifying the
media component of the Media Player Entry that was consumed during this consumption reporting
unit.

    NetworkAssistanceInvocationsCollection:
      description: A collection of Network Assistance Invocation Event records.
      allOf:
        - $ref: '#/components/schemas/BaseEventCollection'
        - type: object
          required:
            - records
          properties:
            records:
              type: array
              minItems: 0
              items:
                $ref: '#/components/schemas/NetworkAssistanceInvocationEvent'
              description: A set of records, each one describing a Network Assistance invocation
or summarising a set of Network Assistance invocations.

    NetworkAssistanceInvocationEvent:
      description: A Network Assistance Invocation Event record.
      allOf:
        - $ref: '#/components/schemas/BaseEventRecord'
        - type: object
          required:
            - networkAssistanceType
          properties:
            networkAssistanceType:
              $ref: '#/components/schemas/NetworkAssistanceType'
```

```
              # The type of Network Assistance solicited by the Media Session Handler.
        - $ref: 'TS26512_CommonData.yaml#/components/schemas/NetworkAssistanceInvocation'

    NetworkAssistanceType:
      description: The type of network assistance sought by the Media Session Handler.
      anyOf:
        - type: string
          enum:
            - AF_THROUGHPUT_ESTIMATION
            - AF_DELIVERY_BOOST
            - ANBR_THROUGHPUT_ESTIMATION
            - ANBR_DELIVERY_BOOST
        - type: string
          description: >
            This string provides forward-compatibility with future
            extensions to the enumeration but is not used to encode
            content defined in the present version of this API.

    DynamicPolicyInvocationsCollection:
      description: A collection of Dynamic Policy Invocation Event records.
      allOf:
        - $ref: '#/components/schemas/BaseEventCollection'
        - type: object
          required:
            - records
          properties:
            records:
              type: array
              minItems: 0
              items:
                $ref: '#/components/schemas/DynamicPolicyInvocationEvent'
              description: A set of records, each one describing a dynamic policy invocation.

    DynamicPolicyInvocationEvent:
      description: A Dynamic Policy Invocation Event record.
      allOf:
        - $ref: '#/components/schemas/BaseEventRecord'
        - type: object
          required:
            - policyTemplateId
          properties:
            policyTemplateId:
              $ref: 'TS26510_CommonData.yaml#/components/schemas/ResourceId'
            applicationFlowDescriptions:
              type: array
              minItems: 1
              items:
                $ref: 'TS26510_CommonData.yaml#/components/schemas/ApplicationFlowDescription'
              description: The set of Service Data Flows to which the Media Session Handler
requested that the Policy Template be applied. At least a domain name or one packet filter shall
be present.
            requestedQoS:
              $ref: 'TS26510_CommonData.yaml#/components/schemas/UnidirectionalQoSSpecification'
              # The network QoS parameters (if any) requested by the Media Session Handler.
            enforcementMethod:
              type: string
              description: The policy enforcement method chosen by the 5GMS AF.
            enforcementBitRate:
              $ref: 'TS29571_CommonData.yaml#/components/schemas/BitRate'
              # The enforcement bit rate (if any) selected by the 5GMS AF.

    MediaStreamingAccessesCollection:
      description: A collection of Media Streaming Access Event records.
      allOf:
        - $ref: '#/components/schemas/BaseEventCollection'
        - type: object
          required:
            - records
          properties:
            records:
              type: array
              minItems: 0
              items:
                $ref: '#/components/schemas/MediaStreamingAccessEvent'
              description: A set of records, each one describing one media streaming access.

    MediaStreamingAccessEvent:
      description: A Media Streaming Access Event record.
```

```
      allOf:
        - $ref: '#/components/schemas/BaseEventRecord'
        - $ref: 'TS26512_CommonData.yaml#/components/schemas/MediaStreamingAccess'
```

Annex D (informative):
Void

Annex E (normative): Controlled vocabularies of 5G Media Streaming UE data parameters

E.1 General

The set of parameters used to provision processing and exposure of UE data is defined for each exposed Event by a controlled vocabulary with a unique name space identifier string in the form of a URN. Each parameter is specified as a term identifier string that is unique within the scope of its parent name space.

In the context of 5G Media Streaming, the values signalled in *DataAccessProfile.parameters* (see clause 6.3.2.3 of TS 26.532 [47]) shall be fully-qualified URIs formed from the name space identifier specified in the following clauses concatenated with a single hash character ('#') concatenated with the appropriate term identifier.

E.2 Controlled vocabularies of DASH QoE metrics reporting parameters

E.2.1 Reporting parameters for 3GP-DASH metrics

The name space identifier for the controlled vocabulary of DASH QoE metrics is:

urn:3GPP:ns:PSS:DASH:QM10

The term identifiers in this controlled vocabulary shall be the set of key names defined in clause 10.2 of TS 26.247 [4], using a single forward slash character ('/') as the hierarchical separator in the resulting path specifier. In the case of metrics lists, the *Entry* object shall be omitted from the term identifier path.

EXAMPLE 1: *urn:3GPP:ns:PSS:DASH:QM10#AvgThroughput/numbytes*

To select all reportable metrics below a common branch of the metrics hierarchy the relevant terminal path element(s) are pruned from the term identifier.

EXAMPLE 2: *urn:3GPP:ns:PSS:DASH:QM10#AvgThroughput*

E.2.2 Reporting parameters for VR metrics

The name space identifier for the controlled vocabulary of VR metrics is:

urn:3gpp:metadata:2020:VR:metrics

The term identifiers in this controlled vocabulary shall be the set of key names defined in clause 9.3 of TS 26.118 [42], using a single forward slash character ('/') as the hierarchical separator in the resulting path specifier. In the case of metrics lists, the *Entry* object shall be omitted from the term identifier path.

EXAMPLE 1: *urn:3gpp:metadata:2020:VR:metrics#CompQualLatency/Latency*

To select all reportable metrics below a common branch of the metrics hierarchy the relevant terminal path element(s) are pruned from the term identifier.

EXAMPLE 2: *urn:3gpp:metadata:2020:VR:metrics#CompQualLatency*

E.3 Controlled vocabulary of 5GMS consumption reporting parameters

The name space identifier for the controlled vocabulary of 5GMS consumption reporting parameters is:

urn:3gpp:5gms:event-exposure:consumption-reporting

The term identifiers in this controlled vocabulary are specified in table E.3-1 below.

EXAMPLE: *urn:3gpp:5gms:event-exposure:consumption-reporting#locations*

Table E.3-1: Controlled vocabulary of 5GMS consumption reporting parameters

Term identifier	Description
start-time	The date and time of the consumption reporting unit.
duration	The duration of the consumption reporting unit.
media-player-entry	The entry pointer for the media streaming session.
reporting-client-identifier	Identifier for the reporting client that consumed the media.
media-consumed	Identifies the media consumed within the context of the media player entry.
locations	The UE location(s) where the media was consumed. (Only available to trusted event consumer.)

E.4 Controlled vocabulary of 5GMS Network Assistance reporting parameters

The name space identifier for the controlled vocabulary of 5GMS Network Assistance parameters is:

urn:3gpp:5gms:event-exposure:network-assistance

The term identifiers in this controlled vocabulary are specified in table E.4-1 below.

EXAMPLE: *urn:3gpp:5gms:event-exposure:network-assistance#requested-qos*

Table E.4-1: Controlled vocabulary of 5GMS Network Assistance parameters

Term identifier	Description
timestamp	The date and time of the Network Assistance invocation by the Media Session Handler.
service-data-flow-information	Identification of the media streaming application flow for which Network Assistance was requested.
policy-template-identifier	The policy template in force for the media streaming session.
requested-qos	The network Quality of Service requested by the media streamer.
recommended-qos	The network Quality of Service recommended by the 5GMS AF.

E.5 Controlled vocabulary of 5GMS Dynamic Policy reporting parameters

The name space identifier for the controlled vocabulary of 5GMS Dynamic Policy parameters is

urn:3gpp:5gms:event-exposure:dynamic-policy

The term identifiers in this controlled vocabulary are specified in table E.5-1 below.

EXAMPLE: *urn:3gpp:5gms:event-exposure:dynamic-policy#enforcement-bit-rate*

Table E.5-1: Controlled vocabulary of 5GMS Dynamic Policy parameters

Term identifier	Description
timestamp	The date and time of the dynamic policy invocation by the Media Session Handler.
policy-template-identifier	The policy template instantiated for the media streaming session.
service-data-flow-descriptions	The set of media streaming application flows managed by the Dynamic Policy.
qos-specification	The network Quality of Service described by the policy template currently in force.
enforcement-method	The Policy Enforcement Method set by the 5GMS AF.
enforcement-bit-rate	The bit rate currently being enforced by this Dynamic Policy.

E.6 Controlled vocabulary of 5GMS media access activity parameters

The name space identifier for the controlled vocabulary of 5GMS media access activity is:

urn:3gpp:5gms:event-exposure:access-activity

The term identifiers in this controlled vocabulary are specified in table E.6-1 below.

EXAMPLE: *urn:3gpp:5gms:event-exposure:access-activity#request-message/url*

Table E.6-1: Controlled vocabulary of 5GMS media access activity parameters

Term identifier	Description
timestamp	The date and time of the media access.
media-stream-handler-endpoint-address	The endpoint address of the Media Stream Handler accessing the 5GMS AS.
application-server-endpoint-address	The service endpoint on the 5GMS AS to which the Media Stream Handler is connected.
session-identifier	An opaque identifier for the HTTP session on which the Media Stream Handler request was made.
request-message	All term identifiers below with prefix *request-message*.
request-message/method	The request method.
request-message/url	The request URL.
request-message/protocol-version	The HTTP protocol version, e.g. "HTTP/1.1".
request-message/range	The value of the Range request header.
request-message/size	The total number of bytes in the request message.
request-message/body-size	The number of bytes supplied by the Media Stream Handler in the HTTP request body.
request-message/content-type	The MIME content type of the request message, if any.
request-message/user-agent	A string describing the requesting Media Stream Handler from the `User-Agent` request header.
request-message/user-identity	A string identifying the user that made the access.
request-message/referer	The URL that the Media Player reports being referred from in the `Referer` request header.
cache-status	An indication of whether the 5GMS AS served the response object corresponding from cache.
response-message	All term identifiers below with prefix *response-message*.
response-message/response-code	The HTTP response code.
response-message/size	The total number of bytes in the response message.
response-message/body-size	The number of bytes in the HTTP response message body.
response-message/content-type	The MIME content type of response message.
processing-latency	The time, expressed in milliseconds, taken by the 5GMS AS to respond to the Media Stream Handler request.
connection-metrics	All term identifiers below with prefix *connection-metrics*.
connection-metrics/mean-rtt	Mean network round-trip time for the HTTP session, expressed in milliseconds.
connection-metrics/rtt-variation	The variation in mean network round-trip time, expressed in milliseconds.
connection-metrics/congestion-window-size	The current size (in bytes) of the congestion window for the transport connection underlying the HTTP session.

Annex F (informative): 5GMS AS Certificate provisioning and discovery

F.1 General

This annex describes 5GMS AS discovery by the 5GMS Client, including provisioning aspects that leverage the Domain Name System (DNS).

F.2 5GMS AS discovery and media streaming access with a Server Certificate created by the 5GMS System

Figure F.2-1 illustrates the initial provisioning needed to allow discovery of a 5GMS AS by the 5GMS Client as well as the eventual 5GMS AS discovery sequence using the Domain Name System (DNS). Specific focus here is on the provisioning and usage of TLS Certificates. The desired outcome is that the 5GMS Client is satisfied that it has established a TLS connection with an authorized 5GMS AS instance.

Here, the *Server Certificate Create* procedure (see clause 4.3.6.2) is used to request that the 5GMS AF creates the server certificate resource. In this case, the certificate's Common Name (*CN*) is assigned in a domain under the control of the 5GMS System operator (i.e., the 5GMS System operator is the legitimate owner of the domain name). The 5GMS System operator may use a third-party DNS service to host the domain in question.

For example, the 5GMS AF assigns the *canonicalDomainName* value `com-provider-service.ms.as.3gppservices.org` as the Common Name in the Server Certificate per clause 6.0.2.2. The 5GMS AF embeds this host name in the distribution base URL it returns to the 5GMS Application Provider.

Table F.2-1: Example Content Hosting Configuration corresponding to Create Server Certificate procedure

Content Hosting Configuration property	Example value
distributionConfigurations[n]	
canonicalDomainName	com-provider-service.ms.as.3gppservices.org
domainNameAlias	Not present.
baseURL	https://com-provider.ms.as.3gppservices.org/
certificateId	Pointing to Server Certificate resource with: - *CN* = com-provider.ms.as.3gppservices.org - *subjectAltName[0]* = com-provider.ms.as.3gppservices.org

The Media Entry Point URL advertised via reference point M5 or M8 (used by the Media Stream Handler to access the content *<relativePath>* in the 5GMS AS at reference point M4) is then:

`https://com-provider-service.ms.as.3gppservices.org/`*<relativePath>*

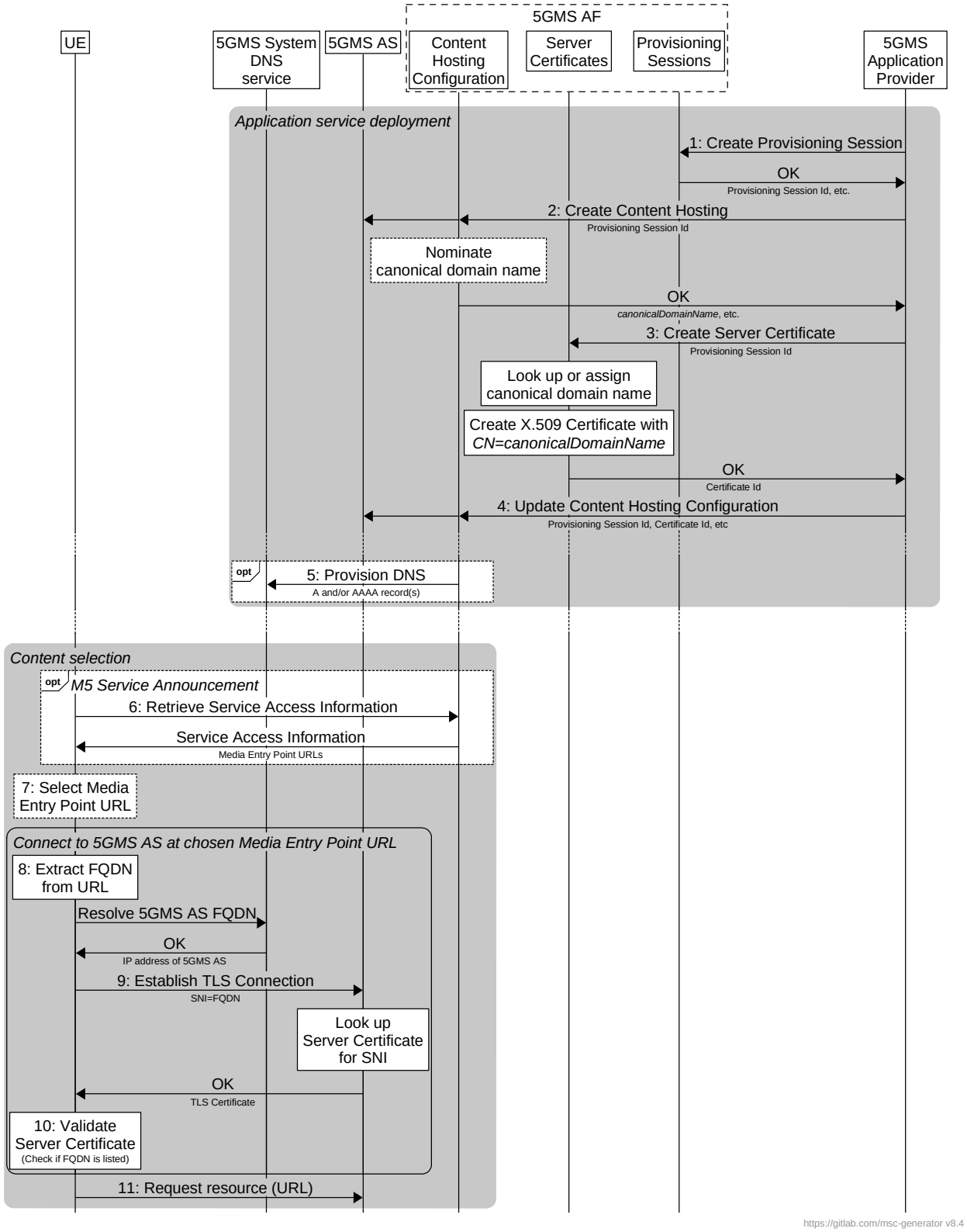

Figure F.2-1: 5GMS AS discovery using DNS using 5GMS System created server certificates

Prerequisites:

- A 5GMS-Aware Application is installed on the UE. This includes a list of API endpoint addresses for interacting with the 5GMS AF at reference point M5.

At application service deployment time:

1. The 5GMS Application Provider creates a Provisioning Session using the procedure specified in clause 4.3.2.2. The 5GMS AF provides the Provisioning Session Id in its response to the 5GMS Application Provider.

2. The 5GMS Application Provider creates a Content Hosting Configuration using the procedure specified in clause 4.3.3.2. If it has not already done so, the 5GMS AF assigns a canonical domain name for the 5GMS AS and includes this in its respose to the 5GMS Application Provider (*canonicalDomainName*).

3. The 5GMS Application Provider requests that the 5GMS AF creates a Server Certificate for this Provisioning Session using the procedure specified in clause 4.3.6.2. If it has not already done so, the 5GMS AF assigns a canonical domain name for the 5GMS AS and this is used as the Common Name and the first (and only) Subject Alternative Name of the generated server certificate. The CertificateId is provided to the 5GMS Application Provider upon success.

NOTE: The order of step 2 and step 3 may be reversed, in which case step 4 is not needed and the 5GMS AS is updated as a consequence of step 2.

4. The 5GMS Application Provider updates the Content Hosting Configuration using the procedure specified in clause 4.3.3.4, adding the Certificate Identifier of the newly created Server Certificate resource (i.e., modifying the value of *distributionConfigurations[ ].certificateId*).

   As a consequence, the 5GMS AF provisions the 5GMS AS with relevant information from the Provisioning Session, including the Server Certificate and Content Hosting Configuration.

5: If it has not already done so, the 5GMS AF provisions *A* and/or *AAAA* records in the DNS service mapping the canonical domain name of the 5GMS AS instance to its assigned IP address(es).

NOTE: The DNS service may be provided by a third-party service provider under the direction of the 5GMS System operator.

When content is selected in the 5GMS-Aware Application:

6. When Service Access Information retrieval at reference point M5 is used (see clause 4.7.2.3), the 5GMS Client in the UE retrieves the Service Access Information. This may include media entry point URLs within the *streamAccess.entryPoints* array. Otherwise, the 5GMS-Aware Application obtains this information via reference point M8.

7. The 5GMS Client in the UE selects one of the offered Media Entry Point URLs corresponding to the its media stream handling capabilities.

8. The 5GMS Client extracts the Fully-Qualified Domain Name (FQDN) from the chosen media entry point URL and uses the DNS service to resolve its IP address.

9. When establishing the TLS connection to the 5GMS AS at reference point M4, the Media Stream Handler in the UE cites the FQDN of the media entry point URL in the Server Name Indication (SNI) field of the TLS Client Hello message. The 5GMS AS uses the value of the SNI field to look up the corresponding Server Certificate and returns it to the Media Stream Handler in its Server Hello response. If the Server Certificate was provisioned with a wildcard Common Name, appropriate matching rules are followed by the 5GMS AS to identify the correct Server Certificate to present to the Media Stream Handler.

10. The 5GMS Client validates the Server Certificate, including whether the value of the Common Name (or one of its Subject Alternative Names) matches the FQDN of the chosen Media Entry Point URL.

When all server certificate validation steps are successfully passed, the following steps are executed:

11. The 5GMS Client requests the resource identified by the Media Entry Point over the TLS connection established with the 5GMS AS at reference point M4.

F.3 5GMS AS discovery and service access with a Server Certificate owned by the 5GMS Application Provider

Figure F.3-1 illustrates the initial provisioning needed to allow discovery of a 5GMS AS by the 5GMS Client as well as the eventual 5GMS AS discovery sequence using the Domain Name System (DNS). Specific focus here is on the provisioning and usage of TLS Certificates. The desired outcome is that the 5GMS Client is satisfied that it has established a TLS connection with an authorized 5GMS AS instance.

Here, the *Reserve Server Certificate* (see clause 4.3.6.3) and *Upload Server Certificate* (see clause 4.3.6.5) procedures are used for creating the Server Certificate resource and for subsequently providing it to the 5GMS AF. In this case, the certificate's Common Name (*CN*) is assigned in a domain under the control of the 5GMS Application Provider (i.e., Application Provider is the legitimate owner of the domain name). The 5GMS Application Provider may use the 5GMS System operator or any third-party DNS service to host the domain in question.

For example, the 5GMS Application Provider wishes to use the alias `5gms.provider.com` to access content through the 5GMS AS and it includes its chosen host name as a parameter to the *Reserve Server Certificate* operation. In response, the 5GMS AF generates a Certificate Signing Request (CSR) which it returns to the 5GMS Application Provider. The 5GMS AF assigns a canonical host name for the 5GMS AS in a domain under its control per clause 6.0.2.2. The 5GMS AF embeds the Fully-Qualified Domain Name of the alias in the distribution base URL of the Content Hosting Configuration it returns to the 5GMS Application Provider.

Table F.3-1: Example Content Hosting Configuration corresponding to Reserve/Upload Server Certificate procedure

Content Hosting Configuration property	Example value
distributionConfigurations[n]	
canonicalDomainName	com-provider-service.ms.as.3gppservices.org
domainNameAlias	5gms.provider.com
baseURL	*https://5gms.provider.com/*
certificateId	Pointing to Server Certificate resource with: - *CN* = 5gms.provider.com - *subjectAltName[0]* = 5gms.provider.com - *subjectAltName[1]* = …

The 5GMS Application Provider additionally configures the 5GMS AF-nominated *canonicalDomainName* as a *CNAME* record for its chosen 5GMS AS domain name alias in its preferred DNS service.

Listing F.3-1: Example DNS *CNAME* record to support distribution configuration in table F.3-1

```
5gms.provider.com.  CNAME   com-provider-service.ms.as.3gppservices.org
```

The Media Entry Point URL advertised via reference point M5 or M8 (used by the Media Stream Handler to access the content *<relativePath>* in the 5GMS AS at reference point M4) is then:

`https://5gms.provider.com/`*<relativePath>*

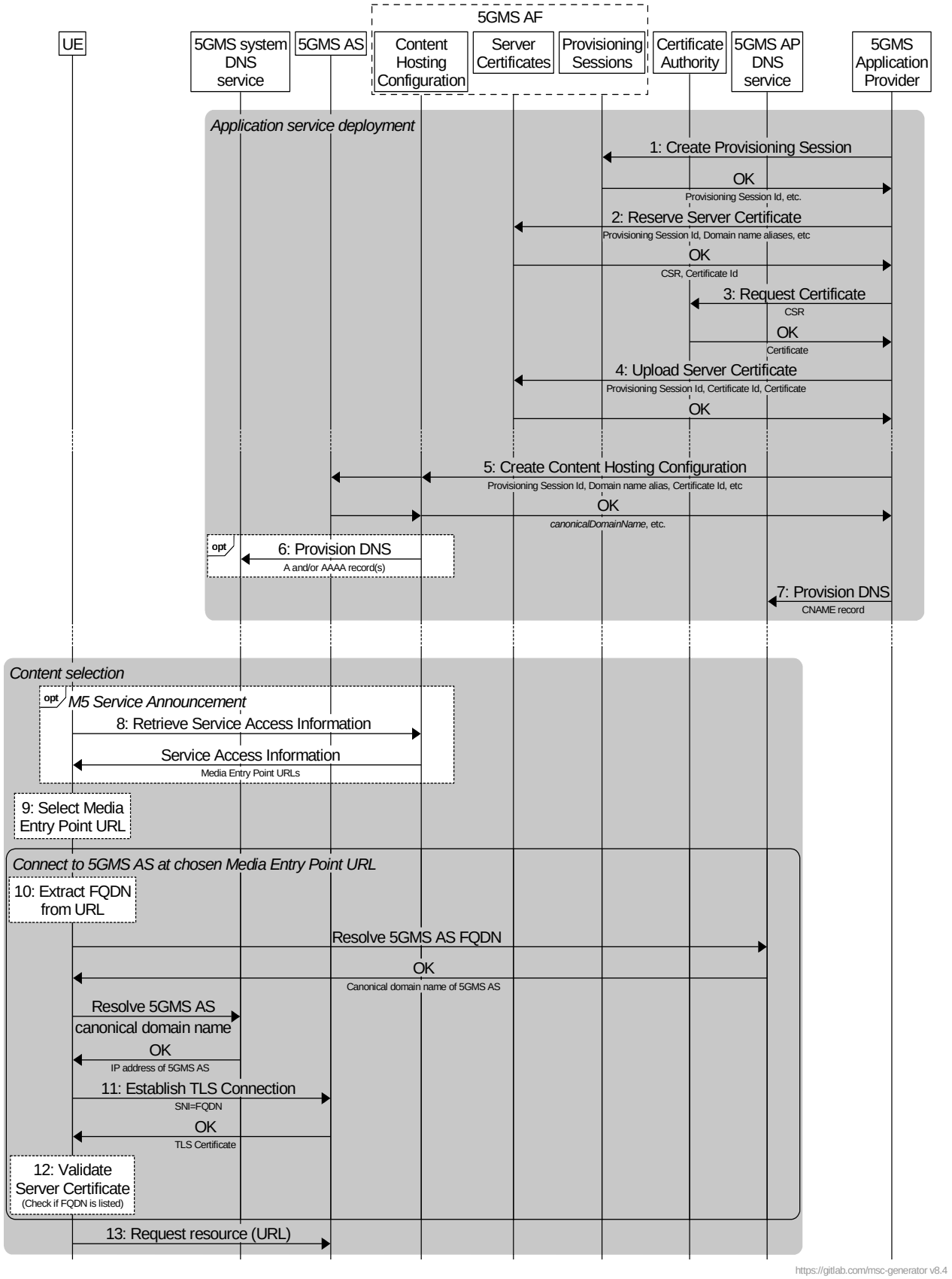

Figure F.3-1: 5GMS AS discovery using DNS using uploaded Server Certificates

Prerequisites:

- A 5GMS-Aware Application is installed on the UE. This includes a list of API endpoint addresses for interacting with the 5GMS AF at reference point M5.

At application service deployment time:

1. The 5GMS Application Provider creates a Provisioning Session using the procedure specified in clause 4.3.2.2. The 5GMS AF provides the Provisioning Session Id in its response to the 5GMS Application Provider.

2. The 5GMS Application Provider creates a CSR using the *Reserve Server Certificate* procedure of this Provisioning Session using the procedure specified in clause 4.3.6.3. The 5GMS Application Provider provides a set of 5GMS AS domain name aliases as input. The CSR and the Certificate Id are provided upon success in the response.

3. The 5GMS Application Provider uses the CSR for obtaining the Server Certificate from its prefered Certificate Authority.

4. The Application Provider uses the Upload Server Certificate procedure (see clause 4.3.6.5) to upload the received Server Certificate.

5. The 5GMS Application Provider creates the Content Hosting Configuration using the procedure specified in clause 4.3.3.2, adding the Domain Name Alias *distributionConfigurations.domainNameAlias* and CertificateId of the uploaded Server Certificate (*distributionConfigurations.certificateId*). The 5GMS AF assigns a cannonical domain name (*canonicalDomainName*) and provides its with the response.

   As a consequence, the 5GMS AF provisions the 5GMS AS with relevant information from the Provisioning Session, including the Server Certificate and Content Hosting Configuration.

6: If it has not already done so, the 5GMS AF provisions *A* and/or *AAAA* records in the 5GMS System's DNS service mapping the canonical name of the 5GMS AS instance to its assigned IP address(es).

NOTE 1: The DNS service may be provided by a third-party service provider under the direction of the 5GMS System operator.

7. The 5GMS Application Provider provisions its DNS service with the *CNAME* record mapping its chosen host name alias to the canonical name of the 5GMS AS instance.

NOTE 2: The 5GMS Application Provider may leverage the DNS of the 5GMS System.

When content is selected in the 5GMS-Aware Application:

8. When Service Access Information retrieval at reference point M5 is used (see clause 4.7.2.3), the 5GMS Client in the UE retrieves the Service Access Information. This may include media entry point URLs within the streamAccess.entryPoints array. Otherwise, the 5GMS-Aware Application obtains this information via reference point M8.

9. The 5GMS Client in the UE selects one of the offered Media Entry Point URLs corresponding to the its media stream handling capabilities.

10. The 5GMS Client extracts the Fully-Qualified Domain Name (FQDN) from the chosen Media Entry Point URL and uses the DNS service to resolve its IP address, first resolving the domain name alias to the canonical domain name using the 5GMS Application Provider's nominated DNS service, and then resolving the canonical domain name to the IP address(es) using the 5GMS System operator's nominated DNS service.

11. When establishing the TLS connection to the 5GMS AS at reference point M4, the Media Stream Handler in the UE cites the FQDN of the Media Entry Point URL in the Server Name Indication (SNI) field of the TLS Client Hello Message. The 5GMS AS uses the value of the SNI field to look up the corresponding Server Certificate and returns it to the Media Stream Handler in its Server Hello response.

NOTE 3: If the Server Certificate was provisioned with a wildcard Common Name, appropriate matching rules are followed by the 5GMS AS to identify the correct Server Certificate to present to the Media Stream Handler.

12. The 5GMS Client Validates the Server Certificate, including whether the value of the Common Name (or one of its Subject Alternative Names) matches the FQDN of the chosen Media Entry Point URL.

When all server certificate validation steps are successfully passed, the following steps are executed

13. The 5GMS Client requests the resource identified by the Media Entry Point over the TLS connection established with the 5GMS AS at reference point M4.

Annex G (informative): Change history

Change history							
Date	**Meeting**	**TDoc**	**CR**	**Rev**	**Cat**	**Subject/Comment**	**New version**
25.6.2019	SA4#104	S4-190649				Initial Version	0.0.1
23.1.2020	SA4#107	S4-200077, S4-200238, S4-200239, S4-200318				Updates during SA4#107	0.3.0
07.02.2020	ConfCall	S4-AHI931, S4-AHI932				Scope, editorial improvements and online edits from Conf Call (6th Feb 2020)	0.3.1
11.02.2020	offline					Editorial updates according to offline email discussions	0.3.2
2020-02	ConfCall	S4-AHI950				Editorial updates from Conf Call (Online, 13th Feb 2020)	0.4.0
2020-03	-	SP-200237				Specification to TSG: 5G Media Streaming (5GMS); Protocols TS 26.512, Version 1.0.0	1.0.0
		S4-AHI953					1.0.1
2020-04	SA4#108e	S4-200513, S4-200514, S4-200633				Renaming entities in the 5GMS Provisioning API, Additional clauses to specify procedures for manipulating Ingest Protocols, Content Preparation Templates and Server Certificates, Consumption Reporting Procedure API- M1d and M5d	1.0.2
2020-05	Conf Call	S4-AHI989				New Structure	1.1.0
2020-06	SA4#109e	S4-200920, S4-200886, S4-200889, S4-200883				920: Consumption reporting in M7d interface, 886: RAN Signaling-based Network Assistance, 889: API for Service Access information acquisition, 883: APIs for Server Certificates, Content Preparation Templates and Ingest Protocols	1.2.0
2020-08	SA4#110e	S4-AHI996 S4-AHI998 S4-AHIA33				996: Completion of Content Preparation Template procedures, 998: Completion of content distribution geofencing feature, A33: Completion of Server Certificates Provisioning API	1.3.0
2020-08	SA4#110e	Cor of S4-AHI998				Correction of S4-AHI998 implementation, Editorial Correction in Clause 11.2.4	1.3.1
2020-08	SA4#110e	S4-201092, S4-201114, S4-201210, S4-201208, S4-201213, S4-201230, S4-201004, S4-201229, S4-201221, S4-201231, S4-201225, S4-201271, S4-201266, S4-201282, S4-201281				1092: Editorial Improvements, 1114: Specification structure – interfaces and APIs, 1210: Completion of Ingest Protocols API, 1208: Informative Annex on Parameter Population, 1213: Addition of General Sections, 1230: M6d APIs for 5GMS, 1004: Informative annex on Content Hosting Configuration examples, 1229: Correction of the Policy Template resource state transitions, 1221: DASH/CMAF in 5GMSd, 1231: M7d APIs, 1225: Update on consumption reporting, 1271: Update on Metrics Reporting, 1266: Updated on M5 Dynamic Policy activation API and M1 Policy Template Provisioning API, 1282: 5GMS3: AF-based Network Assistance, 1281: Provisioning Sessions API	1.4.0
2020-09	SA#89-e	SP-200666				5G Media Streaming (5GMS); Protocols (This was the presentation of Specification to TSG: 5G Media Streaming (5GMS); Protocols TS 26.512, Version 2.0.0 to bring UCC)	16.0.0

2020-12	SA#90-e	SP-200935	0004	3	F	Cumulative corrections of 5GMS3 APIs [CRs implemented: S4-201432: Cumulative corrections of 5GMS3 APIs, Ericsson S4-201305: Editorial corrections, BBC S4-201363: Additions and Modifications to M1 API on Metrics Reporting Configuration, Qualcomm S4-201622: Text on Procedures for Uplink Streaming, Qualcomm, Ericsson S4-201580: Correction of the missing SdfMethod type definition, Ericsson S4-201593: Correction of the missing CRUD operation notation, Ericsson S4-201594: Correction of the MediaPlayerEntry and ClientMetricsReportingConfiguration cardinality in the Service Access Information resource, Ericsson S4-201596: Correction of the Service Access Information subresource (URL), Ericsson S4-201597: Annex for OpenAPI Implementation, Ericsson S4-201595, Update Consumption reporting, Enensys Technology, BBC S4-201590: Bug Fixes on Metrics Reporting Functionality, Ericsson LM, Qualcomm Incorporated S4-201486: AF-based Network Assistance, Sony Europe B.V., Ericsson LM S4-201608: CR on AT Commands for RAN-based Assistance, Qualcomm Inc.]	16.1.0
2021-05	SA#91-e	SP-210039	0007	2	F	OpenAPI implementation and aggregated essential corrections	16.2.1
2021-06	SA#92-e	SP-210566	0010	1	F	ClientId for Consumption and Metrics Reporting	16.3.0
2021-06	SA#92-e	SP-210566	0011	1	F	Corrections to 5GMS stage 3 specification	16.3.0
2021-06	SA#92-e	SP-210566	0012	1	F	Correction on Dynamic Policy parameters	16.3.0
2021-09	SA#93-e	SP-210826	0013	1	F	Corrections to TS 26.512	16.4.0
2022-03	SA#95-e	SP-220055	0014	0	F	Correction to QoE metrics reporting client configuration	16.5.0
2022-03	SA#95-e	SP-220238	0019	0	F	Add support for VR QoE metrics	16.5.0
2022-03	SA#95-e						17.0.0
2022-06	SA#96	SP-220595	0020	2	B	CR on Adding Edge Support	17.1.0
2022-06	SA#96	SP-220595	0021	1	F	Fixing api-version in 5GMS RESTful APIs	17.1.0
2022-06	SA#96	SP-220598	0023	1	B	Support for Data Collection and Reporting for 5G Media Streaming	17.1.0
2022-06	SA#96	SP-220597	0024	1	B	[5MBP3] 5GMS Protocol Extensions for 5GMS via eMBMS	17.1.0
2022-07	SA#96					Editorial Corrections	17.1.1
2022-08	SA#96					Editorial Corrections	17.1.2
2022-09	SA#97-e	SP-220757	0025	1	F	[5GMS_EDGE_3] [EVEX] Rel-17 API corrections	17.2.0
2022-12	SA#98-e	SP-221043	0028	2	F	[5GMS3] Rel-17 clarifications and corrections	17.3.0
2023-03	SA#99	SP-230253	0032	1	F	[5GMS3] Rel-17 corrections	17.4.0
2023-06	SA#100	SP-230546	0033	5	F	[5GMS3, TEI17] Rel-17 corrections	17.5.0
2023-09	SA#101	SP-231053	0037	3	F	[5GMS3, TEI17] Essential maintenance	17.6.0
2023-09	SA#101	SP-230913	0053	3	F	[5GMS, TEI17] Content hosting essential correction	17.6.0
2023-09	SA#101	SP-230918	0039	5	F	[5GMS_EDGE_3] Correction of EAS Discovery	17.6.0
2023-12	SA#102	SP-231368	0054	1	F	[5GMS3, TEI17] Essential maintenance	17.7.0
2023-12	SA#102	SP-231761	0060	5	F	[5GMS3, TEI17] Correction of Server Certificate handling	17.7.0
2023-12	SA#102	SP-231347	0040	4	B	[5GMS_Pro_Ph2] ANBR-based network assistance data reporting	18.0.0
2023-12	SA#102	SP-231229	0041	4	B	[5GMS_Pro_Ph2] Event exposure APIs	18.0.0
2024-03	SA#103	SP-240040	0036	5	B	[5GMS_Pro_Ph2] Default 5GMS AF address	18.1.0
2024-06	SA#104	SP-240568	0070	2	F	[EVEX, TEI18] Add missing explicit data reporting and event exposure parameters	18.2.0
2024-06	SA#104	SP-240859	0046	4	B	[5GMS_Pro_Ph2] Service URL Handling	18.2.0
2024-06	SA#104	SP-240925	0057	8	D	[5GMS_Pro_Ph2] Remove M1, M5 and M6 procedures and APIs	18.2.0
2024-06	SA#104	SP-240689	0055	4	B	[5GMS_Pro_Ph2] 5GMS AS configuration procedures and APIs at M3	18.2.0
2024-06	SA#104	SP-240689	0048	9	B	[5GMS_Pro_Ph2] 5GMS over MBS and 5GMS hybrid services	18.2.0
2024-06	SA#104	SP-240689	0047	12	B	[5GMS_Pro_Ph2] Consolidated media plane enhancements	18.2.0
2024-06	SA#104	SP-240689	0066	7	B	[5GMS_Pro_Ph2] Media delivery session identifier at M4+M7+M11	18.2.0
2024-06	SA#104	SP-240697	0067	-	F	[EVEX, TEI18] Data packaging strategies for 5GMS	18.2.0

2024-07						Fixing implementation of CR0066r7 and CR0070r2	18.2.1
2024-09	SA#105	SP-241108	0075	1		[5GMS_Pro_Ph2] Alignment with renamed data types	18.3.0
2024-09	SA#105	SP-241108	0077			[5GMS_Pro_Ph2] Essential corrections	18.3.0
2024-09	SA#105	SP-241108	0078			[5GMS_Pro_Ph2] Pre-selection of Service Operation Point in Service URL	18.3.0
2024-09	SA#105	SP-241108	0079	1		[5GMS_Pro_Ph2]: OAuth 2.0 security at Reference Point M3	18.3.0
2024-09	SA#105	SP-241118	0076	1		[EVEX, TEI18] Add context identifiers to BaseRecord	18.3.0
2025-01	SA#106	SP-241742	0081	3	F	[5GMS_Pro_Ph2] Alignment of 3GPP Service URL parameter	18.4.0
2025-01	SA#106	SP-241742	0083	3		[5GMS_Pro_Ph2] Completion of media stream handling client API for Background Data	18.4.0
2025-01	SA#106	SP-241587	0084	2		[5GMS_Pro_Ph2] Canonical 5GMS AS host name for universal Media Entry Point URL embedded in portable Service URL	18.4.0
2025-03	SA#107	SP-250131	0085			[5GMS3, TEI18] Align OpenAPI YAML with normative description	18.5.0
2025-06	SA#108	SP-250695	0094	1	F	[5MBP3, TEI18] References, reference points, and other corrections	18.6.0
2025-06	SA#108	SP-250567	0095		F	Update of info and externalDocs fields	18.6.0

History

Document history		
V18.1.0	May 2024	Publication
V18.2.1	August 2024	Publication
V18.3.0	October 2024	Publication
V18.4.0	January 2025	Publication
V18.5.0	April 2025	Publication
V18.6.0	July 2025	Publication