**3GPP TSG-SA4 Meeting #127-bis-e *S4-240591r02***

**Online, , 8th Apr 2024 - 12th Apr 2024**

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| *CR-Form-v12.3* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
|  | | | | | | | | |
|  | **26.804** | **CR** | **0006** | **rev** | **-** | **Current version:** | **18.1.0** |  |
|  | | | | | | | | |
| *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)*.* | | | | | | | | |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

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| ***Title:*** | [FS\_AMD] Multi-CDN and Multi-Access Media Delivery | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Dolby France SAS | | | | | | | | | |
| ***Source to TSG:*** | S4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_AMD | | | | |  | ***Date:*** | | | 2024-04-02 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-19 |
|  | *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 can be 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)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Document the FS\_AMD key topic “c) Multi-Access and Multi-CDN Delivery” description and collaboration scenarios. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Addition of new clause 5.x Multi-CDN and Multi-Access Media Delivery including sub-clause structure and headings. Addition of prose for Description and Collaboration Scenarios. | | | | | | | | |
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| ***Consequences if not approved:*** | | FS\_AMD objectives not achieved. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 5.x (NEW) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | | Rev1: SA4#127-bis-e, description and collaboration scenarios | | | | | | | | |

## FIRST CHANGE

## 5.x Multi-CDN and Multi-Access Media Delivery

### 5.x.1 Description

#### 5.x.1.1 General

Media streaming applications traditionally obtain content from a single source over a single path within a network. This imposes several limitations. First, performance is constrained to that of the source and path chosen. Whatever the limits on network bandwidth and latency between the client and that source are directly translated to the clients’ achievable Quality of Service (QoS) and Quality of Experience (QoE). Second, disruptions or degraded performance caused by the source in use or on any of the network links between the client and source can lead to poor user experience. Often in the form of lower playback quality, rebuffering, or complete playback failure. This study considers integration of different technologies into the 5G Media Streaming System that addresses these, and similar, issues by allowing media streaming applications to efficiently access content across multiple Content Delivery Networks (CDNs) and/or access networks. Different client implementations may then beneficially use the content on these multiple sources or networks concurrently, potentially guided by service or network provider. In addition, formats and techniques for generating content for multiple CDN or multiple access network delivery such as MPEG-DASH Part 9 (ReAP) may be considered. Further extensions include the ability for a client to use multiple access networks at the same time to support media delivery. Study of integration of different technologies into the 5G Media Streaming System is of relevance to address content provisioning, content hosting, impacts on user plane reference points M2 and M4, and on media session handling at reference point M5 as well as potential benefits in terms of quality and resource usage.

#### 5.x.1.2 Multi-CDN Media Delivery

CDNs are often used by content distributors to globally scale delivery of their content to end-users. These networks consist of a number of Points of Presence (PoPs) located at various locations around the networks’ edge. These PoPs help load-balance delivery of content as well as improve Quality of Service (QoS) by reducing the distance/latency between every client and the content they are accessing. In many cases, content distributors employ multiple CDNs to leverage the strengths of one CDN over another in every location those CDNs have a PoP. For example, a client experiencing degraded performance while using one CDN may switch to another that is offering better performance at that time and location. As another example, a content distributor may prefer one CDN over another at a given time to reduce delivery costs and/or meet monthly contractual commitments. These Multi-CDN deployments aim to solve content delivery issues that exist when only one CDN is used; but the benefits they provide may not be fully realized because of the various challenges experienced and underlying methods used to stream content to every client.

Challenges Multi-CDN deployments and architectures aim to address may include:

1. Sustained CDN/network wide service disruptions where network access, connectivity, or QoS is severely degraded. An example may include cases where an entire CDN’s network is degraded because of a network-wide misconfiguration. The duration of these events may last minutes to hours and affect a majority of the client population.
2. Intermittent or short-term disruptions affecting QoS for an individual or small group of clients. An example of degraded QoS that commonly occurs is shown in Figure 5.x.1.2-1 where the time-to-first-byte (TTFB) for HTTP requests sent to three different CDNs from a single client are illustrated by the lines and complete HTTP request failures are illustrated as markers. In this example, the nominal TTFB for all three CDNs is in the range of 200 to 300 ms. However, one of the CDNs first experiences a significant increase in the TTFB to over 5500 ms followed by three request failures. Following this short duration of degraded performance, performance for that CDN returns to normal. The total duration of degraded performance for this specific example was only 30 seconds.
3. Augmentation of one CDNs performance with that of another to achieve a level of performance that neither can provide on their own. An example may include a peer-to-peer CDN where each peer has limited uplink capacity and is unable to satisfactorily service client demand on their own.

A graph with a line

Description automatically generated

Figure 5.x.1.2-1: Example of an intermittent HTTP request failure.

#### 5.x.1.3 Multi-Access Media Delivery

Multi-Access media delivery is also an approach aimed at improving media streaming QoS and QoE while also helping to solve content delivery issues that exists when only one network interface/access network is used. Media is traditionally streamed via only one client network interface/access network (e.g., Wi-Fi, 5G, etc.) at a time, even when multiple are available. A client may only switch between these network interfaces/access networks when the one in use becomes unusable. A process that often has significant negative impacts to the media application’s QoE. Multi-Access Media Delivery aims to mitigate issues like these by utilizing every network interface/access network available to the client.

Challenges that Multi-Access architectures aim to address may include:

1. Disruptions to QoS and QoE resulting from degraded performance or loss of availability of one or more network interfaces/access networks. An example may involve disruptions such as significant delays and loss of throughput caused during the process of switching from one access network as transport layer connections are destroyed and re-established.
2. Inability to efficiently utilize multiple network interfaces/access networks concurrently to achieve a target QoS or QoE. An example may include the inability of clients to effectively utilize its connection with a secondary, reliable but high-cost, 5G access network in support of the primary, unreliable but inexpensive, access network using Wi-Fi.

### 5.x.2 Gap Analysis

TBD

### 5.x.3 Use-cases

#### 5.x.3.1 OTT VOD Streaming using a Multi-CDN Architecture

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| --- |
| **Description**  TBD |
| **Categorization**  TBD |
| **Preconditions**  TBD |
| **Nominal Cost Analysis**  TBD |
| **Potential Standardization Status and Needs**  TBD |

#### 5.x.3.2 OTT Live Streaming using a Multi-CDN Architecture

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| --- |
| **Description**  TBD |
| **Categorization**  TBD |
| **Preconditions**  TBD |
| **Nominal Cost Analysis**  TBD |
| **Potential Standardization Status and Needs**  TBD |

#### 5.x.3.3 OTT VOD Streaming using a Multiple Access Networks

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| **Description**  TBD |
| **Categorization**  TBD |
| **Preconditions**  TBD |
| **Nominal Cost Analysis**  TBD |
| **Potential Standardization Status and Needs**  TBD |

#### 5.x.3.4 OTT Live Streaming using a Multiple Access Networks

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| --- |
| **Description**  TBD |
| **Categorization**  TBD |
| **Preconditions**  TBD |
| **Nominal Cost Analysis**  TBD |
| **Potential Standardization Status and Needs**  TBD |

#### 5.x.3.4 Unmanaged Wi-Fi to 5G Network Handover

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| --- |
| **Description**  TBD |
| **Categorization**  TBD |
| **Preconditions**  TBD |
| **Nominal Cost Analysis**  TBD |
| **Potential Standardization Status and Needs**  TBD |

### 5.x.4 Collaboration Scenarios

#### 5.x.4.1 Multi-CDN Media Delivery

In this scenario, the 5GMSd Client requests adaptive media streaming content from 2 or more 5GMSd Application Servers (AS). The Client may choose one or use multiple simultaneously. This allows the client to distribute network load across ASes and M4 downlink transports, optimize costs, as well as improve QoS.

The client’s media session handler discovers the URLs of these application servers from the 5GMSd Application Function (AF), either through a media entry point or from a separate piece of metadata. QoE metrics from the client may be used by the AF to determine the best application server(s) for each client to use when streaming media.

Figure 5.x.4.1-1 shows the client communicating with multiple ASes. Each AS has no direct communication with its peers, rather it communicates (minimally) with the Application Provider and with the AF via M3d.

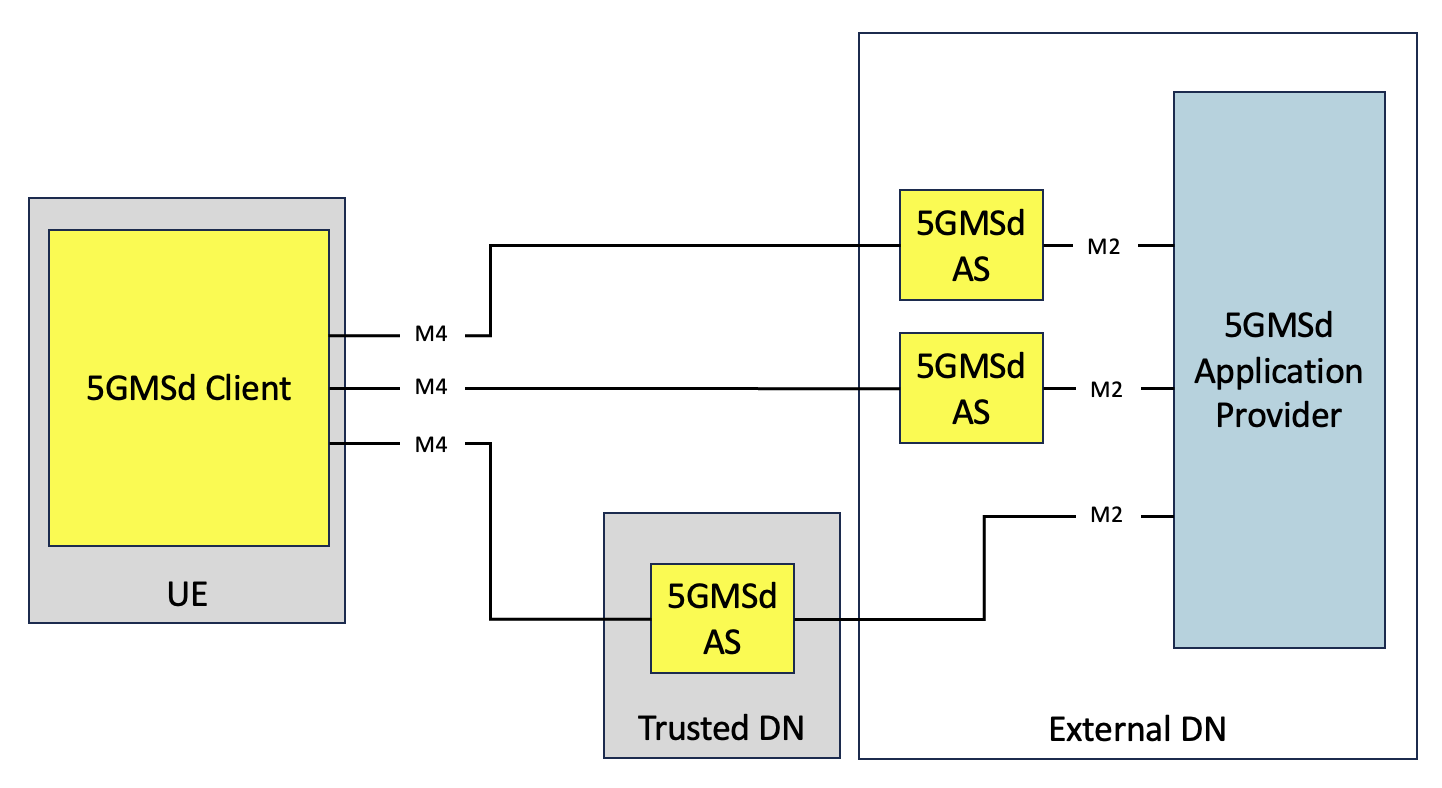


Figure 5.x.4.1-1: Multi-CDN media delivery within 5G system

#### 5.x.4.2 Multi-Access Media Delivery

In this scenario, the 5GMSd Client is directly connected to multiple data, or access, networks (e.g., an unmanaged Wi-Fi network and the 5G network). The client requests adaptive media streaming content from 2 or more 5GMSd Application Servers (AS). The Client may choose one or use multiple simultaneously. This allows the client to distribute network load across access networks and ASes, optimize costs, as well as improve QoS.

The client’s media session handler discovers the URLs of these application servers from the 5GMSd Application Function (AF), either through a media entry point or from a separate piece of metadata. QoE metrics from the client may be used by the AF to determine the best application server(s) for each client to use when streaming media.

Figure 5.x.4.2-1 shows the client communicating with multiple ASes through different data networks. Neither data network nor AS has direct communication with its peers. Rather each AS communicates (minimally) with the Application Provider and with the AF via M3d.

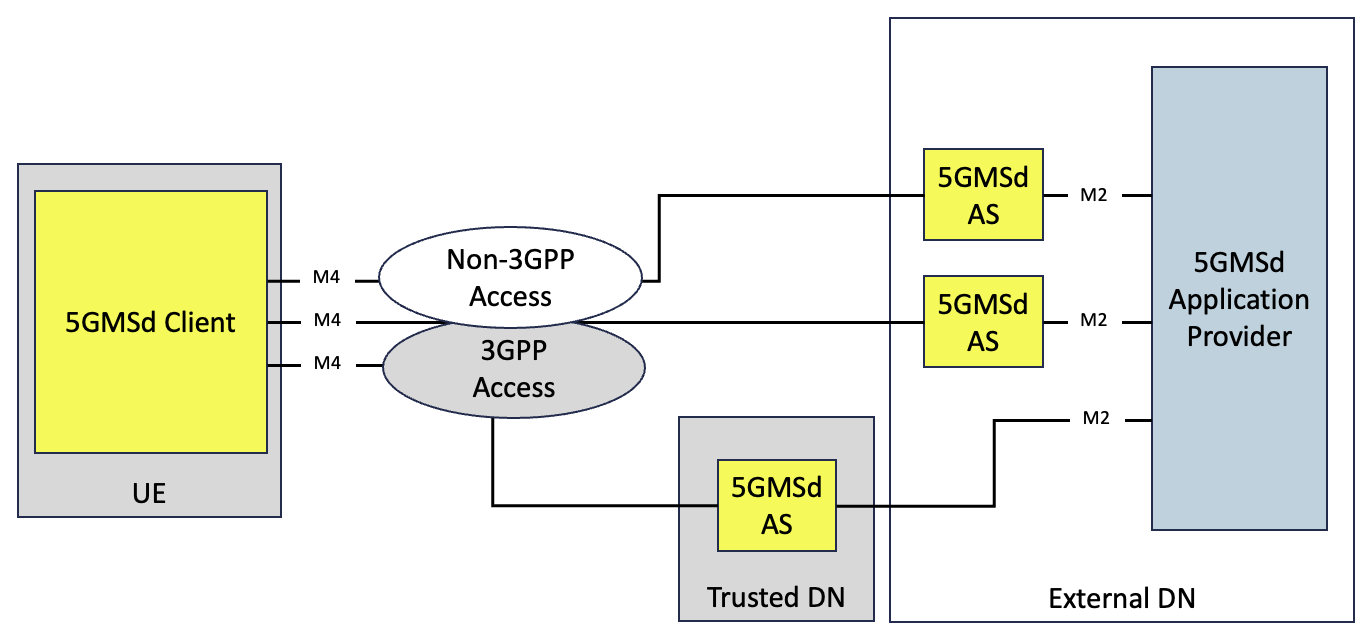


Figure 5.x.4.2-1: Multi-Access media delivery within 5G system

### 5.x.5 Deployment Architectures

TBD

### 5.x.6 Mapping to 5G Media Streaming and High-Level Call Flows

#### 5.x.6.1 TBD

TBD

### 5.x.7 Potential open issues

#### 5.x.7.1 TBD

TBD

### 5.x.8 Candidate Solutions

#### 5.x.8.1 TBD

TBD

### 5.x.9 Conclusion and recommendations

TBD

## END OF CHANGES