**3GPP TSG-SA4 Meeting 113-e *S4-210537***

**Electronic Meeting, 6th - 14th April 2021**

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| *CR-Form-v12.0* | | | | | | | | |
| **Pseudo CHANGE REQUEST** | | | | | | | | |
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|  | **26.804** | **CR** | **<CR#>** | **rev** | **3** | **Current version:** | **0.1.1** |  |
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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:*** | Key Topic Traffic Identification | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Qualcomm Incorporated, Ericsson LM | | | | | | | | | |
| ***Source to TSG:*** | SA4 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | FS\_5GMS-EXT | | | | |  | ***Date:*** | | | 2021-02-23 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *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-12 (Release 12)* *Rel-13 (Release 13) Rel-14 (Release 14) Rel-15 (Release 15) Rel-16 (Release 16)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | The study item description identifes the key topic “Traffic Identification”. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | Adds the structure and description for this key topic | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Key topic not addressed | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **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:*** | |  | | | | | | | | |

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# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 26.501: " 5G Media Streaming (5GMS); General description and architecture".

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

[4] 3GPP TS 26.512: "5G Media Streaming (5GMS); Protocols".

[5] 3GPP TS 23.501: "System architecture for the 5G System (5GS)".

[6] 3GPP TS 29.551: “5G System; Packet Flow Description Management Service; Stage 3".

[PP] 3GPP TS 29,244: "Interface between the Control Plane and the User Plane nodes".

[XX] 3GPP TS 29.214: "Policy and Charging Control over Rx reference point; Stage 3".

[DD] IETF RFC 7657: "Differentiated Services (Diffserv) and Real-Time Communication", November 1995.

[EE] IETF RFC 3168: "The Addition of Explicit Congestion Notification (ECN) to IP", September 2001.

[x1] …

[x2] …

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# 4 Introduction to 5G Media Streaming

## 4.1 Introduction

## 4.2 Collaboration Scenarios

## 4.3 Architectures

## 4.4 Summary of Stage-3 enablers

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# 5 Key Topics

## 5.1 Introduction

## 5.3 Traffic Identification

### 5.3.1 Description

For different features within the 5G Media Streaming Architecture, it is necessary for the 5G System to identify the traffic flows. Multimedia streaming applications might not be able to uniquely identify the 5-tuple of the streaming session, since the 5-tuples are often changing. This is due to factors such as load balancing, CDN distribution, multiple concurrent requests for different types of resources, etc. This study will address how to properly configure the 5G System to enable efficient detection of application flows (service data flows) e.g. for event reporting, and QoS profile usage, etc.

Figure 5.3.1-1 depicts the chain of functions (taken from TS 29.244 [PP], Figure 5.2.1-1) within a UPF for incoming IP packets (from DN side). The UPF always first looks up the PFCP session to which a packet belongs. The PFCP session is similar to a PDU session. Then there are so-called Packet Detection Rules (PDR), which implement traffic identification with respect to different conditions.



Figure 5.3.1-1: Packet processing flow in the UP function (Figure 5.2.1-1 from TS 29.244 [PP])

Based on the PDR result, the next rules are executed, namely Multi-Access Rule (MAR), Forward Action Rule (FAR), QoS Enforcement Rule (QER), and Usage Reporting Rule (URR).

Only the Forward Action Rule (FAR) is mandatory. The QoS Enforcement Rule (QER) is only present for QoS Flows. The Usage Reporting Rule (URR) is only available when traffic volume measurements (e.g. for charging) are needed.

The Packet Detection Rule (PDR) is based on Service Data Flow (SDF) Filters or Application Identifiers. An Application Identifier refers to one or more Packet Flow Descriptions (PFDs).

A Service Data Flow (SDF) Filter contains a single IP Packet filter, i.e. a Flow Description (5-tuple), and/or a ToS Traffic Class and/or a Security Parameter Index and/or a Flow Label.

The Management of Packet Flow Descriptions enables the UPF to perform accurate application detection when PFD(s) are provided by an Application Service Provider (ASP) and then to apply enforcement actions as instructed in a PCC Rule.

The operator is able to configure pre-defined PCC Rules in the SMF or dynamic PCC Rules in the PCF that include at least an application identifier for service data flow detection, charging control information, i.e. charging key and optionally a Sponsor identifier or an SP identifier or both. Depending on the service level agreements between the operator and the Application Server Provider, it may be possible for the ASP to provide to the SMF individual PFDs or the full set of PFDs for each application identifier maintained by the ASP via the PFD Management service in the NEF (PFDF). The PFDs become part of the application detection filters in the SMF/UPF and are thereafter used as part of the logic to detect traffic generated by an application. The ASP may remove or modify some or all of the PFDs which have been provided previously for one or more application identifiers. The SMF may report the application stop to the PCF for an application instance identifier as defined in clause 5.8.2.8.4 of TS 23.501 [5] if the removed/modified PFD in SMF/UPF would result in an inability to detect traffic for that application instance.

The ASP manages (provisions, updates, deletes) the PFDs through the NEF (PFDF). The PFD(s) are transferred to the SMF through the NEF (PFDF). The PFDF is a logical functionality in the NEF which receives PFD(s) from the ASP through the NEF, stores the PFD(s) in the UDR and provides the PFD(s) to the SMF(s) either on the request from ASP PFD management through NEF (PFDF) (push mode) or on the request from SMF (pull mode). The PFDF functionality is a service provided by the NEF.

The ASP may provide/update/remove PFDs with an allowed delay to the NEF (PFDF). Upon reception of the request from the ASP, the NEF (PFDF) checks if the ASP is authorized to provide/update/remove those PFD(s) and request the allowed delay. The NEF (PFDF) may be configured with a minimum allowed delay based on SLA to authorize the allowed delay provided by the ASP. When both the requesting ASP and the requested allowed delay are successfully authorized, the NEF (PFDF) translates each external Application Identifier to the corresponding Application Identifier known in the core network. Finally, the NEF (PFDF) stores the PDF(s) into the UDR.

The Application Identifier is simply an index to a set of application detection rules configured in the UPF. It is an identifier that can be mapped to a specific application traffic detection rule.

The procedure is depicted by the following diagram:



Figure 5.3.1‑2:

The PFD (Packet Flow Description) is a set of information enabling the detection of application traffic.

Each PFD may be identified by a PFD ID. A PFD ID is unique in the scope of a particular Application Identifier. Conditions for when a PFD ID is included in the PFD are described in TS 29.551 [6]. There may be different PFD types associated with an Application Identifier.

A PFD includes a PFD ID and one or more of the following:

- 3-tuple(s) including protocol, server-side IP address and port number.

- the significant parts of the URL to be matched, e.g. host name.

- a domain name matching criterion and information about applicable protocol(s).

### 5.3.2 Collaboration Scenarios

The 5GMSd Application Provider negotiates with the MNO an SLA to provide differentiated treatment, including network QoS and charging for its 5GMSd-Aware Application. The Application Provider provides the necessary information to the MNO to identify the traffic, to ensure its correct and exclusive identification. The MNO identifies the traffic correctly and applies the agreed traffic treatment.

Due to privacy concerns, the content hosting is provided by the Application Provider in an external Data Network. However, the 5GMSd Application Provider leverages the network features either via a 5GMSd AF in the trusted Data Network (Figure 5.9.2‑1) or via a 5GMSd AF in the external Data Network (Figure 5.9.2‑2).



Figure 5.9.2-1: Collaboration 1 (Collaboration 3 of TS 26.501)



Figure 5.9.2-2: Collaboration 2 (Collaboration 4 of TS 26.501)

In order to use flow-based network features (such as different QoS classes or different charging policies), the 5G System needs to detect the relevant traffic. The 5G System uses so-called **Packet Detection Rules** (PDRs) in the UPF to detect the traffic. The PDRs are created based on **Service Data Flow Templates**. The Service Data Flow Templates are provided by the 5GMSd AF.

### 5.3.3 Deployment Architectures

The following figure depicts a potential architecture design for the realization of traffic identification. The architecture shows the involved network functions in the traffic identification.



Figure 5.3.3-1: Relevant architecture components

### 5.3.4 Mapping to 5G Media Streaming and High-Level Call Flows

#### 5.3.4.1 General

Editor’s Note: Short introduction into the different Traffic Identification schemes.

#### 5.3.4.2 Usage of Packet Flow Descriptions for Traffic Identification

The following are potential and simplified call flows for the realization of the traffic identification.

In the first call flow (Figure 5.3.4‑1) the provisioning step is described, in which one or more PFDs for a single application are provisioned. The provisioned PFDs for a single application are identified by the Application Identifier.



Figure 5.3.4-1: PFD Provisioning using the PFD Management API (simplified)

In the second call flow (Figure 5.3.4‑2) the update procedure for the PFD to adjust to an actual session is described.



Figure 5.3.4-2: PFD usage within an application traffic detection rule (simplified)

#### 5.3.4.3 Usage of ToS Traffic Class for Traffic Identification

The following is a simplified call flow when using the ToS Traffic Class for Traffic Identification. The Type of Service (ToS) is an 8-bit field within the IP header (both IPv4 and IPv6) that can be used to carry a DiffServ Code Point (DSCP) value [DD] and for ECN [EE] marking. It is assumed here that the QoS flow should be used (e.g. for Premium QoS) as described in TS 26.512, Annex A.



Figure 5.3.4.3-1: PFD usage within a application traffic detection rule (simplified)

Figure 5.3.4.3-1 depicts a call flow for ToS-based traffic detection. It is assumed here that the 5GMSd AF provides the ToS value for traffic identification in the Policy Activation response message (step 2). Another solution might be that the Media Session Handler allocates a ToS value and then provides the value to the 5GMSd AF.

The call flow works as the following steps:

1: The Media Session Handler activates a Dynamic Policy and provides the Policy Template Id with the activation request (among other parameters).

2: If the Dynamic Policy can be activated, the 5GMSd AF provides a value for the ToS field in return.

NOTE: The ToS field value is scoped with the IP address of the requesting UE. The UPF first looks up the relevant PDRs for a PDU Session based on the incoming GTP Tunnel Id.

The 5GMSd AF triggers the activation of a Dynamic PCC rule:

3: The 5GMSd AF uses the Policy Authorization Service API and triggers a PCC rule activation. The 5GMSd AF provides the ToS value together with the IP address of the requesting UE and QoS parameters.

4: As result, the PCF uses the Npcf\_SMPolicyControl APIs to provide a new PCC rule to the SMF.

5: The SMF uses the N4 interface to provide a new Packet Detection Rule (PDR) together with other rules for the UE to the UPF. Once the new rule is installed in the UPF, the UPF starts taking actions on the detected traffic.

6: The Media Player prepares a new TCP connection and sets the ToS value nominated by the 5GMSd AF on the TCP socket using the setsockopt() API or equivalent. As a result, all TCP packets for the flow will be marked by the UE with the ToS value.

7: The TCP connection is established, and the traffic is marked with the ToS field. The UPF detects the traffic (by inspecting the IP header) and handles it according to the policy in the PCC rule.

The UPF also nees to detect the downlink traffic matching the uplink traffic. There are different solutions to achieve this:

A: The 5GMSd AS uses the same ToS field for downlink traffic as used for uplink traffic.

NOTE 1: The traffic should not cross operational domain boundaries, since the ToS header field is often reset by border IP routers.

B: The UPF captures the 5-tuple carrying a specific ToS field from the TCP SYN Packet that establishes the connection in the uplink direction. As result, the UPF automatically creates a new PDR in the opposite direction derived by inverting the address fields found in the SYN packet.

NOTE 2: The connection handshake of other transport protocols may be more difficult to detect.

C: Often, the UEs in a PLMN are shielded from public Internet traffic by means of firewalls that employ Network Address Translation (NAT). In order to set the ToS field within the Trusted DN to an appropriate value, the N6‑NAT may set the downlink ToS to the same value as the uplink ToS.

NOTE 3: This is similar to solution A above.

#### 5.3.4.4 Usage of 5-Tuples for Traffic Identification

Besides the PFD related traffic identification method which identifies the 3-tuple and/or the domain name, the application detection filters required in the UPF can also be configured in the SMF and provided to the UPF, which can be used to detect a specific 5-tuples streaming within one specific application, e.g. subtitles, video, audio and bullet screen comments. The 5GMS AF is able to provision, update and remove a dynamic PCC rule which contains flow description parameters for traffic handling and application/flow detection in the UPF.

The application detection filter can be configured in the SMF and the SMF will then provide it in the Service Data Flow filter to the UPF, as well as flow description parameters for traffic handling in the UPF received from the dynamic PCC rule.

The flow description defines a packet filter for an IP flow with the following information as defined in clause 5.3.8 of TS 29.214 [XX]:

- Source/destination IP address or IPv6 prefix.

- Source/destination port number.

- Protocol ID of the protocol above IP/Next header type.

- Packet Filter direction.

As shown in the figure below, the 5GMSd AF in the extrenal DN can send a request using Nnef\_AFsessionWithQos API to provision, update or remove a request to reserve resources for a specific application/flow with specific flow descriptions. After the AF request authorization, NEF interacts with the PCF, providing the flow description together with the QoS reference and optional other parameters like Alternative Service Requirements, period of time or traffic volume, etc.

If the request is authorised, the PCF determines the required QoS parameters based on the information provided by NEF/AF. After the Nnef\_AFSessionWithQoS Creation procedure completes, a transaction identifier is allocated by the NEF to identify this AF Session. The 5GMSd AF can subsequently invoke the Nnef\_AFSessionWithQoS Update API with this transaction identifier to update the flow descrption.

Alternatively, the 5GMSd AF in the trusted DN can directly send a request using Npcf\_PolicyControl API to provision, update and remove a request to reserve resources for a specific application/flow with specific flow descriptions.

Then the PCF initiates the PDU Session modification procedure to provide the updated PCC rule to the SMF, and the SMF updates the PDRs in the UPF for the application/traffic identification and policy handling.

However, when a first TCP connection is closed and a second one is opened, the 5-tuple in the Flow Description need to be changed. This may be the consequence of factors such as load balancing, multiple concurrent requests for different types of resources, shared TCP pool, etc. In such cases, the 5GMSd AF can invoke the NEF/PCF related APIs with new flow description to update the PDRs installed in UPF to follow the changed application layer 5-tuples r application/flow identification.



Figure 1 Traditional application/flow identification method

### 5.3.5 Potential open issues

The exact behavior and information that needs to be provided to and by the 5GMSd AF as well as the MSH need to be specified.

### 5.3.6 Candidate Solutions

Editor’s Note: Provide candidate solutions (including call flows) for each of the identified issues.

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# Annex X – Media Streaming Protocols

### X.1 Status and usage of Web Protocols

The site HTTPArchive.org [x1] offers some insights into the uptake of different HTTP protocol versions by publicly accessible websites. The Report “State of the Web” contains statistics about the number of TCP connections per page and the number of HTTP/2 requests over a time period. The site crawls millions of URLs every month. The URLs are taken from the Chrome User Experience Report.

Currently, around 70% of websites support HTTP/2. Unfortunately, the site does not show statistics for video usage.

The site quic.netray.io [x2] offers some insights into the HTTP/3 (QUIC) take-up.

### X.1.1 M4d protocol usage

It is anticipated that MPEG‑DASH would be used by many Application Providers on the M4d Interface if 5GMS services become widely deployed. MPEG‑DASH defines the manifest format and also the media segment format. MPEG‑DASH allows several different ways to use the underlying HTTP transport, depending on the DASH Profile.

For traffic identification, the identification of the transport protocol (TCP or UDP) used on interface M4d is essential, since the transport protocol needs to be described in the Service Data Flow Template. HTTP/1.1 and HTTP/2 both use TCP transport. HTTP/3 uses a UDP-based QUIC transport. Furthermore, HTTP/1.1. often leverages multiple TCP connections simultaneously, while HTTP/2 and HTTP/3 allow more efficient reuse of the transport through the technique of non-blocking request multiplexing on a single transport connection.

### X.1.2 Results of HTTP protocol version usage study

Editor’s Note: It is currently unclear how to document the results of the transport connection usage study. It is clear, this this represents only a small snapshot on how the different HTTP versions are used and currently only focused on browser based clients.

Within a small study, the transport protocol usage of three major video-on-demand providers were studied, namely YouTube, Netflix and Amazon. The study leveraged browser-based DASH players, using the popular web browsers Google Chrome (version 87.0.4280.141, 64-bit running on Win 10 Pro Version 2004 b 19041.746) and Mozilla Firefox (version 84.0.2, 64-bit running on Win 10 Pro Version 2004 b 19041.746). The intention was to get more insights into HTTP usage.

a) Accessing YouTube with Chrome, we found that YouTube in a Chrome Browser uses MPEG‑DASH with HTTP/3 transport. Several YouTube clips were selected, and HTTP/3 was consistently used for retrieving both media segments and other content. Detailed investigations showed that only a single HTTP/3 connection was established to the server.

b) Accessing Amazon Prime with Chrome, we found that Amazon Prime uses MPEG‑DASH. For some movies, HTTP/2 is used for all content (including media segments). Some other movies used HTTP/1.1 for media segments and HTTP/2 for non-media segments. It is not clear on which basis the application protocol is selected.

c) Accessing Netflix with Firefox, we found that Netflix uses MPEG‑DASH with HTTP/1.1. Some objects, such as images, are fetched using HTTP/2.

d) Accessing YouTube with Firefox, we found that YouTube uses MPEG‑DASH with HTTP/1.1. Non-video transactions use HTTP/2.