**3GPP TSG-SA5 Rapporteur call *S5-22xxxx***

**e-meeting, 16 March 2022**

**Source: Ericsson AB**

**Title: Triggers for interacting with two CHFs**

**Document for: Discussion**

**Agenda Item: Roaming**

# 1 Decision/action requested

**Agree on the way forward for the triggers related to roaming with local breakout.**

# 2 References

[1] [1] 3GPP TS 32.255: "Telecommunication management; Charging management; 5G data connectivity domain charging; stage 2"

# 3 Rationale

A new trigger is needed to give the SMF a possibility to indicate that it could not reach the other CHF, and in this case it would terminate the sessions since there is no way of knowing how to handle the PDU session any more.

There is no need to state the usage of QBC in HPLMN and VPLMN in the clause on triggers, since this is already stated in the clauses 5.1.9 and 5.2.1.7 on QBC.

See proposed changes to TS 32.255 [1] in clause 4.

# 4 Detailed proposal

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| **First change** |

#### 5.2.1.4 Flow Based Charging (FBC)

For FBC charging, the SMF categorizes the service data flows within PDU session data traffic by rating group and / or combination of the rating group and service id. The level of the reporting and charging method is defined per PCC rule. Details of this functionality are specified in TS 23.503 [202] and TS 32.240 [1].

The SMF can include the QoS Information per rating group or per combination of rating group/service id. If the QoS Information cannot be unambiguously determined per rating group or per combination of rating group/service id, it should be omitted.

NOTE: The SMF can only include one QoS Information occurrence per combination of rating group/service id. This implies if an operator wishes to be able to separate usage according to 5QI and ARP for the same charging method, they will need to ensure that service data flows having different 5QI and ARP do not have the same:

- rating group in cases where rating reporting is used;

- rating group/service id where rating group/service id reporting is used.

When a service data flow is governed by a PCC Rule indicated with "Online" charging method, quota management is required for the service data flow. It may also indicate if authorization for the service data flow is needed or not before service delivery, i.e. blocking or non-blocking mode.

When a service data flow is governed by a PCC Rule indicated with "Offline" charging method, quota management is not required for this service data flow. Usage reporting is required for this service data flow without affecting the delivery.

According to TS 23.503 [202], FBC shall support different charging models per PCC rule. These charging models may be based on volume and/or time and on number of events matching a specific service data flow template in PCC rule. When a chargeable event occurs for which quota needs to be requested by the SMF to the CHF, the type of requested quota may depend on measurement method configured for the PCC rule.

In general, the charging of a service data flow shall be linked to the PDU session under which the service data flow has been activated.

The amount of data counted shall be the user plane payload at the UPF separated between UL and DL.

For PDU session specific charging, time metering shall start when PDU session is activated.

Table 5.2.1.4.1 summarizes the set of default trigger conditions and their category which shall be supported by the SMF. For "immediate report" category, the table also provides the corresponding Charging Data Request [Initial, Update, Termination] message sent from SMF towards the CHF.

Table 5.2.1.4.1: Default Trigger conditions in SMF

| Trigger Conditions | Trigger level | Converged Charging default category | Offline only charging default category | CHF allowed to change category | CHF allowed to enable and disable | Message when "immediate reporting" category |
| --- | --- | --- | --- | --- | --- | --- |
| Start of PDU Session. | PDU session | Immediate | Immediate | Not Applicable | Not Applicable | Charging Data Request [Initial] |
| Start of the Service data flow and no charging session exists. | RG | Immediate | Immediate | No | No |
| **Change of Charging conditions** | | | | | | Charging Data Request [Update] |
| QoS change | PDU session/ RG | Deferred | Deferred | Yes | Yes |
| GFBR guaranteed status change | RG | Deferred | Deferred | Yes | Yes |
| User Location change | PDU session/ RG | Deferred | Deferred | Yes | Yes |
| Serving Node change | PDU session/ RG | Deferred | Deferred | Yes | Yes |
| Change of UE presence in Presence Reporting Area(s) | PDU session/ RG | Deferred | Deferred | Yes | Yes |
| Change of 3GPP PS Data off Status | PDU session/ RG | Deferred | Deferred | Yes | Yes |
| Tariff time change | PDU session/ RG | Deferred | Deferred | No | No |
| UE time zone change | PDU session/ RG | Immediate | Deferred | Yes | Yes |
| PLMN change | PDU session/ RG | Immediate | Deferred | Yes | Yes |
| RAT type change | PDU session/ RG | Immediate | Deferred | Yes | Yes |
| Session-AMBR change | PDU session | Immediate | Deferred | Yes | Yes |
| Addition of UPF | PDU Session/RG | Immediate | Deferred | Yes | Yes |
| Removal of UPF | PDU session/RG | Immediate | Deferred | Yes | Yes |
| Insertion of I-SMF | PDU Session | Deferred | Deferred | Yes | Yes |
| Change of I-SMF | PDU Session | Deferred | Deferred | Yes | Yes |
| Removal of I-SMF | PDU Session | Deferred | Deferred | Yes | Yes |
| Handover cancel | PDU session | Immediate | Deferred | Yes | Yes |
| Handover start | PDU session | Immediate | Deferred | Yes | Yes |
| Handover complete | PDU session | Immediate | Deferred | Yes | Yes |
| Addition of access | PDU session/ RG | Immediate | Deferred | Yes | Yes |
| Removal of access | PDU session/ RG | Immediate | Deferred | Yes | Yes |
| Redundant transmission change | RG | Immediate | Deferred | Yes | Yes |
| **Limit per PDU session** | | | | | |
| Expiry of data time limit per PDU session | PDU session | Immediate | Immediate | No | Yes |
| Expiry of data volume limit per PDU session | PDU session | Immediate | Immediate | No | Yes |
| Expiry of data event limit per PDU session | PDU session | Immediate | Immediate | No | Yes |
| Expiry of limit of number of charging condition changes | PDU session | Immediate | Immediate | No | Yes |
| **Limit per Rating group** | | | | | |
| Expiry of data time limit per rating group | RG | Deferred | Deferred | Yes | Yes |
| Expiry of data volume limit per rating group | RG | Deferred | Deferred | Yes | Yes |
| Expiry of data event limit per rating group | RG | Deferred | Deferred | Yes | Yes |
| **Quota management** | | | | | |
| Time threshold reached | RG | Immediate | Not applicable | No | Yes |
| Volume threshold reached | RG | Immediate | Not applicable | No | Yes |
| Unit threshold reached | RG | Immediate | Not applicable | No | Yes |
| Time quota exhausted | RG | Immediate | Not applicable | No | Yes |
| Volume quota exhausted | RG | Immediate | Not applicable | No | Yes |
| Unit quota exhausted | RG | Immediate | Not applicable | No | Yes |
| Expiry of quota validity time | RG | Immediate | Not applicable | No | Yes |
| Expiry of quota holding time | RG | Immediate | Not applicable | No | Yes |
| Re-authorization request by CHF | RG | Immediate | Not applicable | No | No |
| Start of service data flow, in case no valid quota for this rating group | RG | Immediate | Not applicable | No | No |
| Start of SDF additional access, in case no valid quota for this access rating group | RG | Immediate | Not applicable | No | No |
| **Others** | | | | | |
| Termination of service data flow - last service data flow under a given Rating Group. | RG | Immediate | Immediate | No | No |
| Management intervention | PDU session | Immediate | Immediate | No | No |
| Expiry of Unit Count Inactivity Timer | PDU session | Immediate | Not applicable | No | No | Charging Data Request [Termination] |
| End of PDU session | PDU session | Immediate | Immediate | No | No |
| Failure to reach other CHF, in the case of interaction with two CHFs | PDU session | Immediate | Not applicable | No | No |
| CHF response with session termination | PDU session | Immediate | Not applicable | No | No |
| Abort request is received from the CHF | PDU session | Immediate | Immediate | No | No |
| NOTE 1: If GFBR guaranteed status change is enabled, SMF needs to ensure the request for the notification from the access network (i.e. 3GPP RAN) when the GFBR can no longer (or can again) be guaranteed for a QoS Flow during the lifetime of the QoS Flow. | | | | | | |

The default "Limit" trigger conditions are trigger thresholds configured in the Charging Characteristics applied to the PDU session. It shall be possible for the CHF to override these default triggers when providing Charging Data Response [Initial], either to disable the triggers, or to enable triggers new thresholds value.

When the traffic is counted in more than one UPF, the CHF overrides these default triggers of volume limit for the all UPFs.

For converged charging, the following details of chargeable events and corresponding actions in the SMF are defined in Table 5.2.1.4.2:

Table 5.2.1.4.2: Chargeable events and their related actions in SMF

| Chargeable event | Conditions | SMF action |
| --- | --- | --- |
| Start of PDU session |  | Charging Data Request [Initial] with a possible request quota for later use. |
| Start of service data flow | If quota management is required, and valid quota for this rating group does not exist | Charging Data Request [Update] to request quota with a possible amount of quota. |
| If service identifier level reporting is required by the PCC rule | Start new counts with time stamps for the combination of the rating group and service id |
| If rating group level reporting is required by the PCC rule | Start new counts with time stamps for the rating group |
| If sponsored connectivity level reporting is required by the PCC rule | Start new counts with time stamps for the combination of the rating group, sponsor identity and application service provider identity |
| If charging resource, i.e. charging session, for the PDU session does not exist | Charging Data Request [Initial] with a possible request quota |
| Start of SDF additional access | If ATSSS is supported with access differentiated rating groups, quota management is required, and valid quota for this access rating group does not exist. | Charging Data Request [Update] to request quota with a possible amount of quota. |
| If ATSSS is supported with access differentiated rating groups, service identifier level reporting is required by the PCC rule | Start new counts with time stamps for the combination of the access rating group and service id |
| If ATSSS is supported with access differentiated rating groups, rating group level reporting is required by the PCC rule | Start new counts with time stamps for the access rating group |
| If ATSSS is supported with access differentiated rating groups, sponsored connectivity level reporting is required by the PCC rule | Start new counts with time stamps for the combination of the access rating group, sponsor identity and application service provider identity |
| Termination of service data flow | If service identifier level reporting is required by the PCC rule and this is the last service data flow for this combination of the rating group and service id | Close the counts with time stamps |
| If rating group level reporting is required by the PCC rule and this is the last service data flow utilizing that specific rating group | Close the counts with time stamps |
| If sponsored connectivity level reporting is required by the PCC rule and this was the last active service data flow for this combination of rating group, sponsor identity and application service provider identity | Close the counts with time stamps |
| Expiry of the Unit Count Inactivity Timer for the PDU session | If the corresponding trigger is enabled | Charging Data Request [Termination], indicating that charging session is terminated, and the PDU session is still active  May include the configured Unit Count Inactivity Timer value |
| End of PDU session in the SMF |  | Charging Data Request [Termination]  Close the counts with time stamps |
| Quota specific chargeable events (e.g. threshold reached, QHT expires, quota exhaustion, validity time reached, forced re-authorization, expiry of quota holding time) | If the corresponding trigger is enabled | Charging Data Request [Update] with a possible request quota  Close the counts and start new counts with time stamps |
| Change of charging condition in the SMF (e.g. QoS change, Session-AMBR change, user location change, Radio access type change, PLMN change, Serving Node change, UE Time Zone change, change of UE presence in Presence Reporting Area(s), change of 3GPP PS Data Off status, handover cancel, GFBR guaranteed status change) | If the corresponding trigger is enabled | Close the counts and start new counts with time stamps for all active service data flows |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update] with a possible request quota. |
| Handover start | If the corresponding trigger is enabled | Close the counts with time stamps and start new counts with time stamps for active service data flows. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update] with a possible request quota. |
| Handover cancel | If the corresponding trigger is enabled | Close the counts with time stamps and start new counts with time stamps for active service data flows. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update] with a possible request quota. |
| Handover complete | If the corresponding trigger is enabled | Close the counts with time stamps and start new counts with time stamps for active service data flows. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update] |
| Addition of UPF | If the corresponding trigger is enabled | Start new counts with time stamps for the added UPF. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" with the quota management is being performed and quota is granted per each UPF | Charging Data Request [Update] to request quota with a possible amount of quota. |
| Tariff time change |  | Close the counts and start new counts with time stamps |
| CHF response with session termination (e.g. Not Applicable), abort request |  | Charging Data Request [Termination]  Close the counts with time stamps |
| Removal of a UPF | If the corresponding trigger is enabled | Close the counts with time stamps for the removed UPF |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" with quota management is being performed and quota is granted per each UPF | Charging Data Request [Update]. |
| Insertion of I-SMF | If the corresponding trigger is enabled | Close the counts with time stamps for all active service data flows in SMF, open new accounts for all active service data flows with I-SMF information. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" with quota management is being performed and quota is granted per each UPF | Charging Data Request [Update] to request quota with a possible amount of quota. |
| Removal of I-SMF | If the corresponding trigger is enabled | Close the counts with time stamps for the removed I-SMF |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" with quota management being performed and quota is granted per each UPF | Charging Data Request [Update]. |
| Change of I-SMF | If the corresponding trigger is enabled | Close the counts with time stamps for the removed I-SMF, open active traffic flows’ counts for the new I-SMF |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" with quota management being performed and quota is granted per each UPF | Charging Data Request [Update]. |
| Addition of access | If the corresponding trigger is enabled | Close the counts with time stamps for all active service data flows usage report in SMF, open new counts for all active service data flows. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update] with a possible request quota. |
| Removal of access | If the corresponding trigger is enabled | Close the counts with time stamps for all active service data flows usage report in SMF, open new counts for all active service data flows. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update]. |
| Redundant transmission change | If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update].  Close the counts and start new counts with time stamps. |
| Expiry of time limit per rating group | If the corresponding trigger is enabled | Close the counts with time stamps |
| If the category is set to "immediate reporting" | Charging Data Request [Update] |
| If any matching service data flow is still active | Start new counts with time stamps |
| Expiry of data volume limit per rating group | If the corresponding trigger is enabled | Close the counts with time stamps |
| If the category is set to "immediate reporting" | Charging Data Request [Update] |
| If any matching service data flow is still active | Open a new service data container |
| Expiry of data event limit per rating group | If the corresponding trigger is enabled | Close the counts with time stamps |
| If the category is set to "immediate reporting" | Charging Data Request [Update] |
| If any matching service data flow is still active | Open a new service data container |
| Expiry of data event limit per PDU session | If the corresponding trigger is enabled | Charging Data Request [Update]  Close the counts with time stamps |
| If the PDU session is still active | Start new counts with time stamps |
| Expiry of time limit per PDU session | If the corresponding trigger is enabled | Charging Data Request [Update]  Close the counts with time stamps |
| If the PDU session is still active | Start new counts with time stamps |
| Expiry of data volume limit per PDU session |  | Charging Data Request [Update]  Close the counts with time stamps |
| If the PDU session is still active | Start new counts with time stamps |
| Expiry of a limit of number of charging condition changes per PDU session |  | Charging Data Request [Update]  Close the counts with time stamps |
| If the PDU session is still active | Start new counts with time stamps |
| Management intervention |  | Charging Data Request [Update]  Close the counts with time stamps |
| If the PDU session is still active | Start new counts with time stamps |

When event based charging applies, the first occurrence of an event matching a service data flow template in PCC rule shall be considered as the start of a service.

How the termination of service data flows is detected, is specified in TS 23.503 [202]. Termination of the service data flow itself does not trigger Charging Data Request [Update].

The CDR generation mechanism processed by the CHF upon receiving Charging Data Request [Initial, Update, Termination] issued by the SMF for these chargeable events, is specified in clause 5.2.3.

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| **Second change** |

#### 5.2.1.6 QoS flow Based Charging

QoS flow Based Charging is optional and only used in roaming scenarios. It allows the SMF to collect charging information related to data volumes per PDU session, categorized per QoS Flow.

The following applies for QBC:

- no support of quota management.

- subscriber can be identified by SUPI.

- For a given PDU session, QBC shall be performed by the SMF within the same charging session used for Flow Based Charging.

- The SMF categorizes the volume within PDU session by QoS Flow identified by QoS Flow Identifier (QFI).

- The amount of data counted for the QoS Flow shall be the user plane payload at the UPF.

Table 5.2.1.6.1 summarizes the set of default trigger conditions and their category which shall be supported by the SMF in QBC. For "immediate report" category, the table also provides the corresponding Charging Data Request [Initial, Update, Termination] message sent from SMF towards the CHF.

Table 5.2.1.6.1: Default Chargeable events in SMF for QBC

| Chargeable event | Trigger level | Default category | CHF allowed to change category | CHF allowed to enable and disable | Message when "immediate reporting" category |
| --- | --- | --- | --- | --- | --- |
| Start of PDU session | PDU session | Immediate | Not Applicable | Not Applicable | Charging Data Request [Initial] |
| Start of a QoS Flow | QoS Flow | Deferred | Not Applicable | Not Applicable | Charging Data Request [Update] |
| **Change of Charging conditions** | | | | |
| QoS change | QoS Flow | Deferred | Yes | Yes |
| GFBR guaranteed status change | QoS Flow | Deferred | Yes | Yes |
| User Location change | PDU session | Deferred | Yes | Yes |
| Serving Node change | PDU session | Deferred | Yes | Yes |
| Change of UE presence in Presence Reporting Area(s) | PDU session | Deferred | Yes | Yes |
| Change of 3GPP PS Data off Status | PDU session | Deferred | Yes | Yes |
| Tariff time change | PDU session | Deferred | No | No |
| UE time zone change | PDU session | Immediate | Yes | Yes |
| PLMN change | PDU session | Immediate | Yes | Yes |
| RAT type change | PDU session | Immediate | Yes | Yes |
| Session-AMBR change | PDU session | Immediate | Yes | Yes |
| Addition of UPF | PDU session | Immediate | Yes | Yes |
| Removal of UPF | PDU session | Immediate | Yes | Yes |
| Handover cancel | PDU session | Immediate | Yes | Yes |
| Handover start | PDU session | Immediate | Yes | Yes |
| Handover complete | PDU session | Immediate | Yes | Yes |
| Redundant transmission change | QoS Flow | Immediate | Yes | Yes |
| **Limit per PDU session** | | | | |
| Expiry of data time limit per PDU session | PDU session | Immediate | No | Yes |
| Expiry of data volume limit per PDU session | PDU session | Immediate | No | Yes |
| Expiry of data event limit per PDU session | PDU session | Immediate | No | Yes |
| Expiry of limit of number of charging condition changes | PDU session | Immediate | No | Yes |
| **Limit per QoS Flow** | | | | |
| Expiry of data time limit per QoS Flow | QoS Flow | Deferred | Yes | Yes |
| Expiry of data volume limit per QoS Flow | QoS Flow | Deferred | Yes | Yes |
| **Others** | | | | |
| End of QoS Flow | QoS Flow | Deferred | Yes | Yes |
| Management intervention | PDU session | Immediate | No | No |
| End of PDU session | PDU session | Immediate | No | No | Charging Data Request [Termination] |
| Abort request is received from the CHF | PDU session | Immediate | No | No |
| NOTE 1: If GFBR guaranteed status change is enabled, SMF needs to ensure the request for the notification from the access network (i.e. 3GPP RAN) when the GFBR can no longer (or can again) be guaranteed for a QoS Flow during the lifetime of the QoS Flow. | | | | | |

The default "Limit" trigger conditions, are trigger thresholds configured in the Charging Characteristics applied to the PDU session for QBC. It shall be possible for the CHF to override these default triggers when providing Charging Data Response [Initial], either to disable the triggers, or to enable triggers new thresholds value.

For QBC the following details of chargeable events and corresponding actions in the SMF are defined in Table 5.2.1.6.2:

Table 5.2.1.6.2: Chargeable events and their related actions in SMF for QBC

| Chargeable event | Conditions | SMF action |
| --- | --- | --- |
| Start of PDU session |  | Charging Data Request [Initial]. |
| Start of a QoS Flow | Start of the QoS Flow associated with the default QoS rule | Charging Data Request [Update]. |
| Start of a QoS Flow | Start new counts with time stamps. |
| End of a QoS Flow |  | Close the counts with time stamps for the QoS flows |
| End of PDU session |  | Charging Data Request [Termination]  Close the counts with time stamps |
| Change of charging condition in the SMF (e.g. QoS change, Session-AMBR change, user location change, Radio access type change, PLMN change, Serving Node change, UE Time Zone change, change of UE presence in Presence Reporting Area(s), change of 3GPP PS Data Off status, GFBR guaranteed status change) | If the corresponding trigger is enabled | Close the counts and start new counts with time stamps for all active QoS flows. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update] |
| Handover start | If the corresponding trigger is enabled | Close the counts with time stamps and start new counts with time stamps. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update]. |
| Handover cancel | If the corresponding trigger is enabled | Close the counts with time stamps and start new counts with time stamps for active QoS flows. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update]. |
| Handover complete | If the corresponding trigger is enabled | Close the counts and start new counts with time stamps for active QoS flows. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update] |
| Redundant transmission change | If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update].  Close the counts and start new counts with time stamps. |
| Addition of UPF | If the corresponding trigger is enabled | Start new counts with time stamps for the added UPF. |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update]. |
| Removal of UPF | If the corresponding trigger is enabled | Close the counts with time stamps for the removed UPF |
| If the corresponding trigger is enabled and the category is set to "immediate reporting" | Charging Data Request [Update]. |
| Expiry of time limit per QoS Flow | If the corresponding trigger is enabled | Close the counts with time stamps. |
| If the category is set to "immediate reporting" | Charging Data Request [Update] |
| If the QoS Flow is still active | Start new counts with time stamps |
| Expiry of data volume limit per QoS Flow | If the corresponding trigger is enabled | Close the counts with time stamps |
| If the category is set to "immediate reporting" | Charging Data Request [Update] |
| If the QoS Flow is still active | Start new counts with time stamps |
| Expiry of time limit per PDU session | If the corresponding trigger is enabled | Close the counts with time stamps for all QoS flows. |
| If the category is set to "immediate reporting" | Charging Data Request [Update] |
| If the PDU session is still active | Start new counts with time stamps for all active QoS flows |
| Expiry of data volume limit per PDU session | If the corresponding trigger is enabled | Close the counts with time stamps for all QoS flows. |
| If the category is set to "immediate reporting" | Charging Data Request [Update] |
| If the PDU session is still active | Start new counts with time stamps for all active QoS flows |
| Expiry of a limit of number of charging condition changes per PDU session | If the corresponding trigger is enabled | Close the counts with time stamps for all QoS flows. |
| If the category is set to "immediate reporting" | Charging Data Request [Update] |
| If the PDU session is still active | Start new counts with time stamps for all active QoS flows |
| Management intervention |  | Charging Data Request [Update]  Close the counts with time stamps for all QoS Flows |
| If the PDU session is still active | Start new counts with time stamps |
| Abort |  | Charging Data Request [Termination]  Close the counts with time stamps |

The CDR generation mechanism processed by the CHF upon receiving Charging Data Request [Initial, Update, Termination] issued by the SMF for these chargeable events in QBC, is specified in clause 5.2.3.

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| **End of changes** |