**3GPP TSG-SA5 Meeting #141-e *S5-21xxxx***

**e-meeting, 17th – 26th January 2022** Revision of S5-20xxxx

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **32.255** | **CR** | **0** | **rev** | **-** | **Current version:** | **17.4.1** |  |
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| *For* [***HELP***](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 | **X** |

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|  |
| ***Title:***  | Additional charging architecture for LBO |
|  |  |
| ***Source to WG:*** | Huawei |
| ***Source to TSG:*** | S5 |
|  |  |
| ***Work item code:*** | CHROAM |  | ***Date:*** | 2022-03-02 |
|  |  |  |  |  |
| ***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 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:*** | For the support of local breakout roaming scenario charging, the general description about local breakout roaming scenario charging and charging architecture is introduced. |
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| ***Summary of change:*** | Add the charging architecture for the support of local breakout roaming scenario charging.  |
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| ***Consequences if not approved:*** | The support of the local breakout roaming scenario charging is incomplete. |
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| ***Clauses affected:*** | 4.1.4,4.1.5.1,4.1.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:*** |  |

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| **First change** |

### 4.1.X Roaming Local Breakout reference architecture

Figure 4.1.X.1 shows the 5G System high level Roaming Local Breakout architecture as defined in TS 23.501 [200] for 5G data connectivity, in the service-based representation for Control Plane (CP) Network Functions.



Figure 4.1.X.1: Roaming 5G System architecture- local breakout scenario in service-based interface representation

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| **Next change** |

### 4.1.4 Architecture reference for Non-3GPP Accesses

Figure 4.1.4.1 shows the non-roaming architecture for Non-3GPP Accesses as defined in TS 23.501 [200] for 5G data connectivity.

Figure 4.1.4.1: Non-roaming architecture for Untrusted Non-3GPP Accesses

This reference architecture supports service based interfaces for AMF, SMF and other NFs not represented in the figure.

Figure 4.1.4.2 shows the non-roaming architecture for 5G Core Network with trusted non-3GPP access as defined in TS 23.501 [200] for 5G data connectivity.



Figure 4.1.4.2: Non-roaming architecture for 5G Core Network with trusted non-3GPP access

The UE is connected to the 5G Core Network over non-3GPP access. This reference architecture supports service based interfaces for AMF, SMF and other NFs not represented in the figure.

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| **Next change** |

#### 4.1.5.1 Non-roaming architecture with an I-SMF insertion without ULCL/BP

Figure 4.1.5.1 shows the 5G System high level non-roaming architecture, as defined in TS 23.501 [200], with an I-SMF insertion to the PDU Session without UL-CL/BP, using reference point representation.



Figure 4.1.5.1: Non-roaming architecture with I-SMF insertion to the PDU Session in reference point representation, with no UL-CL/BP

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| **Next change** |

## 4.2 5G data connectivity domain converged charging architecture

The SMF embedding the CTF, generates charging events towards the CHF for PDU connectivity converged charging or offline only charging.

As described in TS 32.240 [1], the CTF generates charging events towards to the CHF for converged online and offline charging processing. The CDRs generation is performed by the CHF acting as a CDF, which transfers them to the CGF.
Finally, the CGF creates CDR files and forwards them to the BD.

If the CGF is external, the CHF acting as a CDF, forwards the CDRs to the CGF across the Ga interface.
If the CGF is integrated, there is only one internal interface between the CHF and the CGF. In this case, the relationship between CHF and CGF is 1:1. An integrated CGF may support the Ga interface from other CDFs.

When an external CGF is used, this CGF may also be used by other, i.e. non-5GCS, network elements, according to network design and operator decision. It should be noted that the CGF may also be an integrated component of the BD – in this case, the Bd interface does not exist and is replaced by a proprietary solution internal to the BD.

Figure 4.2.1 depicts the architectural options for converged charging in service-based representation for CHF.



**Figure 4.2.1: 5G data connectivity converged charging architecture**

Architectural options of figure 4.2.1 apply to any 5G data connectivity converged charging architectures in this clause.

Ga is described in clause 5.2.4 and Bd in clause 5.2.5 of the present document and Nchf is described in TS 32.290 [57].

Figure 4.2.2 depicts the 5G data connectivity converged charging architecture in reference point representation for non-roaming:



Figure 4.2.2: 5G data connectivity converged charging architecture non-roaming reference point representation

Figure 4.2.3 depicts the 5G data connectivity converged charging architecture service-based representation for roaming Home Routed:



Figure 4.2.3: 5G data connectivity converged charging architecture roaming Home Routed service based representation

Figure 4.2.4 depicts the 5G data connectivity converged charging architecture for roaming Home Routed in reference point representation:



Figure 4.2.4: 5G connection and mobility converged charging architecture in roaming Home routed reference point representation

The N40 reference point is defined for the interactions between H-SMF and H-CHF and between V-SMF and V-CHF in the reference point representation.

Figure 4.2.X depicts the 5G data connectivity converged charging architecture service-based representation for roaming Local Breakout:



Figure 4.2.X: 5G data connectivity converged charging architecture roaming Local Breakout scenario service based representation

Figure 4.2.Y depicts the 5G data connectivity converged charging architecture for roaming Local breakout in reference point representation:



Figure 4.2.Y: 5G connection and mobility converged charging architecture in Local breakout scenario reference point representation

The N40 reference point is defined for the interactions between V-SMF and V-CHF, the N47 reference point is defined for the interactions between V-SMF and H-CHF and in the reference point representation.

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| **End of change** |

### 5.1.2 Requirements

The following are high-level charging requirements specific to the packet domain, derived from the requirements in TS 22.115 [101], TS 22.261 [102], TS 23.501 [200], TS 23.502 [201] and TS 23.503 [202].

- The SMF shall support converged online and offline charging.

- The SMF may support offline only charging.

- The SMF shall support PDU session charging using service based interface.

- The SMF shall support network slice instance charging.

- The SMF shall collect charging information per PDU session for UEs served under 3GPP access and non-3GPP access (untrusted non-3GPP access, trusted non-3GPP access and wireline).

- Every PDU session shall be assigned a unique identity number for billing purposes per PLMN. (i.e. the Charging Id).

- Data volumes on both the uplink and downlink directions shall be counted separately. The data volumes shall reflect the data as delivered to and forwarded from the user.

- The charging mechanisms shall provide the date and time information when the PDU session starts.

- The SMF shall be capable of handling the Charging Characteristics. Charging Characteristics can be specific to a subscription or subscribed DNN.

- The SMF may be capable of identifying data volumes, elapsed time or events for individual service data flows (flow based charging). One PCC rule identifies one service data flow.

- SMF shall allow reporting of the service or the detected application usage per rating group or per combination of the rating group and service id. This reporting level can be activated per PCC rule.

- The quota management shall be per rating group per PDU session.

- If there are multiple UPFs for one PDU session, the quota management may be one for all UPFs or separate per UPF and the usage and charging information reporting per UPF.

- The SMF shall support charging for PDU Session types of IP, Ethernet and Unstructured.

- In Home Routed scenario, the SMF shall collect charging information per PDU session and, based on Home Operator policy and agreement between Home and Visit Operators, shall be able to collect charging information per Qos Flow for in-bound and out-bound roamers in Home Routed scenario.

- In Local breakout scenarios, the SMF in VPLMN shall collect charging information per PDU session.

- For interworking between 5GS and EPC, the dedicated PGW-C + SMF shall collect charging information using the same mechanisms as the SMF.

- The SMF shall support PDU session charging when the PDU session is served by both I-SMF and SMF.

- The SMF shall support charging for MA PDU Connectivity Service over 3GPP access and non-3GPP access.

- The SMF in VPLMN and in HPLMN shall support charging for MA PDU Connectivity Service in roaming Home Routed scenario with UE registered to the same VPLMN for 3GPP access and non-3GPP access.

 - The SMF in HPLMN shall support charging for MA PDU Connectivity Service in roaming Home Routed scenario with UE registered in different PLMNs.

- The SMF shall support the charging of redundant transmission for high reliability communication.

- The SMF shall support the charging of 5G LAN VN group communication.

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| **End of change** |

### 5.1.9 Roaming

#### 5.1.9.1 General

Based on roaming agreements between the V-PLMN and the H-PLMN, in Home Routed scenario, for each UE roaming in VPLMN:

- The SMF in VPLMN (V-SMF) shall be able to collect charging information per QoS Flow within a PDU session when UE is determined as an in-bound roamer, for CDR generation in VPLMN.

- The SMF in HPLMN (H-SMF) shall be able to collect charging information per QoS Flow within a PDU session when UE is determined as an out-bound roamer, for CDR generation in HPLMN.

This charging information collection mechanism is achieved under Roaming QoS flow Based Charging (QBC) performed by each PLMN, based on a set of charging parameters exchanged between the V-SMF and the H-SMF on a per PDU session basis.

The main parameters exchanged at PDU session establishment are:

- The Charging Id which may include the VPLMN PLMN ID, assigned by the V-SMF and transferred to the H-SMF in the HPLMN.

- Optionally, the "Roaming Charging Profile" negotiated between the VPLMN and the HPLMN.

The parameters exchanged during the PDU session handover from EPS to 5GS in Home routed roaming scenario:

- The Home Provided Charging Id which includes the Charging Id assigned by the H-SMF to the original PDU session over EPS and transferred by the H-SMF to the V-SMF. This Home Provided Charging Id shall be used by the V-SMF to replace the existing Charging Id previously generated by V-SMF.

- Optionally, the "Roaming Charging Profile" negotiated between the VPLMN and the HPLMN on 5GS side.

In roaming Home routed PDU session, upon V-SMF change:

- intra-PLMN V-SMF change: Charging Id, "Roaming Charging Profile" and CHF address (optional) are transferred from the old V-SMF to the new V-SMF.

NOTE: how the new V-SMF selects the CHF is operator specific.

- inter-PLMN V-SMF change: The Charging Id is transferred from the old V-SMF to the new V-SMF.

- The "Roaming Charging Profile" is optionally exchanged between the new V-SMF and the H-SMF as for a PDU session establishment.

Based on roaming agreements between the V-PLMN and the H-PLMN, in local breakout scenario, for each UE roaming in VPLMN:

- The SMF in VPLMN (V-SMF) can be able to collect charging information per QoS Flow and/or per service data flow within a PDU session when UE is determined as an in-bound roamer, for CDR generation in VPLMN.

- 5V-SMF) can be able to collect charging information per QoS Flow and/or per service data flow within a PDU session when UE is determined as an out-bound roamer, for CDR generation in HPLMN.

- The SMF in VPLMN (V-SMF) shall collect the charging information for offline charging for CHF in VPLMN (V-CHF).

- The SMF in VPLMN (V-SMF) shall collect the charging information for converged charging and offline charging for CHF in HPLMN (H-CHF).

The main parameters exchanged at PDU session establishment are:

- The Charging Id assigned by the V-SMF and reported to the V-CHF and H-CHF.

- Optionally, for QBC, the "Roaming Charging Profile" is used for the set of triggers, associated category, and trigger thresholds.

#### 5.1.9.2 CHF selection

In roaming Home routed scenario, at PDU session establishment, the CHF selection mechanism specified in clause 5.1.8 applies to:

- The V-SMF for CHF selection in VPLMN, with the following differences:

- CHF address(es) selection mechanisms based on PCF and UDM are not applicable.

- When charging characteristics is used it will be based on local configuration.

- When NRF is used, the V-CHF can be selected based on UE identified as in-bound roamer and the PLMN Id of the H-PLMN;

- The H-SMF for CHF selection in HPLMN, with the following difference: when NRF is used, the H-CHF can be selected based on UE identified as out-bound roamer and the PLMN Id of the V-PLMN.

In roaming Home routed PDU session, upon V-SMF change:

- intra-PLMN V-SMF change: CHF address supplied by the old V-SMF shall be used.

- inter-PLMN V-SMF change: CHF selection mechanism as per V-SMF CHF selection in VPLMN at PDU session establishment.

In roaming Local breakout scenario, at PDU session establishment, the CHF selection mechanism specified in clause 5.1.8 applies to:

The V-SMF for CHF selection in VPLMN, there is no differences:

The V-SMF for CHF selection in HPLMN, with the following differences:

- CHF address(es) with possible associated CHF instance ID(s) and/or CHF set ID(s) provided by the V-PCF.

- UDM provided and local pre-configuration for charging characteristics are not applicable.

- When NRF is used, the V-CHF can be selected based on UE identified as out-bound roamer and the PLMN Id of the H-PLMN.

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#### 5.2.1.9 Sponsored data connectivity charging

The Sponsor Identifier and Application Service Provider Identifier are provided for sponsored data connectivity to the PCF from the AF, according to TS 23.503 [215].

The Sponsor Identifier and Application Service Provider Identity may be included in PCC rules with "offline" charging method from the PCF to the SMF. In this case, charging information collected by the SMF includes the Sponsor Identity and the Application Service Provider Identity. Correlation of charging information from multiple users per sponsor and/or application service provider can then be based on Sponsor Identity and Application Service Provider Identity.

NOTE: Sponsored data connectivity is not supported in the roaming with local breakout scenario in this Release.

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##### 5.2.1.2.2 QoS flow Based Charging (QBC) triggers

The set of chargeable events and associated category, which shall be supported by the SMF as the default for QoS flow Based Charging, when applicable, is specified in the sub-clause 5.2.1.6.

Two level of triggers can be supplied by the CHF:

- Triggers associated to the PDU session.

- Triggers associated to a QoS Flow within the PDU session.

The set of triggers along with their category (i.e. immediate or deferred report) and level (i.e. per PDU session or per QoS Flow), which can be supplied by the CHF to the SMF for 5G data connectivity converged charging are detailed in the sub-clause 5.2.1.6 for QBC.

In Home Routed roaming scenario, when QBC is used in the context of roaming, the set of triggers, their associated category, and trigger thresholds, compose the "Roaming Charging Profile", which governs the SMF charging data generation, synchronously between the V-SMF and the H-SMF when shared.

In local breakout scenario, the QBC is used in the context of roaming. The set of triggers, accociated category and trigger thresholds are provided by H-CHF for the charging in the HPLMN and V-CHF for the charging in the VPLMN.

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#### 5.2.2.X PDU session charging for roaming in Local breakout scenario

##### 5.2.2.X.1 General

The clause below describes PDU session charging in roaming with local breakout scenarios.

##### 5.2.2.X.2 PDU session establishment

The following figure 5.2.2.X.2-1 describes a PDU session establishment charging, based on figure 4.3.2.2.1-1 UE-requested PDU Session Establishment for non-roaming and roaming with local breakout TS 23.502 [202] description:



Figure 5.2.2.X.2-1: PDU session establishment

9ch-a. The UE is identified as a roamer (PLMN ID of the received SUPI is different from VPLMN PLMN ID), the V-CHF is selected accordingly.

9ch-b. The Charging Data Request [Initial] is sent to V-CHF, indicating "in-bound roamer" for authorization for the subscriber to start the PDU session which is triggered by start of PDU session charging event.

9ch-c. The V-CHF opens a CDR (indicating "in-bound roamer")

9ch-d. The V-CHF acknowledges by sending Charging Data Response [Initial] to the V-SMF and optionally supplies a "Roaming Charging Profile" to the V-SMF which overrides the default one.

9ch-e. Based on the agreement, the H-CHF is selected.

9ch-f. A Charging Data Request [Initial] is sent to H-CHF, indicating "out-bound roamer" with charging id.

This step may request the quota from V-SMF, H-CHF can grant the quota in the step 9ch-h.

9ch-g. The H-CHF opens a CDR (indicating "out-bound roamer").

9ch-h. The H-CHF acknowledges by sending Charging Data Response [Initial] to the V-SMF and supplies the HPLMN selected "Roaming Charging Profile" to the V-SMF.

16ch-a. The Charging Data Request [Update] is sent to V-CHF, when triggers for QBC or the triggers for FBC is armed.

16ch-b. The V-CHF update the CDR.

16ch-c. The V-CHF acknowledges by sending Charging Data Response [Update] to the V-SMF.

16ch-d. A Charging Data Request [update] is sent to H-CHF, when the FBC or QBC triggers specified in the clause 5.2.1 is armed.

This step may occur in case "start of service data flow" needs quota from H-CHF, for the V-SMF to request quota.

16ch-e. The H-CHF update a CDR.

16ch-f. The H-CHF acknowledges by sending Charging Data Response [Initial] to the V-SMF.

##### 5.2.2.X.3 PDU Session Modification

The following figure 5.2.2.X.3-1 describes the PDU session modification charging, based on figure 4.3.3.2-1 UE or network requested PDU Session Modification (for non-roaming and roaming with local breakout) TS 23.502 [202] description:



Figure 5.2.2.X.3-1: PDU Session Modification

2ch-a. The Charging Data Request [Update] is sent to V-CHF for reporting the charging information when the corresponding trigger for FBC and/or QBC specified in the clause 5.2.1 is armed.

2ch-b. The V-CHF update the CDR.

2ch-c. The V-CHF acknowledges by sending Charging Data Response [Update] to the V-SMF.

2ch-d. A Charging Data Request [update] is sent to H-CHF, when the FBC or QBC triggers specified in the clause 5.2.1 is armed.

This step may occur in case "start of service data flow" needs quota from H-CHF, for the V-SMF to request quota.

2ch-e. The H-CHF update a CDR.

2ch-f. The H-CHF acknowledges by sending Charging Data Response [Initial] to the V-SMF.

##### 5.2.2.x.4 PDU Session Release

The following figure 5.2.2.x.4-1 describes the PDU session release charging, based on figure 4.3.4.2-1 UE or network requested PDU Session Release for non-roaming and roaming with local breakout TS 23.502 [202] description:



Figure 5.2.2.X.4-1: PDU Session Release

2ch-a. The Charging Data Request [Termination] is sent to V-CHF.

2ch-b. The V-CHF close the CDR.

2ch-c. The V-CHF acknowledges by sending Charging Data Response [Termination] to the V-SMF.

2ch-d. A Charging Data Request [Termination] is sent to H-CHF.

2ch-e. The H-CHF close a CDR.

2ch-f. The H-CHF acknowledges by sending Charging Data Response [Termination] to the V-SMF.

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| **End of change** |

#  6. Definition of charging information

Editor’s note: the charging information which is applicable to LBO is FFS.

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| **End of change** |

Annex X (normative):
5G Non-roaming Mobile Virtual Network Operators charging (MVNO) Charging

## B.1 General

This clause specifies the 5G Non-roaming MVNO (with CHF) Charging.

## B.2 5G data connectivity domain converged charging architecture

The SMF embedding the CTF, generates charging events towards the CHF in MNO and the CHF in MVNO for PDU connectivity converged charging.

As described in TS 32.240 [1], the CTF generates charging events towards to the CHF for converged online and offline charging processing. The CDRs generation is performed by the CHF acting as a CDF, which transfers them to the CGF.
Finally, the CGF creates CDR files and forwards them to the BD.

Figure B.2.X depicts the 5G data connectivity converged charging architecture service-based representation for MVNO:



Figure B.2.X: 5G data connectivity converged charging architecture for MVNO service based representation

A-CHF is used when an additional actor (i.e. MVNO) performs retail charging for its own subscribers.

Figure B.2.Y depicts the 5G data connectivity converged charging architecture for MVNO in reference point representation:



Figure 4.2.4: 5G connection and mobility converged charging architecture in MVNO reference point representation

The N40 reference point is defined for the interactions between SMF and CHF in MNO, the N47 reference point is defined for the interactions between SMF in the MNO and CHF in the MVNO in the reference point representation.

## B.3 Message flow

Editor’s note: the message flow applicable to MVNO charging is FFS.

## B.4 Definition of charging information

Editor’s note: the charging information MVNO charging is FFS.