**3GPP TSG- Meeting #**

**, , -** revision of S4aI240184

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| *CR-Form-v12.3* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** |  |  |
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| *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)*.* |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

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| ***Title:***  |  |
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| ***Source to WG:*** |  |
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| ***Work item code:*** |  |  | ***Date:*** |  |
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| ***Category:*** |  |  | ***Release:*** |  |
|  | *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-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19) Rel-20 (Release 20)* |
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| ***Reason for change:*** |  |
|  |  |
| ***Summary of change:*** |  |
|  |  |
| ***Consequences if not approved:*** |  |
|  |  |
| ***Clauses affected:*** | 2, 5.16 (new), 6.16 (new) |
|  |  |
|  | **Y** | **N** |  |  |
| ***Other specs*** |  |  |  Other core specifications  | TS/TR ... CR ...  |
| ***affected:*** |  |  |  Test specifications | TS/TR ... CR ...  |
| ***(show related CRs)*** |  |  |  O&M Specifications | TS/TR ... CR ...  |
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| ***Other comments:*** |  |
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| ***This CR's revision history:*** |

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| [**S4aI240167**](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_MBS/Docs/S4aI240167.zip) | [FS\_AMD] Common Client Metadata | Qualcomm Germany, BBC | Thomas Stockhammer |

**E-mail Discussion**:[Re: [FS\_AMD] S4aI240167 "WT#13: New clause 5.24 QUIC-based Media Delivery"](https://list.etsi.org/scripts/wa.exe?A2=3GPP_TSG_SA_WG4_MBS;526e4b35.2410C&S=)* Thomas Stockhammer
* Tue, 15 Oct 2024 12:57:54 +0000

[[FS\_AMD] S4aI240167 "WT#13: New clause 5.24 QUIC-based Media Delivery"](https://list.etsi.org/scripts/wa.exe?A2=3GPP_TSG_SA_WG4_MBS;de45040.2410C&S=)* Richard Bradbury
* Tue, 15 Oct 2024 13:54:51 +0100

**Revisions**:

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| --- | --- | --- |
| [S4aI240167r01-26804-0015rev5-CMCD.docx](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_MBS/Inbox/Drafts/S4aI240167r01-26804-0015rev5-CMCD.docx) | 2024/10/18 8:03 | 412,7 KB |
| [S4aI240167r01\_BBC.docx](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_MBS/Inbox/Drafts/S4aI240167r01_BBC.docx) | 2024/10/18 11:47 | 528,4 KB |

**Presenter**: Thomas Stockhammer**Online Discussion**:* October 16, 2024:
	+ Thomas presents original version
	+ Richard: Who handles such information?
	+ Fred: SA5.
	+ Thomas: I believe it is almost complete. So I want to know what other options are left for us. I am not asking to conclude right now, but we could do a revision.
	+ Fred: so, we keep one of these options right?
	+ Thomas: Do we support CMCD at all?  It is redundant?
	+ Richard: it is not redundant i believe.
	+ Thomas: may be in revision, we could add some justification
	+ Rufael: “final cmcd report” in diagram is misleading, because it could be continuous stream.
	+ Thomas: i will do a r01 and upload
* October 18, 2024:
	+ Thomas presents [r01\_BBC](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_MBS/Inbox/Drafts/S4aI240167r01_BBC.docx)
		- Small online edits done
		- We getting close to completing the work topic, small edits expected still

**Decision**: * October 16, 2024: parked - waiting for a revision.
* October 18, 2024: r01\_BBC with online updates agreed as basis for future work. A revision is needed that is than endorsed.

[S4aI240167](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_MBS/Docs/S4aI240167.zip) is **revised** to [S4aI240184](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_MBS/Docs/S4aI240184.zip).[S4aI240184](https://www.3gpp.org/ftp/TSG_SA/WG4_CODEC/3GPP_SA4_AHOC_MTGs/SA4_MBS/Docs/S4aI240184.zip) is **endorsed**.This revision addresses remaining open issues.  |

## ===== CHANGE =====

## 2 References

[CTA-5004] Consumer Technology Association Specification CTA‑5004: "Web Application Video Ecosystem – Common Media Client Data", September 2020.

[26531] 3GPP TS 26.531: "Data Collection and Reporting; General Description and Architecture".

[26532] 3GPP TS 26.532: "Data Collection and Reporting; Protocols and Formats".

[26510] 3GPP TS 26.510: "Media delivery: Interactions and APIs for provisioning and media session handling (Release 18)".

[26247] 3GPP TS 26.247: "Transparent end-to-end Packet-switched Streaming Service (PSS); Progressive Download and Dynamic Adaptive Streaming over HTTP (3GP-DASH)".

[29591] 3GPP TS 29.591: "Network Exposure Function Southbound Services; Stage 3 (Release 18)".

## ===== CHANGE (new clause – no change marks) =====

## 5.16 Common Client Metadata

### 5.16.1 Description

#### 5.16.1.1 Introduction

While 3GPP and MPEG in DASH support DASH metrics, the reporting is not common to any player, for example all DASH players as well as HLS players. As an example, CTA WAVE has developed: CTA-5004: Web Application Video Ecosystem Common Media Client Data (CMCD) [CTA-5004]. It is worthwhile to study the benefits of integrating commonly supported metrics and client data reporting in 5GMS workflows. The focus is the integration of already defined metrics rather than developing new metrics. Examples of study include support of specific metric keys, player APIs, sending options from client to server (user plane, M5 reference point, as specified in TS 26.510 [26510], Data collection and reporting as defined in TS 26.531 [26531] and as specified in TS 26.532 [26532]), M3 reference point impact), as well as usage of the data in operations. A study of creating a common harmonized reporting framework and studying the interaction of different frameworks may be included.

CMCD defines a set of *media client data*, structured as key/value pairs, that allows a media player to communicate mutually beneficial media-related information to a CDN via either (i) a set of custom headers, (ii) a URL request query string, or (iii) a JSON object. *Common* is used because the same data structure can be used across all players and all CDNs.

NOTE: CTA WAVE is currently extending its specification [CTA-5004], and a new version is expected to be published by the middle of 2025.

A player may be instructed through a configuration API, for example defined in dash.js, on how to exactly report. In addition, in the 6th edition of MPEG-DASH in ISO/IEC 23009-1 [11], an configuration API and an MPD-based configuration signalling mechanism is specified in order for the DASH client to be instructed to enable CMCD information collection and reporting.

A basic overview of CMCD is provided in figure 5.16.1-1 illustrating option (i) in green and option (ii) in red. With every HTTP request, typically and primarily for the request of a media segment, some custom data is sent either as HTTP header or as query string appended to the segment request URL. In a third mode that is not widely implemented, corresponding to option (iii) above, the media client may also provide the information in a JSON object to the application out of band of media segment requests.



Figure 5.16.1-1: Basic CMCD concept – Media client sends key–value pairs to CDN in-band with requests

#### 5.16.1.2 Use cases

The use cases which CMCD enables are broad – including robust pre-fetching of content, analytics solutions, forensic debugging, CDN delivery optimisation, alerting and monitoring systems, low latency optimisations, server-side switching, research analytics and content steering decision-making.

In the context of 5G Media Streaming, the CMCD information may be used for several purposes that are elaborated further in the remainder of this clause:

1) *Operational optimisation of the 5GMSd AS:* The Application Server uses CMCD information to optimise its operation. For example, the 5GMSd AS may choose to pre-fetch content from the 5GMSd Application Provider based on the value of the CMCD *Next object request* key signalled by the Media Player.

2) *Operational optimisation of the 5GMSd AF and 5G Media Streaming:* The Application Function uses CMCD information in order to configure the 5G System for optimised media delivery across the User Plane. For example, the 5GMSd AF may invoke service operations on the PCF in order to effect a delivery boost if the CMCD *Buffer starvation* flag is set by the Media Player.

3) *UE data collection, reporting and event exposure by 5GMS System:* The Application Function uses the data collection and reporting framework to provide CMCD information to the 5G System or to external 5GMS Application Providers. This could, for example, take the form of a time series event log for audit purposes.

#### 5.16.1.3 Comparison of CMCD information with 5GMS reporting mechanisms

As part of this study, it is relevant to analyse CMCD [CTA-5004] in comparison with existing client metadata reporting mechanisms already defined by the 5G Media Streaming architecture in TS 26.501 [15], namely:

- *QoE metrics reporting*, as described in clause 4.0.9 of [15]. For DASH streaming using downlink media streaming:

- TS 26.512 [16] specifies the use of the QM10 quality metrics reporting scheme for DASH and the "HSD" quality reporting protocol as specified in clause 10 of TS 26.247 [26247].

- The operations for provisioning QoE metrics reporting are specified in clause 5.2.11 of TS 26.510 [26510].

- The operations for QoE metrics reporting are specified in clause 5.3.5 of TS 26.510 [26510].

- *Consumption reporting*, as described in clause 4.0.8 of [15]. For downlink media streaming:

- The format for consumption reports is specified in clause 11.3.3 of TS 26.512 [26512].

- The operations for provisioning consumption reporting are specified in clause 5.2.12 of TS 26.510 [26510].

- The operations for consumption reporting are specified in clause 5.3.6 of TS 26.510 [26510].

One potential consideration for study is whether CMCD could potentially subsume or obsolete either or both of the above mechanisms. To that end, it is instructive to directly compare the information that can be conveyed using the three mechanisms in order to identify overlaps and/or gaps between them.

Table B-1 shows CMCD information in the left-hand columns, QoE reporting metrics in the central columns and consumption reporting data types in the right-hand columns. The comparison reveals that there is minimal overlap between the existing 5GMS reporting mechanisms and CMCD as specified in [CTA-5004]. Further updates to [CTA-5004] may increase the overlap.

### 5.16.2 Collaboration scenarios

In the context of the collaboration scenarios in annex A of TS 26.501 [15], the following collaboration scenarios are considered relevant:

Scenario 1 The 5GMSd AS is deployed in an external Data Network (OTT) as documented in clause A.1 of [15].

 In this case, a third-party service provider logs data from clients about operational performance. The 5GMSd Application Provider may use the data in order to optimise its overall service including clients served through a 5G System.

Scenario 2 Both the 5GMSd AF and the 5GMSd AS are deployed in the trusted Data Network as documented in clause A.2 of [15].

 In this case, the reported CMCD information can be further processed by the receiving 5GMSd AF in order to drive media delivery optimisations. Many use cases may be considered, for example network assistance, policy updates, etc.

 In a similar fashion, when the 5GMSd AS and 5GMSd AF are external per clause A.2 of [15], such considerations may be taken into account, and also in the case where the 5GMSd AS is internal and the 5GMSd AF is external, as documented in clause A.6 of [15].

Scenario 3 5GMSd AF is deployed in the trusted Data Network and the 5GMSd AS deployed in an external Data Network as documented in clause A.4 of [15]. In this case, provisioning updates may be done by the 5GMSd Application Provider in response to received CMCD information.

 Similar aspects apply for the collaboration document in clause A.4 of [15].

Scenario 2 is the core scenarios for collaboration, namely the case that the 5GMSd AS collects information which is shared with the 5GMSd AF for further actions. The remaining discussion in this clause considers the case in which both the 5GMSd AS and the 5GMSd AF are both deployed in the Trusted DN. However, it is generally also possible for a third-party provided in a non-trusted environment to use CMCD information according to the following scenarios.

In the context of the above collaboration scenarios, the three different use cases introduced in clause 5.16.1.2 may also be considered:

1) *Operational optimisation of the 5GMSd AS:* If the Application Server is deployed externally, the CMCD information may be considered as information describing the media delivery session.

2) *Operational optimisation of the 5GMSd AF and 5G Media Streaming:* If the Application Function is deployed externally, NEF-based access to 5G System functionalities may be employed to optimise the delivery based on CMCD information, for example by applying network assistance or dynamic policy updates.

3) *UE data collection, reporting and event exposure by 5GMS System:* The Data Collection AF instantiated in the 5GMSd AF exposes CMCD information collected in the operational service as events. The Event consumer may be external and/or the Data Collection AF may provide information to the NWDAF for further processing in the operator’s network.

### 5.16.3 Architecture mappings

#### 5.16.3.1 In-band reporting of CMCD information via reference point M4d and M3d

In the case where CMCD information is reported in-band with media requests at reference point M4d, no changes are required to the reference architecture for downlink media streaming defined in clause 4.1.1 of TS 26.501 [15] or to the generalised media delivery architecture defined in clause 4.1.2.1 of [15]. Furthermore, the instantiation of UE data collection, reporting and event exposure in the 5G Media Streaming architecture defined in clause 4.7 of [15] is also applicable unmodified.



Figure 5.16.3.1‑1: Reference architecture for data collection and reporting when
the 5GMS AS is delegated to collect in-band CMCD information from the Media Player
and 5GMS AS reports CMCD information to the 5GMS AF via M3d

In this architectural mapping, the functionality of the system functions is extended as shown in figure 5.16.3.1‑1 (with extensions depicted in red) and as follows:

- The Media Stream Handler (Media Player) additionally collects CMCD information and reports it to the 5GMSd AS via reference point M4d according to configuration previously received from the Media Session Handler via reference point M11d and from the 5GMSd AF via reference point M5d.

- The 5GMSd AS additionally reformats CMCD information received in band from the Media Stream Handler at reference point M4d and shares it with the 5GMSd AF via reference point M3d according to configuration previously received from the 5GMSd AF via reference point M3d.

- As one embodiment, the CMCD information may be processed in the Data Collection AF, and the Data Collection AF exposes the information to the NWDAF via reference point R5 and/or to an external Event Consumer via reference point R6.

#### 5.16.3.2 In-band reporting of CMCD information via reference point M4d and R4

In a variant of the architectural mapping described in clause 5.16.3.1, the CMCD information is instead reported by the 5GMSd AS to the Data Collection AF via reference point R4, as depicted in figure 5.16.3.2‑1.



Figure 5.16.3.2‑1: Reference architecture for data collection and reporting when
the 5GMS AS is delegated to collect in-band CMCD information from the Media Player
and 5GMS AS reports CMCD information to the 5GMS AF via R4

In this architectural mapping, the functionality of the system functions is extended as follows:

- The Media Stream Handler (Media Player) additionally collects CMCD information and reports it to the 5GMSd AS via reference point M4d according to configuration previously received from the Media Session Handler via reference point M11d and from the 5GMSd AF via reference point M5d.

- The 5GMSd AS additionally reformats CMCD information received in band from the Media Stream Handler at reference point M4d and shares it with the Data Collection AF instantiated in the 5GMSd AF via reference point R4 according to configuration for the CMCD data domain previously received from the Data Collection AF via reference point R4.

- The Data Collection AF additionally makes the CMCD information available to the 5GMSd AF that instantiated it in order to drive media delivery optimisations.

- Exposure of events to the NWDAF via reference point R5 and/or to external Event Consumers via reference point R6, is identical to clause 5.15.3.1.

#### 5.16.3.3 Out-of-band reporting of CMCD information at M11d and M5d

In the case where CMCD information is reported out of band, no changes are required to the reference archictecture for downlink media streaming defined in clause 4.1.1 of TS 26.501 [15] or to the generalised media delivery architecture defined in clause 4.1.2.1 of [15]. Furthermore, the instantiation of UE data collection, reporting and event exposure in the 5G Media Streaming architecture defined in clause 4.7 of [15] is also applicable unmodified.



Figure 5.16.3.3‑1: Reference architecture for data collection and reporting when
the Media Session Handler reports CMCD information to the 5GMS AF out of band via M5d

In this architectural mapping, the functionality of the system functions is extended as shown in figure 5.16.3.3‑1 and as follows:

- The Media Stream Handler (Media Player) additionally collects CMCD information according to configuration previously received from the Media Session Handler via reference point M11d and from the 5GMSd AF via reference point M5d.

- The Media Session Handler additionally obtains CMCD information from the Media Stream Handler (Media Player) via reference point M11d.

- The Media Session Handler additionally reports the CMCD information to the 5GMSd AF out of band at reference point M5d.

- Exposure of events to the NWDAF via reference point R5 and/or to external Event Consumers via reference point R6, is identical to clause 5.15.3.1.

### 5.16.4 High-level call flows

#### 5.16.4.1 In-band reporting of CMCD information via reference point M4d and M3d

The focus of the call flow is on Scenario 2 as defined in clause 5.16.2.1 above, for which the CMCD information is initially sent to the 5GMSd AS via reference point M4d, and then provided to the 5GMSd AF at reference point M3d. The call flow is aligned with QoE metrics collection and reporting as defined in clause 5.5 of TS 26.501 [15], but addresses the user plane aspects.

Figure 5.16.4.1-1 illustrates a scenario where CMCD collection and reporting by the 5GMSd AS is configured by the 5GMSd AF via reference point M3d. In this example, it is assumed that the CMCD collection information provided by the 5GMSd AF comprises instructions/rules regarding CMCD reporting. It is further assumed that the 5GMSd AF is required to deliver CMCD reports to separate destination entities, upon optionally having performed post-processing the collected report information. The 5GMSd AF and 5GMSd AS can be either trusted or untrusted.



Figure 5.16.4.1-1: CMCD-based data collection in 5GMSd reported in-band via M4d and M3d

The message sequence steps are described below. Potential gaps are highlighted in **bold** for the purpose of identifying new requirements.

1: The **5GMSd AF is provisioned at reference point M1d with CMCD reporting configuration information** pertaining to CMCD information collection by the Media Player and reporting of it to the 5GMSd AF via the 5GMSd AS. The 5GMSd AF is provisioned with different CMCD collection, reporting and **processing information** regarding required post-processing functionality and subsequent and separate delivery of processed CMCD information to the 5GMSd Application Provider and/or to the NWDAF. **The 5GMSd AF also configures the 5GMSd AS to collect CMCD information and report it to the 5GMSd AF**. Finally, the 5GMSd Application Provider subscribes to receive events containing **CMCD information**.

2: The 5GMSd-Aware Application triggers the Service Announcement and Content Discovery procedure at reference point M8d. The Service Announcement may include the whole **Service Access Information that includes a CMCD collection and reporting configuration** to be used by the Media Player.

3: Time passes until the 5GMSd Client initiates session establishment and media playback.

4: Streaming Session and media playback is established.

4a: The 5GMSd-Aware Application informs the Media Player of impending media playback by invoking a suitable method at reference point M7d.

4b: The Media Player requests the establishment of a streaming session by invoking a suitable method at reference point M11d on the Media Session Handler, which acknowledges the request.

4c: The Media Session Handler requests may acquire whole Service Access Information from the 5GMSd AF via reference point M5d if did not already receive this in step 2 above.

4d: The Media Session Handler informs the Media Player about the successful set-up of the streaming session by means of a suitable notification at reference point M11d.

4e: The media playback pipeline is set up between the Media Player, the 5GMSd AS at reference point M4d and with the 5GMSd Application Provider at reference point M2d.

5: **Using a suitable interaction at reference point M11d, the Media Session Handler interrogates the Media Player on its capability to perform in-band CMCD collection and reporting at reference point M4d and instructs the player to enable CMCD collection and reporting, including a session identifier**.

6: The **Media Player acknowledges** its support for the collection of the required CMCD information at reference point M11d.

During the course of media playback, steps 7a to 7f below may be repeated, depending on the duration of the playback.

7a: The Media Player requests **media content from the 5GMSd AS via reference point M4d and includes configured CMCD information in the request, either as an additional query parameter in the request URL or else as additional HTTP request headers, according to the configuration obtained in step 5 above**.

7b: The 5GMSd AS extracts and processes CMCD information from this request.

7c: In the case of a live streaming service, media content may have already been published by the 5GMSd Application Provider to the 5GMSd AS at reference point M2d. However, in this case it is considered that the 5GMSd AS ingests media from the 5GMSd Application Provider in pull mode. The 5GMSd AS checks if the requested data is already cached and if not, requests the data from the upstream 5GMSd Application Provider. **The 5GMSd AS may also use information in the CMCD information to request future segments in advance of a request at reference point M4d.**

NOTE: CMCD information does not currently include a timestamp when the future media data would be available.

7d: The 5GMSd AS delivers the requested media data to the Media Player at reference point M4d.

7e: The Media Player starts playback and informs the Media Session Handler by means of a suitable notification at reference point M11d.

7f: **The 5GMSd AS provides the requested CMCD information to the 5GMSd AF via reference point M3d**.

7g: **The 5GMSd AF extracts the relevant CMCD information and processes the data.**

7h: **Based on certain information, for example buffer levels, etc., the 5GMSd AF may decide to communicate with the 5G System to initiate media handling functions such as network assistance.**

8: **In accordance with its CMCD reporting configuration as provisioned in step 1, the 5GMSd AF performs separate post-processing in accordance with the received types of CMCD reports.**

9: The Data Collection AF instantiated in the 5GMSd AF exposes an event containing **processed CMCD information** to the 5GMSd Application Provider at reference point R6 in accordance with the Event Data Processing Configuration provisioned in step 1.

10: The Data Collection AF instantiated in the 5GMSd AF exposes an event containing **processed CMCD information** to the NWDAF at reference point R6 in accordance with the Event Data Processing Configuration provisioned in step 1.

NOTE: Although not explicitly shown or described in figure 5.16.3-1, should the 5GMSd AF represent an untrusted network entity and the NWDAF represent a trusted network entity, the NWDAF’s subscription to receive processed CMCD reports from the 5GMSd AF is mediated in the southbound direction by the NEF (Network Exposure Function) through the Nnef\_EventExposure service as specified in TS 29.591 [29591] to enable event notifications as described in step 10.

#### 5.16.4.2 In-band reporting of CMCD information via reference point M4d and R4

In reference to the architectural mapping in clause 5.16.3.2, figure 5.16.4.2-1 illustrates a scenario where the CMCD information initially sent to the 5GMSd AS via reference point M4d is subsequently reported to the 5GMSd AF via reference point R4 according to TS 26.531 [26531], TS 26.532 [26532] and TS 26.512 [26512].

To enable this, CMCD collection and reporting by the 5GMSd AS is first configured by creating a Data Reporting Session with the Data Collection AF instantiated in the 5GMSd AF via reference point R4. In this example, it is assumed that the CMCD collection information provided by the Data Collection AF comprises instructions/rules regarding CMCD reporting. It is further assumed that the 5GMSd AF is required to deliver CMCD reports to separate destination entities, upon optionally having performed post-processing the collected report information. The 5GMSd AF and 5GMSd AS can be either trusted or untrusted.



Figure 5.16.4.2-1: CMCD-based data collection in 5GMSd reported in-band via M4d and R4

The message sequence steps are the same as those in clause 5.16.4.1 with the following exceptions. Potential gaps are highlighted in **bold** for the purpose of identifying new requirements.

1: The **5GMSd AF is provisioned at reference point M1d with CMCD reporting configuration information**, pertaining to CMCD information collection by the Media Player and reporting of it to the 5GMSd AF via the 5GMSd AS. The 5GMSd AF is provisioned with different CMCD collection, reporting and **processing information** regarding required post-processing functionality and subsequent and separate delivery of processed CMCD information to the 5GMSd Application Provider and/or to the NWDAF. The 5GMSd AF passes this configuration to the Data Collection AF instantiated in it. The 5GMSd AS creates a Data Rreporting Session at reference point R4 **and receives a configuration including parameters for collecting CMCD information and reporting it to the Data Collection AF**. Finally, the 5GMSd Application Provider subscribes to receive events containing **CMCD information**.

7f: **The 5GMSd AS provides the requested CMCD information to the Data Collection AF via reference point R4** and this information is passed internally to the enclosing 5GMSd AF.

#### 5.16.4.3 Out-of-band reporting of CMCD information via reference point M11d and M5d

In reference to the architectural mapping in clause 5.16.3.3, figure 5.16.4.3-1 illustrates a scenario where the CMCD information initially sent to the Media Session Handler via reference point M11d is subsequently reported to the 5GMSd AF via reference point M5d using the existing out-of-band reporting mechanisms defined in TS 26.501 [15].

To enable this, CMCD collection and reporting by the Media Session Handler is first configured via Service Access Information obtained from the 5GMSd AF at reference point M5d. In this example, it is assumed that the Service Access Information includes instructions/rules regarding CMCD reporting. It is further assumed that the 5GMSd AF is required to deliver CMCD reports to separate destination entities, upon optionally having performed post-processing the collected report information. The 5GMSd AF and 5GMSd AS can be either trusted or untrusted.



Figure 5.16.4.3-1: CMCD-based data collection in 5GMSd reported in-band via M11d and M5d

The message sequence steps are the same as those in clause 5.16.4.1 with the following exceptions. Potential gaps are highlighted in **bold** for the purpose of identifying new requirements.

1: The **5GMSd AF is provisioned at reference point M1d with CMCD reporting configuration information** pertaining to CMCD information collection by the Media Player and reporting of it to the 5GMSd AF via the Media Session Handler. The 5GMSd AF is provisioned with different CMCD collection, reporting and **processing information** regarding required post-processing functionality and subsequent and separate delivery of processed CMCD information to the 5GMSd Application Provider and/or to the NWDAF.

2: The 5GMSd-Aware Application triggers the Service Announcement and Content Discovery procedure at reference point M8d. The Service Announcement may include the whole **Service Access Information that includes a CMCD collection and reporting configuration** to be used by the Media Session Handler, and hence by the Media Player.

7a: The Media Player requests media content from the 5GMSd AS via reference point M4d.

7b: In the case of a live streaming service, media content may have already been published by the 5GMSd Application Provider to the 5GMSd AS at reference point M2d. However, in this case it is considered that the 5GMSd AS ingests media from the 5GMSd Application Provider in pull mode. The 5GMSd AS checks if the requested data is already cached and if not, requests the data from the upstream 5GMSd Application Provider.

7c: The 5GMSd AS delivers the requested media data to the Media Player at reference point M4d.

7d: The Media Player starts playback and informs the Media Session Handler by means of a suitable notification at reference point M11d.

7e: **The Media Player generates CMCD information for this request.**

7f: **The Media Player provides the requested CMCD information to the Media Session Handler via reference point M11d.**

7g: **The Media Session Handler provides the requested CMCD information to the 5GMSd AF via reference point M5d**.

7h: **The 5GMSd AF extracts the relevant CMCD information and processes the data.**

7i: **Based on certain information, for example buffer levels, etc., the 5GMSd AF may decide to communicate with the 5G System to initiate media handling functions such as network assistance.**

### 5.16.5 Gap analysis and requirements

#### 5.16.5.1 In-band reporting of CMCD information via reference points M4d and M3d

Based on the call flow in clause 5.16.4.1, the following gaps are identified:

1) Lack of provisioning information at reference point M1d in step 1 to configure CMCD reporting, including subsequent exposure to the 5GMSd Application Provider [and to the OAM Server].

2) Lack of configuration signalling at reference point M3d in steps 1a and 1b for the 5GMSd AS to collect CMCD information for specific sessions or all clients.

3) Lack of a CMCD client reporting configuration in Service Access Information at reference point M5d in step 2.

4) Lack of Media Player configuration API at reference point M11d in steps 5 and 6 to configure CMCD collection and reporting, including acknowledgement of the Media Player's capabilities.

5) Missing functionalities in the Media Player in step 7c to report CMCD information as part of media requests at reference point M4d. If the next segment request is included, then CMCD information needs to be extended to add the timestamp when the next media object is available.

6) Missing functionalities in the 5GMSd AS in step 7a to extract and process CMCD information received from the Media Player via reference point M4d and:

a. To proactively request media segments according to the received CMCD information per step 7c, if this optional feature is supported.

b. To provide the CMCD information to the 5GMSd AF at reference point M3d per step 7f.

7) Missing functionalities in the 5GMSd AF to process CMCD information received from the 5GMSd AS via reference point M3d, and to use this information to initiate and re-configure media session handling as needed in the 5G Core, and to aggregate the information for delivery to the 5GMSd Application Provider and/or to the NWDAF per steps 8, 9 and 10.

#### 5.16.5.2 In-band reporting of CMCD information via reference points M4d and R4

Based on the call flow in clause 5.16.4.2, the following gaps are identified. Differences from the gaps identified in clause 5.16.5.1 are highlighted in **bold**.

1) Lack of provisioning information at reference point M1d in step 1 to configure CMCD reporting, including subsequent exposure to the 5GMSd Application Provider [and to the OAM Server].

2) Lack of configuration signalling at reference point **R4** in steps 1a and 1b for the 5GMSd AS to collect CMCD information **for specific applications**.

3) Lack of a CMCD client reporting configuration in Service Access Information at reference point M5d in step 2.

4) Lack of Media Player configuration API at reference point M11d in steps 5 and 6 to configure CMCD collection and reporting, including acknowledgement of the Media Player's capabilities.

5) Missing functionalities in the Media Player in step 7c to report CMCD information as part of media requests at reference point M4d. If the next segment request is included, then CMCD information needs to be extended to add the timestamp when the next media object is available.

6) Missing functionalities in the 5GMSd AS in step 7a to extract and process CMCD information received from the Media Player via reference point M4d and:

a. To proactively request media segments according to the received CMCD information per step 7c, if this optional feature is supported.

b. To provide the CMCD information to **the Data Collection AF instantiated in** the 5GMSd AF at reference point **R4** per step 7f.

7) Missing functionalities in 5GMSd AF to process CMCD information received from the **Data Collection AF**, and to use this information to initiate and re-configure media session handling as needed in the 5G Core, and to aggregate the information for delivery to the 5GMSd Application Provider and/or to the NWDAF per steps 8, 9 and 10.

#### 5.16.5.3 Out-of-band reporting of CMCD information via reference point M5d

Based on the call flow in clause 5.16.4.3, the following gaps are identified. Differences from the gaps identified in clause 5.16.5.1 are highlighted in **bold**.

1) Lack of provisioning information at reference point M1d in step 1 to configure CMCD reporting, including subsequent exposure to the 5GMSd Application Provider [and to the OAM Server].

2) Lack of a CMCD client reporting configuration in Service Access Information at reference point M5d in step 2.

3) Lack of Media Player configuration API at reference point M11d in steps 5 and 6 to configure CMCD collection and reporting, including acknowledgement of the Media Player's capabilities.

4) Missing functionalities in the Media Player in step 7f to report CMCD information **to the Media Session Handler** at reference point **M11d**.

5) **Missing functionalities in the Media Session Handler in step 7g to report CMCD information to the 5GMSd AF at reference point M5d.**

NOTE: It is impractical for the Media Player to signal the next segment request to the 5GMSd AF using out-of-band signalling at reference point M5 and to pass this information on to the 5GMSd AS at reference point M3 for the purposes of pre-fetching media segments.

6) Missing functionalities in the 5GMSd AF to process CMCD information received from the **Media Session Handler** via reference point **M5d**, and to use this information to initiate and re-configure media session handling as needed in the 5G Core, and to aggregate the information for delivery to the 5GMSd Application Provider and/or to the NWDAF per steps 8, 9 and 10.

### 5.16.6 Candidate solutions

#### 5.16.6.1 In-band reporting of CMCD information via reference points M4d and M3d

##### 5.16.6.1.1 Provisioning information at reference point M1d

Provisioning information is needed at reference point M1d to configure CMCD reporting, including delivery to the 5GMSd Application Provider [and to the OAM Server]. For this purpose, the following is a suitable solution:

- To support provisioning information to configure CMCD reporting, the metrics reporting provisioning procedures specified in clause 5.2.11 of TS 26.510 [26510] may be reused at reference point M1d **with the controlled vocabulary of metrics reporting schemes specified in clause 7.8 of TS 26.512 [26512] extended to describe the different forms of CMCD.**

- To support delivery of this information to the 5GMSd Application Provider, the Event Data Processing Configuration may be reused at reference point M1d per clause 5.2.13 of TS 26.510 [26510] with the following enhancements needed to provision exposure of CMCD information as a distinct new type of event:

- **A new enumerated value of AfEvent specified in TS 29.517 [29517] used to signal a CMCD event when one is exposed by the Data Collection AF instantiated in the 5GMSd AF.**

**- New collection and record data types specified in TS 26.512 [26512] used by the Data Collection AF instantiated in the 5GMSd AF to expose CMCD information in events.**

- **A new DataDomain enumerated value specified in TS 26.532 [26532] to specify data exposure restrictions for CMCD information.**

NOTE: Analysis of which data aggregation functions (count, mean, maximum, minimum, etc.) are appropriate to provision for CMCD information in the abovementioned data exposure restrictions is for further study.- Delivery of this information to the NWDAF is for further study.

##### 5.16.6.1.2 Configuration signalling at reference point M3d

Configuration signalling at reference point M3d for the 5GMSd AS to collect CMCD information for specific sessions or all clients. To support this functionality, the following solution may be considered:

- Reuse client metrics reporting configuration in Service Access Information exposed by the 5GMSd AF to the 5GMSd AS at reference point M3d. **A new metrics reporting scheme representing the CMCD JSON format is specified in clauses 4.7.5, 7.8.1 and 11.4.1 of TS 26.512 [26512]** and is always indicated regardless of which metrics reporting scheme has been provisioned at reference point M1d.

- In order to support this, **the 5GMSd AS configuration provided by the 5GMSd AF at reference point M3d as specified in clause 8.8 (and, for symmetry with uplink media streaming, clause 8.9) of TS 26.510 [26510] needs to be enhanced to tell the 5GMSd AS which set of Service Access Information it needs to retrieve to obtain the correct client metrics reporting configuration. The external application identifier of the parent Provisioning Session needs to be additionally passed at reference point M3d. This may be achieved by enhancing the data model specified in clause 9.4.3 (and, for symmetry with uplink media streaming, clause 9.5.3) of TS 26.510 [26510].**

##### 5.16.6.1.3 Configuration signalling at reference point M5d

Provide CMCD configuration information to the Media Session Handler at reference point M5din order to configure collection and reporting of CMCD information by the 5GMSd Client. To support this functionality, the following solution may be considered:

- Reuse client metrics reporting configuration in Service Access Information exposed by the 5GMSd AF to the 5GMSd AS at reference point M5d. **A new metrics reporting scheme representing the CMCD query parameter or CMCD request header is specified in clauses 4.7.5, 7.8.1 and 11.4.1 of TS 26.512 [26512]** and is always indicated.

##### 5.16.6.1.4 Media Player configuration API at reference point M11d

Media Player configuration API at reference point M11d to configure CMCD data collection and reporting, including the acknowledgement of the Media Player's capabilities.

##### 5.16.6.1.5 Data reporting at reference point M4d

The Media Player reports CMCD information at reference point M4d as part of media requests using either a CMCD query parameter or CMCD request headers as specified in CTA‑5004 [CTA-5004]. The CMCD information conveys the media delivery session identifier chosen by the Media Session Handler.

If the next segment request is included, then CMCD needs to be extended to add the timestamp when the segment or media object is available.

##### 5.16.6.1.6 Data reporting at reference point M3d

The 5GMSd AS provides CMCD information to the 5GMSd AF at reference point M3d. To support this functionality, the following solution may be considered:

- Based on CMCD information conveyed using a CMCD query parameter or CMCD request headers in M4d requests, the 5GMSd AS submits a QoE metrics report to the 5GMSd AF using the CMCD JSON format specified in CTA-5004 [CTA-5004].

##### 5.16.6.1.7 Event exposure at reference point R5 and R6

The Data Collection AF instantiated in the 5GMSd AF exposes events to the Event Consumer AF of the 5GMSd Application Provider. To support this functionality, the following solution may be considered:

- Reuse event exposure mechanism per clause 4.7.4 of TS 26.501 [15] and clause 18 of TS 26.512 [26512]. **A new collection data type and record data type need to be specified by the latter. Individual CMCD records are expressed using the JSON representation specified in CTA-5004 [CTA-5004]. In addition, clause 5.6.2.6 of TS 29.517 [29517] needs to be extended by CT3 to allow exposure of events containing this new type of record in an AfEventNotification.**

##### 5.16.6.1.8 Functional changes to 5GMSd AF

Functionalities in the 5GMSd AF to process received CMCD information received, to use this information to initiate and re-configure media session handling functions in the 5G Core as needed, and to aggregate the information for delivery to the 5GMSd Application Provider [and/or to the OAM Server]. To support this functionality, the following solution may be considered:

- Data processing and event exposure for CMCD information per clauses 4.7.3 and 4.7.4 of TS 26.501 [15] and clause 18 of TS 26.512 [16] respectively.

NOTE: How data aggregation functions (count, mean, maximum, minimum, etc.) are applied to reported CMCD information is for further study.

##### 5.16.6.1.9 Functional changes to 5GMSd AS

Functionalities in the 5GMSd AS to extract and process CMCD information received from the Media Player via reference point M4d and:

1. Reformat it into the CMCD JSON format specified in CTA-5004 [CTA-5004] and report it to the 5GMSd AF via reference point M3d.

2. Proactively request media segments from the 5GMSd Application Provider at reference point M2d, if this optional feature is supported.

##### 5.16.6.1.10 Functional changes to Media Player

Functionalities in the Media Player to report CMCD information to the 5GMSd AS at reference point M4d as part of media requests.

The CMCD specification [CTA-5004] may need to be extended to add the timestamp when the next media object is available in order to fully support the pre-fetch optimisation described in step 7c of clause 5.16.4.

##### 5.16.6.1.11 Functional changes to Media Session Handler

Functionalities in the Media Session Handler to process CMCD configuration information and to instruct the Media Player via reference point M11d to initiate CMCD collection and reporting.

#### 5.16.6.2 In-band reporting of CMCD information via reference points M4d and R4

##### 5.16.6.2.1 Provisioning information at reference point M1d

Same as clause 5.16.6.1.1.

##### 5.16.6.2.2 Configuration signalling at reference point R4

Configuration signalling at reference point R4 instructing the 5GMSd AS to collect CMCD information for specific applications. To support this functionality, the following solution may be considered:

- Reuse data reporting configuration exposed by the Data Collection AF to the 5GMSd AS at reference point R4 as part of a DataReportingSession. **The new data domain required by clause 5.16.6.2.1 is used in this configuration for the additional purpose of signalling the need for the 5GMSd AS to collect and report CMCD information.**

##### 5.16.6.2.3 Configuration signalling at reference point M5d

Same as clause 5.16.6.1.3.

##### 5.16.6.2.4 Media Player configuration API at reference point M7d

Same as clause 5.16.6.1.4.

##### 5.16.6.2.5 CMCD reporting at reference point M4d

Same as clause 5.16.6.1.5.

##### 5.16.6.2.6 Data reporting at reference point R4

The 5GMSd AS provides CMCD information to the Data Collection AF instantiated in the 5GMSd AF at reference point R4. To support this functionality, the following solution may be considered:

- The 5GMSd AS creates a data reporting session with the Data Collection AF instantiated in the 5GMSd AF.

- Based on CMCD information conveyed using a CMCD query parameter or CMCD request headers in M4d requests, the 5GMSd AS submits data reports to the Data Collection AF instantiated in the 5GMSd AF. **The format of the data report is a new record data type defined in clause 4.7.2 of TS 26.501 [15] and specified in clause 17 of TS 26.512 [16] based on the CMCD JSON document format specified in CTA‑5004 [CTA-5004]. Clause 7.3.2.3 of TS 26.532 [26532] needs to be extended to allow records of this new type to be reported to the Data Collection AF in a DataReport.**

##### 5.16.6.2.7 Event exposure at reference point R5 and R6

Same as clause 5.16.6.1.7.

##### 5.16.6.2.8 Functional changes to 5GMSd AF

Same as clause 5.16.6.1.8.

##### 5.16.6.2.9 Functional changes to 5GMSd AS

Functionalities in the 5GMSd AS to extract and process CMCD information received from the Media Player via reference point M4d and:

1. Report it to **the Data Collection AF instantiated in** the 5GMSd AF via reference point **R4**.

2. Proactively request media segments from the 5GMSd Application Provider at reference point M2d, if this optional feature is supported.

##### 5.16.6.2.10 Functional changes to Media Player

Same as clause 5.16.6.1.10.

##### 5.16.6.2.11 Functional changes to Media Session Handler

Same as clause 5.16.6.1.11.

#### 5.16.6.3 Out-of-band reporting of CMCD information via reference point M11d and M5d

##### 5.16.6.3.1 Provisioning information at reference point M1d

Same as clause 5.16.6.1.1

##### 5.16.6.2.2 Configuration signalling at reference point M3d/R4

Not relevant to this solution.

##### 5.16.6.3.3 Configuration signalling at reference point M5d

Same as clause 5.16.6.1.3.

##### 5.16.6.3.4 Media Player configuration API at reference point M11d

Same as clause 5.16.6.1.4.

##### 5.16.6.3.5 CMCD reporting at reference point M11d

The Media Player reports CMCD information to the **Media Session Handler** at reference point **M11d**. To support this functionality, the following solution may be considered:

**- Reuse the mechanism for exposing QoE metrics to the Media Session Handler specified in clause 13.2.5 and 13.2.6 of TS 26.512 [16].**

##### 5.16.6.3.6 CMCD reporting at reference point M5d

**The Media Session Handler reports CMCD information to the 5GMSd AF at reference point M5d. To support this functionality, the following solution may be considered:**

**- Reuse the QoE metrics reporting mechanism specified in clause 11.4 of TS 26.512 [16] with the set of report formats extended to include CMCD JSON documents as specified in CTA‑5004 [CTA-5004]. The CMCD JSON document conveys the media delivery session identifier chosen by the Media Session Handler.**

##### 5.16.6.3.7 Event exposure at reference point R5 and R6

Same as clause 5.16.6.1.7.

##### 5.16.6.3.8 Functional changes to 5GMSd AF

Same as clause 5.16.6.1.8.

##### 5.16.6.3.9 Functional changes to 5GMSd AS

Not relevant to this solution.

NOTE: Pre-fetching of media segments by the 5GMSd AS is not supported by this solution.

##### 5.16.6.3.10 Functional changes to Media Player

Functionalities in the Media Player to report CMCD information to the **Media Session Handler** at reference point **M11d**.

NOTE: Pre-fetching of media segments by the 5GMSd AS is not supported by this solution.

##### 5.16.6.3.11 Functional changes to Media Session Handler

Functionalities in the Media Session Handler to process CMCD configuration information and to instruct the Media Player via reference point M11d to initiate CMCD collection reporting.

**Functionalities in the Media Session Handler to reformat the CMCD information into the JSON format specified in CTA‑5004 [CTA-5004] and to submit it to the 5GMSd AF as a QoE metrics report per clause 5.16.6.3.6.**

### 5.16.7 Summary and conclusions

The analysis in clause 5.16.1.3 and annex B indicates minimal overlap between CMCD information [CTA-5004] and existing reporting mechanisms for 5G Media Streaming (QoE metrics reporting and consumption reporting). Based on this, it is recommended that CMCD be considered as a supplementary reporting mechanism for media client data at this point, operating alongside QoE metrics reporting and consumption reporting.

The operational optimisations of the the 5GMSd AS envisaged in point 1 of clause 5.16.1.2 cannot be realised with the out-of-band reporting solution outlined in clauses 5.16.3.3, 5.16.4.3 and 5.16.5.3. For this reason, this is not a preferred solution.

The preferred solution is Option 1 "In-band reporting of CMCD information via reference points M4d and M3d", for the following reasons:

- In-band reporting reference point M4d is broadly implemented in common media clients nowadays.

- In-band reporting permits operational optimizations by the 5GMSd AS, which is not the case with Option 3 *Out-of-band reporting of CMCD information via reference points M11d and M5d*. Solely on the basis of this issue, Option 1 and Option 2 remain valid candidates.

- Passing the CMCD information to the 5GMS AF at reference point M3d (Option 1) permits operational optimisations by the 5GMSd AF, which is not the case with Option 2 *In-band reporting of CMCD information via reference points M5d and R4* where the CMCD information is handed directly to the Data Collection AF instantiated in the 5GMS AF but is not visible to the latter.

- All envisaged use cases can be supported by Option 1.

Hence, it is recommended to implement the solution defined in clause 5.16.6.1 in the relevant 3GPP specifications.

Furthermore, there is a preference to provide deployment choices to the 5GMSd Service Provider to select the use of reporting scheme using either the CMCD query parameter or CMCD request headers.

## ===== CHANGE (new clause) =====

## 6.16 Common Client Metadata

CMCD [CTA-5004] defines a set of *media client data*, structured as key/value pairs, that allows a media player to communicate mutually beneficial media-related information to a CDN via either (i) a set of custom headers, (ii) a URL request query string, or (iii) a JSON object. *Common* is used because the same data structure can be used across all players and all CDNs. CTA WAVE is currently extending its specification, and a new version is expected to be available by the middle of 2025. A player may be instructed through a configuration API, for example defined in dash.js, on how to exactly report. In addition, in the 6th edition of MPEG-DASH in ISO/IEC 23009-1 [11], a configuration API and an MPD-based signalling of configuration are specified in order for the DASH client to be instructed to enable CMCD information collection and reporting.

The use cases which CMCD enables are broad – including robust pre-fetching of content, analytics solutions, forensic debugging, CDN delivery optimisation, alerting and monitoring systems, low latency optimisations, server-side switching, research analytics and content steering decision-making. In the context of 5G Media Streaming, the CMCD information may be used for several purposes as described in clause 5.16.1.2. In addition, the analysis in clause 5.16.1.3 and annex B indicates minimal overlap between CMCD information [CTA-5004] and existing reporting mechanisms for 5G Media Streaming (QoE metrics reporting and consumption reporting). Based on this, it is recommended that CMCD be considered as a supplementary reporting mechanism for media client data at this point, operating alongside QoE metrics reporting and consumption reporting.

Based on the analysis in clausee 5.16.7, the preferred solution to add CMCD to 5G Media Streaming is Option 1 *In-band reporting of CMCD information via reference points M4d and M3d*. Hence, it is recommended to implement the solution defined in clause 5.16.6.1 in the relevant 3GPP specifications. Furthermore, there is a preference to provide deployment choices to the 5GMSd Service Provider to select the use of reporting scheme using either the CMCD query parameter or CMCD request headers.

The updates include stage-2 updates as follows:

- Functional changes to the 5GMSd AF as outlined in clause 5.16.6.1.8,

- Functional changes to the 5GMSd AS as outlined in clause 5.16.6.1.9,

- Functional changes to the Media Player as outlined in clause 5.16.6.1.10,

- Functional changes to the Media Session Handler for downlink media streaming only as outlined in clause 5.16.6.1.11.

No updates to the reference architecture are identified, nor is there any need for new reference points.

Impacts on stage-3 are expected to TS 26.247 [26247], TS 26.510 [26510], TS 26.512 [16], TS 26.532 [26532] and TS 29.517 [29517].

## ===== CHANGE (new clause) =====

Annex B:
Comparison of CMCD information with QoE metrics reporting and consumption reporting

This annex compares the existing 5GMS reporting mechanisms with CMCD [CTA-5004CTA-5004], as discussed in clause 5.16.1.3 of the present document.

Table B-1: Comparison of CMCD information with QoE metrics reporting and consumption reporting

| CMCD[CTA-5004] | Media delivery QoE metrics reporting[3GPP TS 26.510 Rel-18] | Media delivery consumption reporting [3GPP TS 26.510 Rel-18] |
| --- | --- | --- |
| Scope | Key | Description | Type and unit | Source | Xpath | Description | Data type and property | Description |
| CMCD-Session | v | CMCD version | Integer | TS 26.247 clause 10.6.2 | **ReceptionReport‌**@schemaVersion | Schema version |   |   |
| CMCD-Session | cid | Content identifier | String | TS 26.247 clause 10.6.2 | **ReceptionReport‌**@contentURI | Content URI | ConsumptionReport.‌mediaPlayerEntry | Media Player Entry URL |
|   |   |   |   | TS 26.247 clause 10.6.2 | **ReceptionReport‌**@clientID | Client identifier | ConsumptionReport.‌reportingClientId | Reporting client identifier |
| CMCD-Session | sid | Session identifier | String | TS 26.247 clause 10.6.2 | **ReceptionReport**/**QoeReport‌**@recordingSessionID | Media delivery session identifier | ConsumptionReport.‌sessionId | Media delivery session identifier |
| CMCD-Session | st | Stream type (live/on-demand) | String token |   |   |   |   |   |
| CMCD-Session | sf | Streaming format (DASH, HLS, Smooth, other) | String token |   |   |   |   |   |
|   |   |   |   | TS 26.247 clause 10.2.8 | **ReceptionReport**/**QoeReport**/**‌QoEMetric**/**MPDInformation‌**@representationId | RepresentationID |   |   |
|   |   |   |   | TS 26.247 clause 10.2.8 | **ReceptionReport/QoeReport/‌QoEMetric/MPDInformation‌**@subreplevel | *Unspecified* |   |   |
|   |   |   |   | TS 26.247 clause 10.2.8 | **ReceptionReport/QoeReport/‌QoEMetric/MPDInformation/‌MpdInfo‌**@codecs | *Unspecified* |   |   |
|   |   |   |   | TS 26.247 clause 10.2.8 | **ReceptionReport/QoeReport/‌QoEMetric/MPDInformation/‌MpdInfo‌**@bandwidth | Representation bit rate? |   |   |
|   |   |   |   | TS 26.247 clause 10.2.8 | **ReceptionReport/QoeReport/‌QoEMetric/MPDInformation/‌MpdInfo‌@qualityRanking** | *Unspecified* |   |   |
|   |   |   |   | TS 26.247 clause 10.2.8 | **ReceptionReport/QoeReport/‌QoEMetric/MPDInformation/MpdInfo‌@frameRate** | Representation frame rate (video representations only)? |   |   |
|   |   |   |   | TS 26.247 clause 10.2.8 | **ReceptionReport/QoeReport/‌QoEMetric/MPDInformation/‌MpdInfo‌**@width | Representation width (video representations only)? |   |   |
|   |   |   |   | TS 26.247 clause 10.2.8 | **ReceptionReport/QoeReport/‌QoEMetric/MPDInformation/‌MpdInfo‌**@height | Representation height (video representations only)? |   |   |
|  |  |  |  | TS 26.247 clause 10.2.8 | **ReceptionReport/QoeReport/‌QoEMetric/MPDInformation/‌MpdInfo‌**@mimeType | Representation MIME content type? |  |  |
|  |  |  |  | TS 26.247 clause 10.2.10 | **ReceptionReport/QoeReport/‌supplementQoEMetric/‌deviceinformation/Entry‌**@start | Sampling timestamp (wallclock) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.10 | **ReceptionReport/QoeReport/‌supplementQoEMetric/‌deviceinformation/Entry**@mstart | Sampling timestamp (media presentation) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.10 | **ReceptionReport/QoeReport/‌supplementQoEMetric/‌deviceinformation/Entry‌**@videoWidth | Width of video viewport (pixels) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.10 | **ReceptionReport/QoeReport/‌supplementQoEMetric/‌deviceinformation/Entry‌**@videoHeight | Height of video viewport (pixels) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.10 | **ReceptionReport/QoeReport/‌supplementQoEMetric/‌deviceinformation/Entry‌**@screenWidth | Width of screen (pixels) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.10 | **ReceptionReport/QoeReport/‌supplementQoEMetric/‌deviceinformation/Entry‌**@screenHeight | Height of screeen (pixels) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.10 | **ReceptionReport/QoeReport/supplementQoEMetric/deviceinformation/Entry**@pixelWidth | Width of screen pixel (mm) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.10 | **ReceptionReport/QoeReport/‌supplementQoEMetric/‌deviceinformation/Entry‌@pixelHeight** | Height of screen pixel (mm) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.10 | **ReceptionReport/QoeReport/‌supplementQoEMetric/‌deviceinformation/Entry‌**@fieldOfView | Horizontal angle subtended at eye by screen (degrees) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.5 | **ReceptionReport/QoeReport/‌QoEMetric/InitialPlayoutDelay** | Initial playout delay |  |  |
|  |  |  |  | TS 26.247 clause 10.2.9 | **ReceptionReport/QoeReport/‌QoEMetric/PlayoutDelayfor‌MediaStartup** | Media playout start-up delay |  |  |
| CMCD-Status | rtp | Requested maximum throughput | Integer kbit/s |  |  |  |  |  |
| CMCD-Status | bs | Buffer starvation | Boolean |  |  |  |  |  |
|  |  |  |  | TS 26.247 clause 10.2.6 | **ReceptionReport/QoeReport/‌QoEMetric/BufferLevel**@t | Buffer level timestamp |  |  |
|  |  |  |  | TS 26.247 clause 10.2.6 | **ReceptionReport/QoeReport/‌QoEMetric/BufferLevel**@level | Buffer level |  |  |
|  |  |  |  | TS 26.247 clause 10.2.4 | **ReceptionReport/QoeReport/‌QoEMetric/AvgThroughtput@t** | Sampling timestamp (wallclock) |  |  |
|  |  |  |  | TS 26.247 clause 10.2.4 | **ReceptionReport/QoeReport/‌QoEMetric/AvgThroughtput**@duration | Sampling period |  |  |
|  |  |  |  | TS 26.247 clause 10.2.4 | **ReceptionReport/QoeReport/‌QoEMetric/AvgThroughtput@numBytes** | HTTP body bytes downloaded |  |  |
|  |  |  |  | TS 26.247 clause 10.2.4 | **ReceptionReport/QoeReport/‌QoEMetric/AvgThroughtput@activityTime** | Time of incomplete GET |  |  |
|  |  |  |  | TS 26.247 clause 10.2.4 | **ReceptionReport/QoeReport/‌QoEMetric/AvgThroughtput**@inactivityType | Pause, client buffer control, error |  |  |
|  |  |  |  | TS 26.247 clause 10.2.4 | **ReceptionReport/QoeReport/‌QoEMetric/AvgThroughtput**@accessbearer | Access bearer used for download |  |  |
| CMCD-Object | ot | Object type (init, audio, video, audio-video, subtitle, text, crypto, other) | String token |  |  |  |  |  |
| CMCD-Object | d | Object duration | Integer ms |  |  |  |  |  |
| CMCD-Object | br | Encoded bit rate | Integer kbit/s |  |  |  |  |  |
| CMCD-Object | tb | Top bit rate | Integer kbit/s |  |  |  |  |  |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace‌@start** | Playback period start time (wallclock) |  |  |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace‌**@mstart | Playback period start time (media presentation) |  |  |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace‌**@startType | New playout request, Resume from pause, Start metrics collection, Other |  |  |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace/‌TraceEntry**@representationId | RepresentationID | ConsumptionReportingUnit.‌mediaConsumed | e.g. MPEG-DASH representationID |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace/‌TraceEntry**@subrepLevel | Greatest value of sub-representation level being rendered |  |  |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace/‌TraceEntry**@start | Time when first media sample rendered (wallclock) | ConsumptionReportingUnit.‌startTime | Start of consumption |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace/‌TraceEntry**@sstart | Time when first media sample rendered (media presentation) |  |  |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace/‌TraceEntry**@duration | Duration of continuously presented media samples | ConsumptionReportingUnit.‌duration | Duration of consumption |
| CMCD-Session | pr | Playback rate | Decimal | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace/‌TraceEntry**@playbackSpeed | Playback speed relative to normal (normal = 1.0) |  |  |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace/‌TraceEntry**@stopReason | Representation switch, Rebuffering, User request, Period end, Presentation end, Metrics collection end, Failure, other |  |  |
|  |  |  |  | TS 26.510 clause 10.2.7 | **ReceptionReport/QoeReport/‌QoEMetric/PlayList/Trace/‌TraceEntry**@stopReasonOther | Other stop reason (free text) |  |  |
|  |  |  |  |  |  |  | ConsumptionReportingUnit.‌clientEndpointAddress | Client endpoint address |
|  |  |  |  |  |  |  | ConsumptionReportingUnit.‌serverEndpointAddress | Server endpoint address |
|  |  |  |  |  |  |  | ConsumptionReportingUnit.‌sliceInfo | S-NSSAI |
|  |  |  |  |  |  |  | ConsumptionReportingUnit.‌dnn | Data Network Name |
|  |  |  |  |  |  |  | ConsumptionReportingUnit.‌locations | Locations where content was consumed |
| CMCD-Request | bl | Buffer length  | Integer ms |  |  |  |  |  |
| CMCD-Request | dl | Deadline | Integer ms |  |  |  |  |  |
| CMCD-Request | mtp | Measured throughput | Integer kbit/s |  |  |  |  |  |
| CMCD-Request | nor | Next object request | String |  |  |  |  |  |
| CMCD-Request | nrr | Next range request | String |  |  |  |  |  |
| CMCD-Request | su | Start-up | Boolean |  |  |  |  |  |