**3GPP TSG- S4 Meeting #115e**

**, – 27th August 2021**

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| *CR-Form-v12.1* |
| **Pseudo 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 |  | Radio Access Network |  | Core Network |  |

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| ***Title:***  | [FS\_5GMS\_EXT] Proposal of Candidate Solutions for ToS based traffic detection |
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| ***Source to WG:*** |  |
| ***Source to TSG:*** | S4 |
|  |  |
| ***Work item code:*** | FS\_5GMS\_EXT |  | ***Date:*** |  |
|  |  |  |  |  |
| ***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-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)* |
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| ***Reason for change:*** | The technical report does not contain detailed call flows for using different traffic detection parameters, like a ToS field. |
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| ***Summary of change:*** | A set of candidate solutions is proposed, containing detailed call flows when using a ToS field for traffic detection. |
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| ***Consequences if not approved:*** |  |
|  |  |
| ***Clauses affected:*** |  |
|  |  |
|  | **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:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\*\*\*\* First Change \*\*\*\*

## 5.3 Traffic Identification

*< Snip>*

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

#### 5.3.4.1 General

The Service Data Flow Templates support multiple different combinations to define parameters for traffic detection. This clause describes the common parameter combinations to detect specifically media streaming application traffic.

The Service Data Flow Template can take the form of either Service Data Flow filters (i.e. IP Packet Filter Sets) or an Application Id referencing Packet Flow Descriptions (PFDs).

An IP Packet Filter Set can contain different combinations of parameter values. Unspecified parameter values in the IP Packet Filter Sets are used to match any value of the corresponding information in the header of an IP packet. Common IP Packet Filter Set combinations are:

- 5-Tuple: The source and destination IP addresses, source and destination port numbers (potentially expressed as a small range of values) and the Protocol ID. This method of traffic detection is further described in clause 5.3.4.2 below.

- ToS: The source IP address and the Type of Service (ToS). This method of traffic detection is further described in clause 5.3.4.3 below.

NOTE: The Type of Service field is used here to map an application data flow to a specific PCC rule.

Editor’s Note: Additional parameter value combinations such as 3-Tuple or usage of Flow Label (IPV6 only) can be beneficial.

A Packet Flow Description (PFD) can contain different parameters. Common parameters are:

- Domain Name: The Internet domain name of an application server. This method of traffic detection is not described further in the present document.

\*\*\*\* Next Change \*\*\*\*

### 5.3.6 Candidate Solutions

#### 5.3.6.1 Solution overview

This section gives an overview of the different candidate solutions for application traffic flow identification within a PDU Session beyond providing (non-wildcarded) 5-tuples. Solutions fall into one of the following two categories:

- *Charging separation-only:* Only the application detection filters in the UPF are provisioned with either IP Packet Filter Set (PFS) or PFD parameters,

- *QoS separation:* The application detection filters in the UE and in the UPF are provisioned with either IP Packet Filter Set or PFD parameters in order to mark packets with the appropriate QFI inside the 5G System.

NOTE: Both types of solution may also be used for traffic policing.

#### 5.3.6.2 Candidate IP-PFS Solution 1: Using IP ToS marking for downlink-only QoS flow mapping

This candidate solution focuses on a scenario where only downlink traffic needs to be mapped to a specific QoS Flow and handled differently by the 5G System. Related uplink traffic is handled using default QoS.

Editor’s Note: Such a solution is counterproductive for TCP- and QUIC-based transports, i.e. protocols depending on acknowledgements. Such solutions can make sense for RTP/UDP based flows, such as in Media Production.

#### 5.3.6.3 Candidate IP-PFS Solution 2: Using IP ToS marking for uplink-only QoS flow mapping

This candidate solution focuses on a scenario where only uplink traffic needs to be mapped to a specific QoS Flow and handled differently by the 5G System. Related downlink traffic is handled using default QoS.

Editor’s Note: Such a solution is counterproductive for TCP- and QUIC-based transports, i.e. protocols depending on acknowledgements. Such solutions can make sense for RTP/UDP based flows, such as in Media Production.

#### 5.3.6.3 Candidate IP-PFS Solution 3a: Using IP ToS marking for bi-directional QoS flow mapping, initiated by downlink traffic

This candidate solution focuses on a scenario where both downlink and uplink traffic for a particular application flow within a PDU Session shared by several different application flows (from the same or different UE applications) needs to be mapped to a specific QoS Flow and handled differently by the 5G System. In this candidate solution, the 5GMS AF initiates the QoS Flow establishment by using specific ToS values in the downlink traffic.



Figure 5.3.6.3-1:

Assumptions:

- A PCC rule for the UE is activate in the 5G System. The PCC rule contains a Service Data Flow Filter with a ToS value and the UE IP address.

- Reflective QoS is enabled for the PDU Session in question.

Steps:

Provisioning: The 5GMS System is provisioning for Dynamic Policy usage as defined in clause 5.7.2 of TS 26.501 [?]. As a result, various functions of the 5G System are provisioned for QoS usage as follows:

1. The 5GMS Client has received Service Access Information (through M6 or M5), providing the information needed to use the Dynamic Policy Invokation API. Here, the sdfMethod indicates the usage of ToS. The 5GMS Client has activated a Dynamic Policy as described in clause 5.7 of TS 26.501 [?].

2. The 5GMS AF has provisioned the information for a Dynamic PCC rule with the PCF (possibly through NEF).

3. The PCF has authorized the request and created a PCC rule. The PCF has sent the PCC rule to the SMF, which has forwarded the QoS rule to the UE (indicating “reflective QoS” here) and to the UPF.

During media plane usage:

4. The 5GMS Client initiates connection establishment by sending a TCP SYN packet. The packet is forwarded by the SDAP entity of the UE (Layer 2) and the UPF to the 5GMS AS.

5. The 5GMS AS looks up the ToS policy, including the ToS value for this UE/network.

NOTE: The 5GMS AS may also wait until the first HTTP request message is received to determine the purpose of the request. A 5GMS Client may use the TCP connection for subsequent HTTP transactions (persistent TCP connection).

6. The 5GMS AS sends a TCP SYN–ACK to the UE to continue the TCP connection establishment handshake. The 5GMS AS sets the TOS field value. The packet reaches the UPF on its path to the UE.

7. The UPF detects a PDR match for the UE. Here, the PDR for the UE IP address contains the ToS value. (The PDR was provided to the UPF in an earlier step as described in clause 5.3.4.3.)

8. The UPF encapsulates the downlink IP packet inside an N3 packet. The UPF sets the QFI value in the N3 packet header.

9. The UPF sends the N3 packet to the RAN and the RAN marks the QFI value in the SDAP layer, sending the packet to the UE.

10. The SDAP entity in the UE (Layer 2) detects a new QFI.

11. Reflective QoS is activated for the PDU Session and the UE creates a “UE-derived QoS Rule” as defined in TS 23.501 [?], clause 5.7.5.2.

12. The SDAP entity in the UE (Layer 2) forwards the TCP SYN/ACK to the 5GMS Client.

13. The 5GMS Client send the TCP ACK to complete the TCP connection handshake. (This packet does not need to be marked with a specific ToS value by the 5GMS Client.

14. The SDAP entity in the UE (Layer 2) detects a PDR match for the UE. Here, the PDR is the 5-tuple as stored in the UE-derived QoS rule.

15. The SDAP entity in the UE (Layer 2) encapsulates the IP packet containing the TCP ACK into the according radio protocols, including the QFI marking.

The 5GMS Client continues to use the established TCP connection.

Discussion:

- The 5GMS AS needs to determine whether QoS should be used for this session and which ToS value to use.

- The Npcf\_PolicyAuthorization API allows a ToS value to be provisioned (without a direction indication), but the Nnef\_AFsessionWithQOS API does not support provisioning of a ToS value.

#### 5.3.6.4 Candidate IP-PFS Solution 3b: Using IP ToS marking for bi-directional QoS flow mapping, initiated by downlink traffic

This candidate solution focuses on a scenario where both downlink and uplink traffic for a particular application flow within a PDU Session shared by several different application flows (from the same or different UE applications) needs to be mapped to a specific QoS Flow and handled differently by the 5G System. In this candidate solution, the 5GMS AF initiates the QoS Flow establishment by using specific ToS values in the downlink traffic.



Figure 5.3.6.3-1:

Assumptions:

- A PCC rule for the UE is activate in the 5G System. The PCC rule contains a Service Data Flow Filter with a ToS value and the UE IP address.

Steps:

Provisioning: The 5GMS System is provisioned for Dynamic Policy usage as defined in clause 5.7.2 of TS 26.501 [?]. As result, various functions of the 5G System are provisioned for QoS usage as follows:

1. The 5GMS Client has received Service Access Information (through M6 or M5), providing the information needed to use the Dynamic Policy Invokation API. Here, the sdfMethod indicates the usage of ToS. The 5GMS Client has activated a Dynamic Policy as described in clause 5.7 of TS 26.501 [?].

2. The 5GMS AF has provisioned the information for a Dynamic PCC rule with the PCF (possibly through NEF).

3. The PCF has authorized the request and created a PCC rule. The PCF has sent the PCC rule to the SMF, which has forwarded the QoS rule to the UE and to the UPF. The QoS Rule for the UE contains the ToS value.

During media plane usage:

4. The 5GMS Client initiates connection establishment by sending a TCP SYN packet. The packet is forwarded by the SDAP entity of the UE (Layer 2) and the UPF to the 5GMS AS.

5. The 5GMS AS looks up the ToS policy, including the ToS value for this UE/network.

NOTE: The 5GMS AS may also wait until the first HTTP request message is received to determine the purpose of the request. A 5GMS Client may use the TCP connection for subsequent HTTP transactions (persistent TCP connection).

6. The 5GMS AS sends a TCP SYN–ACK to the UE to continue the TCP connection establishment handshake. The 5GMS AS sets the TOS field value. The packet reaches the UPF on its path to the UE.

7. The UPF detects a PDR match for the UE. Here, the PDR for the UE IP address contains the ToS value. (The PDR was provided to the UPF in an earlier step as described in clause 5.3.4.3.)

8. The UPF encapsulates the downlink IP packet inside an N3 packet. The UPF sets the QFI value in the N3 packet header.

9. The UPF sends the N3 packet to the RAN and the RAN marks the QFI value in the SDAP layer, sending the packet to the UE.

10. The SDAP entity of the UE (Layer 2) forwards the TCP SYN–ACK to the 5GMS Client.

11. The 5GMS Client send the TCP ACK to complete the TCP connection handshake. (This packet does not need to be marked with a specific ToS value by the 5GMS Client.

12. The UE detects a PDR match for the UE.

13. The SDAP entity in the UE (Layer 2) encapsulates the IP packet containing the TCP ACK into the according radio protocols, including the QFI marking.

The 5GMS Client continues to use the established TCP connection.

Discussion:

- The 5GMS AS needs to determine whether QoS should be used for this session and which ToS value to use.

- The Npcf\_PolicyAuthorization API allows a ToS value to be provisioned (without a direction indication), but the Nnef\_AFsessionWithQOS API does not support provisioning of a ToS value.

#### 5.3.6.4 Candidate IP-PFS Solution 4a: Using ToS marking for bi-directional QoS flow mapping, initiated by uplink traffic

This candidate solution focuses on a scenario where both downlink and uplink traffic for a particular application flow within a PDU Session shared by several application flows needs to be mapped to a specific QoS Flow and handled separated by the 5G System. In this candidate solution, the 5GMS Client initiates the QoS Flow establishment by using specific ToS values in the uplink traffic. Here, the reception of the ToS-marked IP Packet in the UPF triggers the creation of a new QoS rule in the UPF, similar to reflective QoS principles.

NOTE: Creation of a new QoS rule derived from an IP packet is defined as “UE-derived QoS rule” creation in clause 5.3.4 (Reflective QoS) of TS 23.501 [?].



Figure 5.3.6.4-1:

Assumptions:

- A PCC rule for the UE is activate in the 5G System. The PCC rule contains a Service Data Flow Filter with a ToS value and the UE IP address.

- Reflective QoS is enabled for the PDU Session in question.

Steps:

Provisioning: The 5GMS System is provisioned for Dynamic Policy usage as defined in clause 5.7.2 of TS 26.501 [?]. As result, various functions of the 5G System are provisioned for QoS usage as follows:

1. The 5GMS Client has received Service Access Information (through M6 or M5), providing the information needed to use the Dynamic Policy Invokation API. Here, the *sdfMethod* indicates the usage of ToS. The 5GMS Client has activated a Dynamic Policy as described in clause 5.7 of TS 26.501 [?].

2. The 5GMS AF has provisioned the information for a Dynamic PCC rule with the PCF (possibly through NEF).

3. The PCF has authorized the request and created a PCC rule. The PCF has sent the PCC rule to the SMF, which has forwarded the QoS rule to the UE and to the UPF.

During media plane usage

4. The 5GMS Client initiates connection establishment by sending a TCP SYN packet. The packet is forwarded by the SDAP entity of the UE (Layer 2) and the UPF. The 5GMS Client has set a ToS value in the TCP SYN packet, as provided by the 5GMS AF in an earlier step (see clause 5.3.4.3).

5. The UPF detects a PDR match for the UE. Here, the PDR for the PDU Session (e.g. identified by the TEID) contains the ToS value. (The PDR was provided to the UPF in an earlier step as described in Clause 5.3.4.3.)

6. The UPF creates a “UPF derived QoS Rule”, similar to the “UE derived QoS Rule” (see TS 23.501 [?], clause 5.7.5.2). The UPF derives the IP Packet Filter set (similar to the derivation in the “UE derived QoS rule”) by taking the IP addresses, protocol identifier and port numbers into the IP Packet Filter Set.

7. The UPF forwards the TCP SYN packet to the 5GMS AS.

8. The 5GMS AS replies with a TCP SYN–ACK packet to continue the TCP connection establishment handshake.

9. The UPF detects a PDR match for the UE. Here, the PDR for the UE contains the 5-tuple of the TCP connection.

10. The UPF encapsulates the downlink IP packet into an N3 packet. The UPF sets the QFI value in the N3 packet header.

11. The UPF sends the N3 packet to the UE via the RAN.

12. The SDAP entity of the UE (Layer 2) detects a new QFI value.

13. Since Reflective QoS is activated for the PDU Session, the UE creates a “UE-derived QoS Rule” as defined in TS 23.501, clause 5.7.5.2.

14. The SDAP entity of the UE (Layer 2) forwards the TCP SYN–ACK to the 5GMS Client.

15. The 5GMS Client sends the TCP ACK to complete the TCP connection handshake. (Unlike in step 4, this packet does not need to be marked with a specific ToS value by the 5GMS Client.)

16. The SDAP entity of the UE (Layer 2) detects a PDR match for the UE. Here, the PDR is the 5-tuple as stored in the UE derived QoS rule.

17. The UE encapsulates the IP packet into the according radio protocols, including the QFI marking.

The 5GMS Client continues to use the established TCP connection.

Discussion:

- TS 23.501 [?] defines only a “UE-derived QoS Rule”. The concept does not exist for the UPF.

- The Npcf\_PolicyAuthorization API allows a ToS value to be provisioned (without a direction indication), but the Nnef\_AFsessionWithQOS API does not support provisioning of a ToS value.

#### 5.3.6.5 Candidate IP-PFS Solution 4b: Using ToS marking for bi-directional QoS flow mapping, initiated by uplink traffic

This candidate solution focuses on a scenario where both downlink and uplink traffic for a particular application flow within a PDU Session shared by several application flows needs to be mapped to a specific QoS Flow and handled separated by the 5G System. In this candidate solution, the 5GMS Client initiates the QoS Flow establishment by using specific ToS values in the uplink traffic. Here, the IP packet with the ToS value reaches the 5GMS AS and is re-used for downlink traffic.



Figure 5.3.6.5-1:

Assumptions:

- A PCC rule for the UE is activate in the 5G System. The PCC rule contains a Service Data Flow Filter with a ToS value and the UE IP address.

- Reflective QoS is enabled for the PDU Session in question.

Steps:

Provisioning: The 5GMS System is provisioned for Dynamic Policy usage as defined in clause 5.7.2 of TS 26.501 [?], Clause 5.7.2. As result, various functions of the 5G System are provisioned for QoS usage as follows:

1. The 5GMS Client has received Service Access Information (through M6 or M5), providing the information needed to use the Dynamic Policy Invokation API. Here, the sdfMethod indicates the usage of ToS. The 5GMS Client has activated a Dynamic Policy as described in clause 5.7 of TS 26.501 [?].

2. The 5GMS AF has provisioned the information for a Dynamic PCC rule with the PCF (possibly through NEF).

3. The PCF has authorized the request and created a PCC rule. The PCF has sent the PCC rule to the SMF, which has forwarded the QoS rule to the UE and to the UPF.

During Media Plane usage

4. The 5GMS Client initiates connection establishment by sending a TCP SYN packet. The packet is forwarded by the SDAP entity of the UE (Layer 2) and the UPF to the 5GMS AS. The 5GMS Client has set a ToS value in the TCP SYN packet, as provided by the 5GMS AF in an earlier step (see clause 5.3.4.3).

5. The 5GMS AS reads the ToS value from the uplink packet. The 5GMS AS uses the uplink ToS value to mark all downlink packets in that TCP connection.

NOTE: When the 5G System employs an N6 NAT, the N6 NAT may set the downlink ToS value to the same value as the uplink ToS value.

6. The 5GMS AS sends a TYP SYN–ACK back to the UE. The packet reaches the UPF on its path to the UE.

7. The UPF detects a PDR match for the UE. Here, the PDR for the UE IP address contains the ToS value. (The PDR was provided to the UPF in an earlier step as described in clause 5.3.4.3.)

8. The UPF encapsulates the downlink IP packet into an N3 packet. The UPF sets the QFI value in the N3 packet header.

9. The UPF sends the N3 packet to the RAN and the RAN marks the QFI value in the SDAP layer, sending the packet to the UE.

10. The SDAP entity of the UE (Layer 2) detects a new QFI value.

11. Since Reflective QoS is activated for the PDU Session, the SDAP entity of the UE (Layer 2) creates a “UE-derived QoS Rule” as defined in TS 23.501 [?], clause 5.7.5.2.

12. The SDAP entity of the UE (Layer 2) forwards the TCP SYN–ACK to the 5GMS Client.

13. The 5GMS Client send the TCP ACK to complete the TCP connection handshake. (Unlike in step 4, this packet does not need to be marked with a specific ToS value by the 5GMS Client.)

14. The SDAP entity of the UE (Layer 2) detects a PDR match for the UE. Here, the PDR is the 5-tuple as stored in the UE-derived QoS rule.

15. The SDAP entity of the UE (Layer 2) encapsulates the IP packet into the according radio protocols, including the QFI marking.

The 5GMS Client continues to use the established TCP connection.

Discussion:

- The 5GMS AS needs to determine whether QoS should be used for this session and which ToS value to use.

- The Npcf\_PolicyAuthorization API allows a ToS value to be provisioned (without a direction indication), but the Nnef\_AFsessionWithQOS API does not support provisioning of a ToS value.

\*\*\*\* Last Change \*\*\*\*