**3GPP TSG-SA4 Meeting #114e *S4-210742***

**Electronic meeting, Telco, May 19-28, 2021**

|  |
| --- |
| *CR-Form-v12.0* |
| **Draft CHANGE REQUEST** |
|  |
|  | **26.501** | **CR** | **-** | **rev** | **-** | **Current version:** | **16.7.0** |  |
|  |
| *For* [***HE******LP***](http://www.3gpp.org/3G_Specs/CRs.htm#_blank)*on using this form: comprehensive instructions can be found at* [*http://www.3gpp.org/Change-Requests*](http://www.3gpp.org/Change-Requests)*.* |
|  |

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

|  |
| --- |
|  |
| ***Title:***  | Corrections and Additions to TS 26.501 |
|  |  |
| ***Source to WG:*** |  Qualcomm Incorporated |
| ***Source to TSG:*** | SA4 |
|  |  |
| ***Work item code:*** | 5GMS3 |  | ***Date:*** | 2020-05-12 |
|  |  |  |  |  |
| ***Category:*** | **F** |  | ***Release:*** | Rel-16 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)Rel-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
|  |  |
| ***Reason for change:*** | There are a number of bugs and under-specification in various sections of TS 26.501. |
|  |  |
| ***Summary of change:*** | Proposed corrections to and improved descriptions for various clauses in TS 26.510. Addition of call flow on QoE metrics collection and reporting in uplink media streaming. |
|  |  |
| ***Consequences if not approved:*** | Incorrect, missing and inadequately defined stage 2 specification presents inconsistencies with the stage 3 text in TS 26.512 and may result in implementation and/or interoperability issues. |
|  |  |
| ***Clauses affected:*** | 3.1, 3.3, 4.1-4.3, 5.1, (new) 6.8 |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  | **X** |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  | **X** |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  | **X** |  O&M Specifications | TS/TR ... CR ...  |
|  |  |
| ***Other comments:*** |  |
| ***56***  |  |
| ***This CR's revision history:*** |  |

1st CHANGE: Clause 3.1

## 3.1 Terms

For the purposes of the present document, the terms given in 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 TR 21.905 [1].

*-----<snipped> -----*

**Provisioning Session:** a data structure supplied at interface M1 by a 5GMS Application Provider that configures the 5GMS features relevant to a set of 5GMS-Aware Applications.

**5GMSd Media Player:** UE function that enables playback and rendering of a media presentation based on a media player entry and exposing some basic controls such as play, pause, seek, stop to the 5GMSd-Aware Application.

NOTE 6: A 5GMSd Media Player is expected to include a Media Access Client, Media Decoders, Media rendering/presentation, and possibly also a DRM Client , a Consumption Measurement and Logging Client and a Metrics Measurement and Logging Client.. The 5GMSd Media Player's Media Access Client receives a Media Player Entry. The 5GMSd Media Player renders the media on the provided output devices, such as a display in case of video.

NOTE 7: The 5GMSd Media Player is functionally similar to the combination of a TS 26.247 [7] 3GP-DASH client and a TS 26.234 [8] PSS media decoder and renderer.

**Service Access Information**: Set of parameters and addresses that are needed by a 5GMS Client to activate the reception of a downlink media streaming session or the transmission on an uplink media streaming session, perform dynamic policy invocation, consumption reporting and/or metrics reporting, and request AF-based network assistance .

**Service and Content Discovery:** Functionality and procedures provided by a 5GMS Application Provider to a 5GMS-Aware Application that enables the end user to discover the available streaming service and content offerings and select a specific service or content item for access.

*-----<snipped> -----*

END OF 1st CHANGE

2nd CHANGE: Clauses 3.3

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in 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 TR 21.905 [1].

*-----<snipped> -----*

UPF User Plane Function

*-----<snipped> -----*

END OF 2nd CHANGE

3rd CHANGE: Clauses 4.1 – 4.3

## 4.1 Overall Media Architecture

Streaming in the context of this specification is defined as the delivery of time-continuous media as the predominant media. Streaming points to the fact that the media is predominantly sent only in a single direction and consumed as it is received. Additionally, the media content may be streamed as it is produced, referred to as live streaming. If content is streamed that is already produced, it is referred to as on-demand streaming.

The overall 5G Media Streaming Architecture is shown in Figure 4.1-1 below.



Figure 4.1-1: 5G Media Streaming within the 5G System

NOTE: The functions indicated by the yellow filled boxes are in scope of stage 3 specifications for 5GMS. The functions indicated by the grey boxes are defined in 5G System specifications. The functions indicated by the blue boxes are neither in scope of 5G Media Streaming nor 5G System specifications.

The 5GMS Application Provider uses 5GMS for streaming services. It provides a 5GMS Aware-Application on the UE to make use of 5GMS Client and network functions using interfaces and APIs defined in 5GMS.

The architecture in Figure 4.1-1 represents the specified 5GMS functions within the 5G System (5GS) as defined in TS 23.501 [2]. Three main functions are defined:

- **5GMS AF:** An Application Function similar to that defined in TS 23.501 [2] clause 6.2.10, dedicated to 5G Media Streaming.

- **5GMS AS:** An Application Server dedicated to 5G Media Streaming.

- **5GMS Client:** A UE internal function dedicated to 5G Media Streaming.

5GMS AF and 5GMS AS are Data Network (DN) functions and communicate with the UE via N6 as defined in TS 23.501 [2].

Functions in trusted DNs, e.g. a 5GMS AF in the Trusted DN, are trusted by the operator’s network as illustrated in Figure 4.2.3-5 of TS 23.501 [2]. Therefore, such AFs may directly communicate with the relevant 5G Core functions.

Functions in external DNs, e.g. a 5GMS AF in the External DN, may only communicate with 5G Core functions via the NEF using N33.

The present document specifies the according network architectures for 5GS. The 5GMS architecture may be applied to an EPS although such an application is not specified in the present document and is left to the discretion of deployments and implementations.

The 5G Media Services Architecture maps the overall high-level architecture shown in Figure 4.1-1 above to the general architecture shown in Figure 4.1-2 below.

Figure 4.1-2: 5G Media Streaming General Architecture

NOTE: In Figure 4.1-2 the 5GMS Client in the UE is depicted in the form of Media Session Handler and Media Stream Handler constituent functions which expose APIs to one another in the same way that those APIs are exposed to 5GMS-Aware Applications. This UE architecture is not applicable generally; it is just as valid to implement a 5GMS Client that does not expose interfaces M6 ad M7 within the 5GMS Client. It is also valid for a 5GMS Client inside a UE to be completely self-contained, such that all functionality typically implemented in the 5GMS-Aware Application is embedded in the UE and thus interfaces M6 and M7 are not exposed at all.

The remainder of the present document specifies stage 2 aspects of the media streaming functional entities shown in the general architecture of Figure 4.1-2.

This architecture specification addresses two main scenarios as concerns each individual media streaming operation:

- **Downlink streaming:** The network is the origin of the media and the UE acts as the consumption device.

**- Uplink streaming:** The UE is the origin of the media and the network acts as the consumption entity.

The functional entities and interfaces of the media streaming general architecture need to be elaborated with specificities relating to downlink and uplink streaming. For this purpose, corresponding descriptions add the suffix “d” for downlink and “u” for uplink functionality as appropriate in each case.

Clause 4.2 introduces the 5G Unicast Downlink Media Streaming architecture.

Clause 4.3 introduces the 5G Unicast Uplink Media Streaming architecture.

## 4.2 5G Unicast Downlink Media Streaming Architecture

### 4.2.1 Standalone – Non-Roaming

The 5GMSd Application Provider uses 5GMSd functions for downlink streaming services. It provides a 5GMSd-Aware Application on the UE the ability to make use of 5GMSd Client and network functions using 5GMSd interfaces and APIs.

The architecture in Figure 4.2.1-1 below represents the specified 5GMSd functions within the 5G System (5GS) as defined in TS23.501 [2]. Three main functions are defined:

- **5GMSd AF:** An Application Function similar to that defined in TS 23.501 [2] clause 6.2.10, dedicated to 5G Downlink Media Streaming.

- **5GMSd AS:** An Application Server dedicated to 5G Downlink Media Streaming.

- **5GMSd Client:** A UE internal function dedicated to 5G Downlink Media Streaming.

5GMSd AF and 5GMSd AS are Data Network (DN) functions and communicate with the User Plane Function (UPF) via N6 as defined in TS 23.501 [2].

Functions in trusted DNs are trusted by the operator’s network as illustrated in Figure 4.2.3-5 of TS 23.501 [2]. Therefore, AFs in trusted DNs may directly communicate with relevant 5G Core functions.

Functions in external DNs, i.e. 5GMSd AFs in external DNs, may only communicate with 5G Core functions via the NEF using N33.

NOTE 1: The 5GMS architecture may be applied to an EPS although such an application is not specified in the present document and is left to the discretion of deployments and implementations.



Figure 4.2.1-1: 5G Downlink Media Streaming within 5G System

NOTE 2: The functions indicated by the yellow filled boxes are in scope of stage 3 specifications for 5GMS. The functions indicated by the grey boxes are defined in 5G System specifications. The functions indicated by the blue boxes are neither in scope of 5G Media Streaming nor 5G System specifications.

The architecture in Figure 4.2.1-2 below represents the media architecture connecting UE internal functions and related network functions.



Figure 4.2.1-2: Media Architecture for unicast downlink media streaming

NOTE 3: The functions indicated by the yellow filled boxes are in scope of stage 3 for 5GMSd. The functions indicated by the grey boxes are defined in 5GS. The interfaces indicated by solid lines are in scope of stage 3 for 5GMSd. The interfaces indicated by dashed lines are defined in 5GS. The interfaces indicated by dotted lines are neither in scope of 5GS nor 5GMSd, but are considered as part of informative call flows.

NOTE 4: Red ovals indicate API provider functions.

NOTE 5: The 5GMSd AF may also interact with the NEF for NEF-enabled API access. However, within Release 16, the NEF is only used by the 5GMSd AF to interact with the Policy and Charging Function (PCF) in 5GMS specifications.

NOTE 6: Some information might also be exchanged between 5GMSd entities and the OAM, although the OAM is not explicitly shown in the architecture.

The following functions are defined:

- 5G Media Streaming Client for downlink (**5GMSd Client**) on the UE: Receiver of 5GMS downlink media streaming service that may be accessed through well-defined interfaces/APIs. Alternatively, the UE may be implemented in a self-contained manner such that interfaces M6d and M7d are not exposed at all.

- The 5GMSd Client contains two subfunctions:

- **Media Session Handler:** A function on the UE that communicates with the 5GMSd AF in order to establish, control and support the delivery of a media session, and may perform additional functions such as consumption and QoE metrics collection and reporting. The Media Session Handler may expose APIs that can be used by the 5GMSd-Aware Application.

- **Media Player:** A function on the UE that communicates with the 5GMSd AS in order to stream the media content and may provide APIs to the 5GMSd-Aware Application for media playback and to the Media Session Handler for media session control.

- **5GMSd-Aware Application:** The 5GMSd Client is typically controlled by an external media application, e.g. an App, which implements external application or content service provider specific logic and enables a media session to be established. The 5GMSd-Aware Application is not defined within the 5G Media Streaming specifications, but the function makes use of 5GMSd Client and network functions using 5GMSd interfaces and APIs.

- **5GMSd AS:** An Application Server which hosts 5G media functions. Note that there may be different realizations of the 5GMSd AS, for example a Content Delivery Network (CDN).

- **5GMSd Application Provider:** External application or content-specific media functionality, e.g., media creation, encoding and formatting that uses 5GMSd interfaces to stream media to 5GMSd-Aware Applications.

- **5GMSd AF:** An Application Function that provides various control functions to the Media Session Handler on the UE and/or to the 5GMSd Application Provider. It may relay or initiate a request for different Policy or Charging Function (PCF) treatment or interact with other network functions via the NEF.

NOTE 7: There may be multiple 5GMSd AFs present in a deployment and residing within the Data Network , each exposing one or more APIs.

The following interfaces are defined for 5G Downlink Media Streaming:

- M1d (5GMSd Provisioning API): External API, exposed by the 5GMSd AF which enables the 5GMSd Application Provider to provision the usage of the 5G Media Streaming System for downlink media streaming and to obtain feedback.

- M2d (5GMSd Ingest API): Optional External API exposed by the 5GMSd AS used when the 5GMSd AS in the trusted DN is selected to host content for the streaming service.

- M3d: (Internal and NOT SPECIFIED): Internal API used to exchange information for content hosting on a 5GMSd AS within the trusted DN.

- M4d (Media Streaming APIs): APIs exposed by a 5GMSd AS to the Media Player to stream media content.

- M5d (Media Session Handling API): APIs exposed by a 5GMSd AF to the Media Session Handler for media session handling, control, reporting and assistance that also include appropriate security mechanisms, e.g. authorization and authentication.

- M6d (UE Media Session Handling APIs): APIs exposed by a Media Session Handler to the Media Player for client-internal communication, and exposed to the 5GMSd-Aware Application enabling it to make use of 5GMS functions.

- M7d (UE Media Player APIs): APIs exposed by a Media Player to the 5GMSd-Aware Application and Media Session Handler to make use of the Media Player.

- M8d: (Application API): application interface used for information exchange between the 5GMSd-Aware Application and the 5GMSd Application Provider, for example to provide Service Access Information to the 5GMSd-Aware Application. This API is external to the 5G System and not specified by 5GMS.

NOTE 8: Non-Standalone, Roaming, Non-3GPP Access and EPC-5GC interworking aspects are FFS.

The following subfunctions are identified as a part of a more detailed breakdown of the 5GMSd AS for stage 3 specifications:

- Adaptive Bit Rate (ABR) Encoder, Encryption and Encapsulator.

- Manifest (e.g. MPD) Generator and Segment (e.g. DASH) Packager.

- Origin Server.

- CDN Server (e.g. Edge Servers).

- DRM Server (e.g. DRM License Server).

- Service Directory.

- Content Guide Server.

- Replacement content server (e.g. Ad content server).

- Manifest Proxy, i.e. MPD modification server.

- App Server.

- Session Management Server.

A breakdown of 5GMSd functions in the UE is provided in clause 4.2.2 below.

### 4.2.2 UE 5GMSd Functions

The UE may include many detailed subfunctions that can be used individually or controlled individually by the 5GMSd-Aware Application. This clause breaks down several relevant identified subfunctions for which stage 3 specification is available.

The 5GMSd-Aware Application itself may include many functions that are not provided by the 5GMSd Client or by the 5G UE. Examples include service and content discovery, notifications and social network integration. The 5GMSd-Aware Application may also include functions that are equivalent to ones provided by the 5GMSd Client and may only use a subset of the 5GMSd client functions. The 5GMSd-Aware Application may act based on user input or may for example also receive remote control commands from the 5GMSd Application Provider through M8d.

With respect to Media Player functions, Figure 4.2.2-1 below shows more detailed functional components of a UE for media player functions to access the 5GMSd AS.



Figure 4.2.2-1: UE 5G Downlink Media Streaming Functions (Media Player centric)

The following subfunctions are identified as part of a more detailed breakdown of the Media Player function:

- **Media Access Client:** Accesses media content such as DASH-formatted media segments.

- **Media Decapsulation:** Extracts the elementary media streams for decoding and provides media system related functions such as time synchronization, capability signalling, accessibility signalling, etc.

- **Consumption Measurement and Logging Client:** Performs the measurement and logging of content consumption-related information in accordance with the Consumption Reporting Configuration part of provisioning data, supplied by the 5GMSd Application Provider to the 5GMSd AF, and forwarded by the 5GMSd AF to the Media Player via the Media Session Handler.

- **Metrics Measurement and Logging Client:** Performs the measurement and logging of QoE metrics in accordance with the Metrics Reporting Configuration part of provisioning data, supplied by the 5GMSd Application Provider to the 5GMSd AF, and forwarded by the 5GMSd AF to the Media Player via the Media Session Handler.

- **DRM Client** (optional): When present, the DRM client might or might not be a part of the Media Player. It provides a content protection mechanism with its unique key management and key delivery system, authentication/‌authorization, policy enforcement and entitlement check. The DRM Client is not defined within 5G Media Streaming specifications.

- **Media Decryption** (optional): When present, media decryption is responsible to decrypt the media samples using the keys provided in the DRM license, and further passing to the Media Decoder to enable playback of encrypted media. The media decryption and media decoding could be implemented on a general-purpose processor in software or hardware or, for a more secure and robust architecture, the decryption, decoding and rendering could be implemented on the hardware of secure processors.

- **Media Decoder**: Decodes the media, such as audio or video.

- **Media Presentation and Rendering:** Presents the media using an appropriate output device and enables possible interaction with the media.

With respect to the Media Session Handler, Figure 4.2.2-2 below shows more detailed functional components of a UE to access the 5GMSd AF.



Figure 4.2.2-2: UE 5G Media Streaming Functions (Control-Centric)

NOTE 1: The yellow color indicates here that the 3GPP has created specifications for the function.

NOTE 2: A UE is a logical device which may correspond to the tethering of multiple physical devices or other types of realizations.

The following subfunctions are identified as part of a more detailed breakdown of Media Session Handler:

- **Core Functions:** Realization of a “session” concept for media communications, optionally spanning multiple stateless sessions. May optionally interact with network-based 5GMSd AFs.

- **Metrics Collection and Reporting:** executes the collection of QoE metrics measurement logs from the Media Player and sending of metrics reports to the 5GMSd AF for the purpose of metrics analysis or to enable potential transport optimizations by the network.

- **Consumption Collection and Reporting:** executes the collection of content consumption measurement logs from the Media Player and sending of consumption reports to a 5GMSd AF about the currently consumed media within the available presentation, about the UE capabilities and about the environment of the media session for potential transport optimizations by the network or consumption report analysis.

- **Network Assistance:** downlink streaming delivery assisting functions provided by the network to the 5GMSd Client and Media Player in the form of bit rate recommendation (or throughput estimation) and/or delivery boost. Network Assistance functionality may be supported by 5GMSd AF or ANBR-based RAN signaling mechanisms.

NOTE 3: Based on such a decomposition, additional interfaces and APIs may exist in inside the UE:

- Media control interface(s) to configure and interact with the different UE media functions.

- Media control interface for media session management.

- Control interface for collectionof logged QoE metrics measurements..

- Control interface for collection of logged content consumption measurements.

- Decoded media samples are handed over to the media renderer.

- Decrypted, compressed media samples are handed over to a trusted media decoder.

- In case of encryption, the encrypted, compressed media samples are handed over to the DRM Client.

NOTE 4: Non-Standalone, Roaming, Non-3GPP Access and EPC-5GC interworking aspects are FFS.

### 4.2.3 Service Access Information for Downlink Media Streaming

The Service Access Information is the set of parameters and addresses which are needed by the 5GMSd Client to activate and control the reception of a downlink streaming session, and to report service/content consumption and/or QoE metrics.

The Service Access Information may be provided together with other service announcement information using M8d. Alternatively, the 5GMSd Client fetches the Service Access Information from the 5GMSd AF. Regardless of how it is provided, the Service Access Information contains different information, depending on the collaboration model between the 5GMS System and the 5GMSd Application Provider, and also depending on offered features. Baseline parameters are listed in Table 4.2.3‑1 below:

Table 4.2.3-1: Parameters of baseline service access information

|  |  |
| --- | --- |
| Parameters | Description |
| Provisioning Session identifier | Unique identification of the M1d Provisioning Session. |

When the content hosting feature is activated for a downlink streaming session, the parameters from Table 4.2.3-1a below can additionally be present.

Table 4.2.3-1a: Streaming Access parameters

|  |  |
| --- | --- |
| Parameters | Description |
| Media Player Entry | A document or a pointer to a document that defines a media presentation e.g. MPD for DASH content or URL to a video clip file. |

When the consumption reporting feature is activated for a downlink streaming session, the parameters from Table 4.2.3‑2 below are additionally present.

Table 4.2.3-2: Parameters for consumption reporting configuration

|  |  |
| --- | --- |
| Parameters | Description |
| Reporting interval | Identifies the interval between consumption reports being sent by the Media Session Handler. |
| Server address  | A list of 5GMSd AF addresses where the consumption reports are sent by the Media Session Handler. |
| Sample percentage | The proportion of clients that shall report media consumption.If not specified, all clients shall send reports. |
| Location reporting | Identify whether the Media Session Handler provides location data to the 5GMSd AF (in case of MNO or trusted third parties) |

When the dynamic policy invocation feature is activated for a downlink streaming session the parameters from Table 4.2.3‑3 below are additionally present.

Table 4.2.3-3: Parameters for dynamic policy invocation configuration

|  |  |
| --- | --- |
| Parameters | Description |
| Server address | A list of 5GMSd AF addresses (in the form of opaque URLs) which offer the APIs for dynamic policy invocation sent by the 5GMS Media Session Handler. |
| Valid Policy Template Ids | A list of Policy Template identifiers which the 5GMSd Client is authorized to use. |
| Service Data Flow Methods | A list of recommended Service Data Flow description methods (descriptors), e.g. 5-Tuple, ToS, 2-Tuple, etc, which should be used by the Media Session Handler to describe the Service Data Flows for the traffic to be policed. |
| External reference | Additional identifier for this Policy Template, unique within the scope of its Provisioning Session, that can be cross-referenced with external metadata about the streaming session. |

When the metrics collection and reporting feature is activated for a downlink streaming session, one or more parameter sets for metrics configuration, according to Table 4.2.3‑4, are additionally present. Each metrics configuration set contains specific settings valid for that configuration, which is typically metric scheme dependent, and collection and reporting shall be done separately for each set.

Table 4.2.3-4: Parameters for each metrics configuration set

|  |  |
| --- | --- |
| Parameters | Description |
| Scheme | The scheme associated with this metrics configuration set. A scheme may be associated with 3GPP or with a non-3GPP entity. If not specified, a default 3GPP metrics scheme shall apply.Metrics schemes shall be uniquely identified by URIs. |
| Server address | A list of 5GMSd AF addresses to which metric reports shall be sent for this metrics configuration set. |
| DNN | The Data Network Name (DNN) which shall be used when sending metrics report for this metrics configuration set.If not specified, the default DNN shall be used. |
| Reporting interval | The sending interval between metrics reports for this metrics configuration set.If not specified, a single final report shall be sent after the streaming session has ended. |
| Sample percentage | The proportion of streaming sessions that shall report metrics for this metrics configuration set.If not specified, reports shall be sent for all sessions. |
| Streaming source filter | A list of content URL patterns for which metrics reporting shall be done for this metrics configuration set.If not specified, reporting shall be done for all URLs. |
| Metrics | A list of metrics which shall be collected and reported for this metrics configuration set.For progressive download and DASH streaming services, the listed metrics 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 [7].In addition, for the 3GPP metrics scheme as applied to DASH streaming, the quality reporting scheme and quality reporting protocol as defined in clauses 10.5 and 10.6, respectively, of [7] shall be used.If not specified, a complete (or default if applicable) set of metrics will be collected and reported. |

When 5GMSd AF-based Network Assistance is activated for a downlink streaming session the parameters from Table 4.2.3‑5 below shall be additionally present.

Table 4.2.3-5: Parameters for 5GMSd AF-based Network Assistance configuration

|  |  |
| --- | --- |
| Parameters | Description |
| Server address | 5GMSd AF address that offers the APIs for 5GMSd AF-based Network Assistance, accessed by the 5GMSd Media Session Handler. The server address shall be an opaque URL, following the 5GMS URL format. |

## 4.3 5G Uplink Media Streaming Architecture

### 4.3.1 Media Architecture

The 5GMSu Application Provider uses 5GMSu functions for uplink streaming services. It provides a 5GMSu-Aware Application on the UE the ability to make use of 5GMSu Client and network functions using 5GMSu interfaces and APIs.



Figure 4.3.1-1: Media Architecture for unicast uplink media streaming

NOTE 1: The functions indicated by the yellow filled boxes are in scope of stage 3 specifications for 5GMS. The functions indicated by the grey boxes are defined in 5G System specifications. The functions indicated by the blue boxes are neither in scope of 5G Media Streaming nor 5G System specifications.

The architecture in Figure 4.3.1-1 above represents the specified 5GMSu functions within the 5G System (5GS) as defined in TS23.501 [2]. Three main functions are defined:

- **5GMSu AF:** An Application Function similar to that defined in TS 23.501 [2] clause 6.2.10, dedicated to 5G Uplink Media Streaming.

- **5GMSu AS:** An Application Server dedicated to 5G Uplink Media Streaming.

- **5GMSu Client:** A UE-internal function dedicated to 5G Uplink Media Streaming.

5GMSu AF and 5GMSu AS are Data Network (DN) functions and communicate with the UE via N6 as defined in TS23.501 [2].

Functions in trusted DNs, e.g., a 5GMSu AF in the Trusted DN, are trusted by the operator’s network as illustrated in Figure 4.2.3-5 of TS 23.501 [2]. Therefore, such AFs may directly communicate with relevant 5G Core functions.

Functions in external DNs, e.g., a 5GMSu AF in the External DN, may only communicate with 5G Core functions via the NEF using N33.

The architecture in Figure 4.3.1-2 below represents the media architecture connecting UE internal functions and related network functions for 5G Uplink Media Streaming.



Figure 4.3.1-2: Media Architecture for unicast uplink media streaming

NOTE 2: The functions indicated by the yellow filled boxes are in scope of stage 3 for 5GMSu. The functions indicated by the grey boxes are defined in 5GS. The interfaces indicated by solid lines are in scope of stage 3 for 5GMSu. The interfaces indicated by dashed lines are defined in 5GS. The interfaces indicated by dotted lines are neither in scope of 5GS nor 5GMSu, but are considered as part of informative call flows.

NOTE 3: Red ovals indicate API provider functions.

NOTE 4: The 5GMSu AF may also interact with the NEF for NEF-enabled API access. However, within Release 16, the NEF is only used by the 5GMSu AF to interact with the Policy and Charging Function (PCF) in 5GMS specifications.

NOTE 5: Some information might also be exchanged between 5GMSu entities and the OAM, although the OAM is not explicitly shown in the architecture.

The following functions are defined:

- 5G Media Streaming Client for uplink (**5GMSu Client**) on UE: Originator of 5GMSu service that may be accessed through well-defined interfaces/APIs. The UE may also be implemented in a self-contained manner such that interfaces M6u and M7u are not exposed at all.

- The 5GMSu Client contains two subfunctions:

- **Media Session Handler:** A function on the UE that communicates with the 5GMSu AF in order to establish, control and support the delivery of a media session, and that may perform QoE metrics reporting. The Media Session Handler exposes APIs that can be used by the 5GMSu-Aware Application.

- **Media Streamer:** A function on the UE that communicates with the 5GMSu AS in order to perform uplink streaming of media content and provides a service to both the 5GMSu-Aware Application for media capturing and uplink streaming, and the Media Session Handler for media session control.

- **5GMSu-Aware Application:** The 5GMSu Client is typically controlled by an external media application, e.g. an App, which implements external application or content service provider specific logic and enables a media session to be established. The 5GMSu-Aware Application is not defined within the 5G Media Streaming specifications, but the function makes use of 5GMSu Client and network functions using 5GMSu interfaces and APIs.

- **5GMSu AS:** An Application Server which hosts 5G media functions. Note that there may be different realizations of a 5GMSu AS, for example a Content Delivery Network (CDN) server.

- **5GMSu Application Provider:** External application or content-specific media functionality, e.g., media storage, consumption, transcoding and redistribution that uses 5GMSu interfaces to receive streaming media from 5GMSu-Aware Applications.

- **5GMSu AF:** An Application Function that provides various control functions to the Media Session Handler on the UE and/or to the 5GMSu Application Provider. It may relay or initiate a request for different Policy or Charging Function (PCF) treatment or interact with other network functions via the NEF.

NOTE 6: There may be multiple 5GMSu AFs present in a deployment and residing within the Data, each exposing one or more APIs.

The following interfaces are defined for 5G Uplink Media Streaming:

- M1u (5GMSu Provisioning API): External API, exposed by the 5GMSu AF and which enables the 5GMSu Application Provider to provision the usage of the 5G Media Streaming system for uplink media streaming and to obtain feedback.

- M2u (5GMSu Publish API): Optional External API exposed by the 5GMSu AS used when the 5GMSu AS in the trusted DN is selected to receive the content for the streaming service.

- M3u: (Internal and NOT SPECIFIED): Internal API used to exchange information for content hosting on a 5GMSu AS within the trusted DN.

- M4u (Uplink Media Streaming APIs): APIs exposed by a 5GMSu AS to the Media Streamer to stream media content.

- M5u (Media Session Handling API): APIs exposed by a 5GMSu AF to the Media Session Handler for media session handling, control and assistance that also include appropriate security mechanisms e.g. authorization and authentication, and QoE metrics reporting.

- M6u (UE Media Session Handling APIs): APIs that may be exposed by a Media Session Handler to the Media Streamer for client-internal communication, and to the 5GMSu-Aware Application to make use of 5GMSu functions.

- M7u (UE Media Streamer APIs): APIs that may be exposed by a Media Streamer to the 5GMSu-Aware Application and Media Session Handler to make use of the Media Streamer, including configuration of QoE metrics to be measured and logged, and the collection of metrics measurement logs.

- M8u: (Application API): application interface used for information exchange between the 5GMSu-Aware Application and the 5GMSu Application Provider, for example to provide Service Access Information to the 5GMSu-Aware Aapplication. This API is external and not specified in the 5GMS architecture.

NOTE 7: Non-Standalone, Roaming, Non-3GPP Access and EPC-5GC interworking aspects are FFS.

### 4.3.2 UE Media Functions

The UE may include many detailed subfunctions that can be used individually or controlled individually by the 5GMSu-Aware Application. This clause breaks down several relevant identified subfunctions for which stage 3 specification is available.

The 5GMSu-Aware Application itself may include many functions that are not provided by the 5GMSu Client or to the 5G UE. Examples include peripheral discovery, notifications and social network integration. The 5GMSu-Aware Application may also include functions that are equivalent to ones provided by the 5GMSu Client and may only use a subset of the 5GMSu Client functions.

With respect to the Media Streamer and Media Handler functions, Figure 4.3.2-1 shows more detailed functional components of a 5GMSu Client.

Figure 4.3.2-1: UE 5G Uplink Media Streaming Functions

NOTE 1: A UE is a logical device which may correspond to the tethering of multiple physical devices or other types of realizations.

The following subfunctions are identified as part of a more detailed breakdown of the UE 5G Uplink Media Streaming functions:

- **5GMSu-Aware Application:** application which is out of scope of the present specification and which uses the UE 5G Uplink Media Streaming functions and APIs.

- **Media Capturing:** Devices such as video cameras or microphones that transform an analog media signal into digital media data.

- **Media Encoder(s):** Compresses the media data.

- **Metrics Measurement and Logging:** execution of QoE metrics measurement and logging by the Media Streamer in accordance with the metrics configuration.

- **Metrics Collection and Reporting:** execution of the collection of QoE metrics measurement logs from the Media Streamer by the Media Session Handler for subsequent metrics reporting to the 5GMSu AF, in accordance with the metrics configuration.

- **Media Upstream Client:** encapsulates encoded media data and pushes it upstream.

NOTE 2: The Media Upstream Client maps logically to the FLUS media function in the FLUS Source specified in TS 26.238 Uplink Streaming stage 3 [5].

- **Network Assistance:** uplink streaming delivery assisting functions provided by the network to the 5GMSu Client and Media Streamer in the form of bit rate recommendation (or throughput estimation) and/or delivery boost. Network Assistance functionality may be supported by 5GMSu AF or ANBR-based RAN signaling mechanisms.

NOTE 3: The Network Assistance function maps logically to the FLUS Assistance function specified in TS 26.238 Uplink Streaming stage 3 [5].

- **Media Remote Control:** receives control commands from a 5GMSu AF.

NOTE 4: Media Remote Control maps logically to the FLUS Remote control function specified in TS 26.238 Uplink Streaming stage 3 [5].

- **Core Functions:** configures the 5GMSu AS for uplink streaming reception.

NOTE 5: The Core Functions map logically to the FLUS control function in the FLUS source specified in TS 26.238 Uplink Streaming stage 3 [5].

Here are the roles of the different APIs of the UE 5G Uplink Media Streaming functions:

- M6u: API used to control the Core Functions and the Remote Control function.

- M7u: API used to configure, activate and stop the Media Capturing, Media Encoding(s) and Media Upstream Client functions, and also to support metrics configuration and collection functionality.

END OF 3rd CHANGE

4th CHANGE: Clause 5.1

## 5.1 General

The downlink streaming procedures follow the general high-level workflow depicted in Figure 5.1‑1 below, starting from provisioningandingestsession preparation to the actual content streaming sessions. The **Ingest Session** refers to the time interval during which media content is uploaded to the 5GMSd AS. The **Provisioning Session** refers to the procedures by which the 5GMSd Application Provider provides Service Access Information to the 5GMSd AF with regards to M5d operation (media session control via dynamic policy or network assistance invocation, consumption and/or metrics reporting configuration). Via the Provisioning Session, the 5GMSd Application Provider also supplies content ingestion, hosting and distribution information associated with M2d and M4d operation, to the 5GMSd AS via the 5GMSd AF. The **Media Streaming Session** refers to the time interval during which the 5GMSd Client can access the media content and the 5GMSd Application Provider can control and monitor the media content and its delivery. Interactions between the 5GMSd AF and the 5GMSd Application Provider may occur at any time while the Provisioning Session is active.



Figure 5.1-1: High Level Procedure for downlink streaming

The 5GMSd provisioning API at M1d allows selection of media session handling (M5d) and media streaming (M4d) options, including whether the media content is hosted on trusted 5GMSd ASs. The selection is identified by a Provisioning Session identifier. The 5GMSd AF selects the M5d interface features according to the provisioning option. The Media Session Handling interface exposed by the 5GMSd AF can be used for core session handling; configuring content consumption measurement, logging, collection and reporting; configuring QoE metrics measurement, logging collection and reporting; requesting different policy and charging treatments; or 5GMSd AF-based Network Assistance.

When the media content is hosted by trusted Media ASs, then the 5GMSd AF selects and configures the 5GMSd AS. Interactions between a 5GMSd AF and a 5GMSd AS (M3d interactions) take place for 5GMS Ingest (M2d) and Media Streaming (M4d) resource reservations. The 5GMSd AS allocates M2d and M4d resources and communicates resource identifiers back to the 5GMSd AF. The 5GMSd AF provides information about the provisioned resources (in form of resource identifiers) for Media Session Handling (M5d), the 5GMSd Ingest (M2d) and the Media Streaming (M4d), to the 5GMSd Application Provider. The resource identifiers for Media Session Handling and Media Streaming are needed by the 5GMSd Client to access the 5GMSd functions.

When Content Hosting is provided by a 5GMSd AS in the external DN, then the M3d interface is not used and the 5GMSd AF does not provide 5GMS Ingest (M2d) and Media Streaming (M4d) resource reservations. M3d procedures are not standardized.

5GMSd Clients can (in principle) start streaming media as soon as the corresponding content is ingested by activating a unicast downlink streaming session. However, it may take some time until the media content is available for Media Streaming (via the Media Streaming API) or the distribution availability might be based on a provisioned schedule. The unicast downlink streaming session for a given UE (or "for each UE") is active from the time at which the 5GMSd-Aware Application activates the reception of a streaming service until its termination.

The 5GMSd-Aware Application receives application data from the 5GMSd Application Provider before receiving the downlink streaming media. The application data contains Service Access Information, which acts as an entry point for the 5GMSd Client to start the downlink streaming session. The 5GMSd Client may either receive a reference to that Service Access Information or the full Service Access Information from the 5GMSd Application Provider.

Steps:

1. The 5GMSd Application Provider creates a Provisioning Session with the 5GMSd AF and starts provisioning the usage of the 5G Media Streaming System. During the establishment phase, the used features are negotiated and detailed configurations are exchanged. The 5GMSd AF receives Service Access Information for M5d (Media Session Handling) and, where media content hosting is negotiated, Service Access Information for M2d (Ingestion) and M4d (Media Streaming) as well. This information is needed by the 5GMSd Client to access the service. Depending on the provisioning, only a reference to the Service Access Information might be supplied.

2. When Content Hosting is offered and selected there may be interactions between the 5GMSd AF and the 5GMSd AS, e.g. to allocate 5GMSd content ingest and distribution resources. The 5GMSd AS provides resource identifiers for the allocated resources to the 5GMSd AF, which then provides the information to the 5GMSd Application Provider. The M3d procedures between 5GMSd AF and 5GMSd AS are not specified.

3. The 5GMSd Application Provider starts the Ingest Session by ingesting content. In case of live services, the content is continuously ingested. In case of on-demand streaming services, the content may be uploaded once and then updated later on.

NOTE 1: A 5GMSd AS in the external Data Network may provide the Content Hosting.

4. The 5GMSd Application Provider provides the Service Announcement Information to the 5GMSd-Aware Application. The service announcement includes either the whole Service Access Information (i.e. details for Media Session Handling (M5d) and for Media Streaming access (M4d)) or a reference to the Service Access Information or pre-configured information. When only a reference is included, the 5GMSd Client fetches (in step 6) the Services Access Information when needed.

5. When the 5GMSd-Aware Application decides to begin streaming, the Service Access Information (all or a reference) is provided to the 5GMSd Client. The 5GMSd Client activates the unicast downlink streaming session.

6. (Optional) In case the 5GMSd Client received only a reference to the Service Access Information, then it acquires the Service Access Information from the 5GMSd AF.

NOTE 2: Pre-caching of Service Access Information may also be supported by the 5GMS Client to speed up the activation of the service.

7. The 5GMSd Client uses the Media Session Handling API exposed by the 5GMSd AF at M5d. The Media Session Handling API is used for configuring content consumption measurement, logging, collection and reporting; configuring QoE metrics measurement, logging, collection and reporting; requesting different policy and charging treatments; or 5GMSd AF-based Network Assistance. The actual time of API usage depends on the feature and interactions that may be used during the media content reception.

8. The 5GMSd Client activates reception of the media content.

END OF 4th CHANGE

5th CHANGE: New clause 6.8

## 6.8 Uplink Media Streaming with Metrics Collection and Reporting

The procedure as shown in Figure 6.8-1 illustrates the collection and reporting of QoE metrics in uplink media streaming service operation.



Figure 6.8-1: Metrics collection and reporting in uplink media streaming

The message sequence steps are described below:

1: The 5GMSu AF is provisioned with uplink metrics reporting configuration information in accordance with the metrics scheme defined by the 5GMSu Application Provider. This configuration information describes the desired metrics collection by the Media Streamer, the retrieval of those collected metrics from the Media Streamer by the Media Session Handler, the generation of metrics reports by the Media Session Handler, and the delivery of metrics reports from the Media Session Handler to the 5GMSu AF via M5u.

2: The 5GMSu-Aware Application triggers the acquisition by the 5GMSu Client of Service Access information containing uplink metrics reporting configuration information associated with the metrics scheme. Metrics collection configuration is acquired by the Media Streamer and metrics reporting configuration is acquired by the Media Session Handler.

3: Time passes until the 5GMSu Client initiates session establishment for media uploading.

4 The 5GMSu-Aware Application informs the Media Streamer of impending media uploading.

5: The Media Streamer requests the establishment of an uplink streaming session with the Media Session Handler.

6: The Media Session Handler request a specific QoS policy and charging treatment for the application data flow of an impending uplink media streaming session by invoking, via M5u, the Dynamic Policies API exposed by the 5GMSu AF.

7: The 5GMSu AF triggers a dynamic PCC rule update via its interaction with the PCF (over N5) or NEF (over N33).

8: As outcome of the previous step, dynamic policy treatment will be allocated to the appropriate application data flow of the ensuing uplink streaming session, resulting in the establishment of the uplink media streaming pipeline between the Media Streamer and the 5GMSu AS, with corresponding notification provided to the 5GMSu AF.

9: The 5GMSu AF notifies the Media Session Handler that the requested dynamic policy treatment will be applied to the impending uplink media streaming session.

10: The Media Session Handler informs the Media Streamer of the successful set-up of the uplink streaming session.

11: The Media Session Handler queries the Media Streamer about its capability to perform metrics collection (measurement and logging function) in accordance with the metrics scheme indicated in the uplink metrics reporting configuration.

12: The Media Streamer acknowledges its support for the collection of the required metrics for the associated metrics scheme.

During the course of media uploading, steps 13-19 below may be repeated, depending on the duration of the uplink streaming and the frequency of metrics reporting as set by the metrics configuration of the scheme.

13: The Media Streamer delivers media content to the 5GMSu AS at M4u.

14: The uploaded media content is egested to the 5GMSu Application Provider via M2u.

15: The Media Streamer notifies the Media Session Handler that media uploading has begun, causing the Media Session Handler to initialize and begin countdown of the metrics reporting interval timer.

16: Upon expiration of the timer, the Media Session Handler retrieves the logged metrics measurements from the Media Streamer.

17: In accordance with its metrics reporting configuration as provisioned in step 2, a metrics report is sent from the Media Session Handler to the 5GMSu AF via M5u.

18: In accordance with its metrics reporting configuration as provisioned in step 1, the 5GMSu AF performs post-processing in accordance with the metrics scheme (e.g., filtering, aggregation, reformatting) of the received metrics report.

19: The 5GMSu AF sends a processed metrics report in accordance with the metrics scheme to the 5GMSdu Application Provider via M2u.

Upon the termination of media upload (as notified by the 5GMSu-Aware Application to the Media Streamer) a final round of metrics collection and reporting is performed:

20: The 5GMSu-Aware Application informs the Media Streamer of the end of media uploading.

21: The Media Session Handler obtains the final metrics measurement from the Media Streamer. (This procedure might occur prior to the nominal expiration of the metrics reporting interval timer.)

22: A final metrics report is sent by the Media Session Handler to the 5GMSu AF via M5u. (This procedure might occur prior to the expiration of the nominal metrics reporting interval.)

23: Same as step 18.

24: Same as step 19.

END OF 5th CHANGE