**3GPP TSG-CT WG1 Meeting #133e-bisC1-220xxx**

**E-meeting, 17-21 January 2022 (was C1-220047)**

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **23.122** | **CR** | **0858** | **rev** | **1** | **Current version:** | **17.5.0** |  |
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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:***  | Enabling update of SOR-SNPN-SI in a PLMN |
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| ***Source to WG:*** | Qualcomm Incorporated |
| ***Source to TSG:*** | C1 |
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| ***Work item code:*** | eNPN |  | ***Date:*** | 2022-01-18 |
|  |  |  |  |  |
| ***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:*** | At CT1#133-e it was agreed to enable the use of the Steering Of Roaming (SOR) procedure to update the SOR-SNPN-SI (credentials holder controlled prioritized lists of preferred SNPNs and GINs) when the UE is registering or registered in an SNPN. Whether a similar update can also be done when the UE is registering or registered to a PLMN was left FFS, as captured by the following Editor’s note in TS 23.122 subclause C.1.1:Editor's note (WI eNPN, CR#0790): Whether the UE can receive the SOR-SNPN-SI when registering or registered to a PLMN, and whether the UE can receive the list of preferred PLMN/access technology combinations together with the SOR-SNPN-SI, are FFS.If the credentials holder is a PLMN and the SOR-SNPN-SI for the UE changes while the UE is registered to that PLMN (HPLMN) or a VPLMN, it is beneficial to enable the credentials holder to update the SOR-SNPN-SI at the UE without waiting for the UE to register to an SNPN, so as to ensure that the UE has up-to-date information when the UE switches to SNPN access mode.Consequently, it is proposed to enable the use of the SOR procedure to update the SOR-SNPN-SI when the UE is registered to a PLMN.  |
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| ***Summary of change:*** | * the use of the SOR procedure to update the SOR-SNPN-SI when the UE is registered to a PLMN was enabled
* receipt of the SOR-SNPN-SI in a PLMN does NOT trigger PLMN or SNPN selection at the UE
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| ***Consequences if not approved:*** | If the credentials holder is a PLMN and the SOR-SNPN-SI for the UE changes while the UE is registering or registered to a PLMN, the credentials holder will have to wait until the UE registers to an SNPN to update the SOR-SNPN-SI at the UE, resulting in the UE initially selecting an SNPN that might not be the most preferred one or that might be an SNPN which the UE is no longer allowed to access. |
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| ***Clauses affected:*** | C.1.1, C.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 ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** |  |

\*\*\* First change \*\*\*

### C.1.1 Steering of roaming over the control plane in a PLMN

The purpose of the control plane solution for steering of roaming in 5GS procedure in a PLMN is to allow the HPLMN to update one or more of the following via NAS signalling:

a) the "Operator Controlled PLMN Selector with Access Technology" list in the UE by providing the HPLMN protected list of preferred PLMN/access technology combinations or a secured packet;

b) the SOR-CMCI; and

c) the SOR-SNPN-SI associated with the selected PLMN subscription in the ME.

If the selected PLMN is a VPLMN, the HPLMN can provide the steering of roaming information to the UE using the control plane mechanism during and after registration. If the selected PLMN is the HPLMN, the HPLMN can provide the steering of roaming information to the UE using the control plane mechanism after registration only. The HPLMN updates the "Operator Controlled PLMN Selector with Access Technology" based on the operator policies, which can be based on the registered VPLMN, the location of the UE, etc.

The HPLMN can configure their subscribed UE's USIM to indicate that the UE is expected to receive the steering of roaming information due to initial registration in a VPLMN. At the same time the HPLMN will mark the UE is expected to receive the steering of roaming information due to initial registration in a VPLMN, in the subscription information in the UDM. In this case, it is mandatory for the HPLMN to provide the steering of roaming information to the UE during initial registration in a VPLMN. Otherwise if such configuration is not provided in the USIM, it is optional for the HPLMN to provide the steering of roaming information to the UE during initial registration (based on operator policy). The HPLMN can provide the steering of roaming information to the UE during the registration procedure for mobility registration update and initial registration procedure for emergency services. In addition, the HPLMN can request the UE to provide an acknowledgement of successful reception of the steering of roaming information.

NOTE 1: In annex C of this specification, the User Data Repository (UDR) is considered as part of the UDM.

As the HPLMN needs to consider certain criteria including the number of customers distributed through multiple VPLMNs in the same country or region, the list of the preferred PLMN/access technology combinations is not necessarily the same at all times and for all users. The list of the preferred PLMN/access technology combinations needs to be dynamically generated, e.g. generated on demand, by a dedicated steering of roaming application function (SOR-AF) providing operator specific data analytics solutions.

NOTE 2: The functional description of this dedicated application function (SOR-AF) is out of scope of 3GPP.

The steering of roaming connected mode control information (SOR-CMCI) enables the HPLMN to control the timing of a UE in connected mode to move to idle mode to perform the steering of roaming. The UE shall support the SOR-CMCI. The support and use of SOR-CMCI by the HPLMN is based on the HPLMN's operator policy.

The following requirements are applicable for the SOR-CMCI:

- The HPLMN may configure SOR-CMCI in the UE and may also send SOR-CMCI over N1 NAS signalling. The SOR-CMCI received over N1 NAS signalling has precedence over the SOR-CMCI configured in the UE.

NOTE 3: Based on HPLMN policy, while setting the SOR-CMCI the HPLMN can take into consideration the user preference for the service(s) not to be interrupted due to SOR (e.g. MMTEL voice call, MMTEL video call, HPLMN defined services, among others). The user can communicate its preference for the service(s) not to be interrupted due to SOR to the HPLMN utilizing non-standard operator-specific mechanisms, e.g. web-based.

- The UE shall indicate ME's support for SOR-CMCI to the HPLMN.

NOTE 4: The HPLMN has the knowledge of the USIM's capabilities in supporting SOR-CMCI.

- While performing SOR, the UE shall consider the list of preferred PLMN/access technology combinations or secured packet received in the SOR information together with the available SOR-CMCI.

- The HPLMN may provision the SOR-CMCI in the UE over N1 NAS signalling. The UE shall store the configured SOR-CMCI in the non-volatile memory of the ME or in the USIM as described in clause C.4.

The following requirements are applicable for the SOR-SNPN-SI:

- If the UE supports access to an SNPNs using credentials from a credentials holder, the UE shall indicate ME's support for SOR-SNPN-SI to the HPLMN.

In order to support various deployment scenarios, the UDM may support:

- obtaining a list of preferred PLMN/access technology combinations, and SOR-CMCI, if any (if supported by the UDM and required by the HPLMN), or a secured packet which is or becomes available in the UDM (i.e. retrieved from the UDR);

NOTE 5: A secured packet can be made available at the UDR via implementation specific means. In this case the implementation specific means are required to ensure that the secured packet satisfies the "Replay detection and Sequence Integrity counter" (see ETSI TS 102 225 [73]) every time it is sent out from the HPLMN to the UE.

- obtaining a list of preferred PLMN/access technology combinations and SOR-CMCI, if any (if supported by the UDM and required by the HPLMN), or a secured packet from the SOR-AF; or

- both of the above.

The HPLMN policy for the SOR-AF invocation can be present in the UDM only if the UDM supports obtaining a list of preferred PLMN/access technology combinations and SOR-CMCI, if any, or a secured packet from the SOR-AF.

The UDM discards any list of preferred PLMN/access technology combinations, SOR-CMCI, if any, or any secured packet obtained from the SOR-AF or which is or becomes available in the UDM (i.e. retrieved from the UDR), either during registration (as specified in annex C.2) or after registration (as specified in annex C.3 and C.4.3), when the UDM cannot successfully forward the SOR information to the AMF (e.g. in case the UDM receives the response from the SOR-AF with the list of preferred PLMN/access technology combinations, the SOR-CMCI, if any, or the secured packet after the expiration of the operator specific timer, or if there is no AMF registered for the UE).

The UE maintains a list of "PLMNs where registration was aborted due to SOR". If the UE receives steering of roaming information in the REGISTRATION ACCEPT or DL NAS TRANSPORT message and the security check to verify that the steering of roaming information is provided by HPLMN is successful, the UE shall remove the current selected PLMN from the list of "PLMNs where registration was aborted due to SOR". The UE shall delete the list of "PLMNs where registration was aborted due to SOR" when the MS is switched off, the USIM is removed or after a UE implementation dependent time.

If:

- the UE's USIM is configured to indicate that the UE shall expect to receive the steering of roaming information during initial registration procedure but did not receive it or security check on the steering of roaming information fails;

- the current chosen VPLMN is not contained in the list of "PLMNs where registration was aborted due to SOR";

- the current chosen VPLMN is not part of "User Controlled PLMN Selector with Access Technology" list; and

- the UE is not in manual mode of operation;

then the UE will perform PLMN selection with the current VPLMN considered as lowest priority.

It is mandatory for the VPLMN to transparently forward to the UE the steering of roaming information received from HPLMN and to transparently forward to the HPLMN the acknowledgement of successful reception of the steering of roaming information received from UE, both while the UE is trying to register onto the VPLMN as described in clause C.2, and after the UE has registered onto the VPLMN as described in clause C.3 and C.4.3.

If the last received steering of roaming information contains the list of preferred PLMN/access technology combinations then the ME shall not delete the "Operator Controlled PLMN Selector with Access Technology" list stored in the ME when the UE is switched off.

The "Operator Controlled PLMN Selector with Access Technology" list shall be stored in the ME together with the SUPI from the USIM. The ME shall delete the "Operator Controlled PLMN Selector with Access Technology" list stored in the ME when a new USIM is inserted.

The procedure in this annex for steering of UE in VPLMN can be initiated by the network while the UE is trying to register onto the VPLMN as described in clause C.2, or after the UE has registered onto the HPLMN or the VPLMN as described in clause C.3, C.X and C.4.3.

\*\*\* Next change \*\*\*

## C.X Stage-2 flow for providing UE with SOR-SNPN-SI in HPLMN or VPLMN after registration

The stage-2 flow for providing UE with SOR-SNPN-SI in HPLMN or VPLMN after registration is indicated in figure C.X.1, when the ME supports the SOR-SNPN-SI. The selected PLMN can be the HPLMN or a VPLMN. The AMF is located in the selected PLMN. The UDM is located in the HPLMN.

In this procedure, the SOR-SNPN-SI is sent without the list of preferred PLMN/access technology combinations.

Editor's note (WI eNPN, CR#0858): Whether the secured packet can contain SOR-SNPN-SI is FFS.

NOTE 1: The SOR-AF can determine that the ME supports the SOR-SNPN-SI if the Nsoraf\_SoR\_Info service operation has returned the "ME support of SOR-SNPN-SI" indicator. The UDM can determine that the ME supports the SOR-SNPN-SI if the "ME support of SOR-SNPN-SI" indicator is stored for the UE.

The procedure is triggered:

- If the UDM supports obtaining the SOR-SNPN-SI from the SOR-AF, the HPLMN policy for the SOR-AF invocation is present in the UDM and the SOR-AF provides the UDM with the SOR-SNPN-SI for a UE identified by SUPI; or

- When the SOR-SNPN-SI becomes available in the UDM (i.e., retrieved from the UDR).

Figure C.X.1: Procedure for configuring UE with SOR-SNPN-SI in a PLMN after registration

For the steps below, security protection is described in 3GPP TS 33.501 [24].

1) The SOR-AF to the UDM: Nudm\_ParameterProvision\_Update request is sent to the UDM to trigger the update of the UE with the SOR-SNPN-SI.

2) The UDM to the AMF: The UDM notifies the changes of the user profile to the affected AMF by the means of invoking Nudm\_SDM\_Notification service operation. The Nudm\_SDM\_Notification service operation contains the steering of roaming information that needs to be delivered transparently to the UE over NAS within the Access and Mobility Subscription data. If the HPLMN or subscribed SNPN decided that the UE is to acknowledge successful security check of the received steering of roaming information, the Nudm\_SDM\_Notification service operation also contains an indication that the UDM requests an acknowledgement from the UE as part of the steering of roaming information. Upon receiving the SOR-SNPN-SI, the UDM shall include the SOR-SNPN-SI and the HPLMN indication that 'no change of the "Operator Controlled PLMN Selector with Access Technology" list stored in the UE is needed and thus no list of preferred PLMN/access technology combinations is provided'.

NOTE 2: The UDM cannot provide the SOR-SNPN-SI, if any, to the AMF which does not support receiving SoR transparent container (see 3GPP TS 29.503 [78]).

3) The AMF to the UE: the AMF sends a DL NAS TRANSPORT message to the served UE. The AMF includes in the DL NAS TRANSPORT message the steering of roaming information received from the UDM.

4) Upon receiving the steering of roaming information containing the SOR-SNPN-SI and the HPLMN indication that 'no change of the "Operator Controlled PLMN Selector with Access Technology" list stored in the UE is needed and thus no list of preferred PLMN/access technology combinations is provided', the UE shall perform a security check on the steering of roaming information included in the DL NAS TRANSPORT message to verify that the steering of roaming information is provided by HPLMN, and:

a) if the security check is successful, the ME shall replace the credentials holder controlled prioritized lists of preferred SNPNs for the selected PLMN subscription with the received credentials holder controlled prioritized lists of preferred SNPNs, if any, the ME shall replace the credentials holder controlled prioritized lists of GINs for the selected PLMN subscription with the received credentials holder controlled prioritized lists of GINs, if any, and the ME shall delete the SNPNs identified by the credentials holder controlled prioritized lists of preferred SNPNs or credentials holder controlled prioritized lists of GINs from the list of "temporarily forbidden SNPNs" and the list of "permanently forbidden SNPNs", if they are present in these lists.

 If the UDM has requested an acknowledgement from the UE in the DL NAS TRANSPORT message, the UE sends an UL NAS TRANSPORT message to the serving AMF with an SOR transparent container including the UE acknowledgement and the UE shall set the "ME support of SOR-SNPN-SI" indicator to "supported".

 If the UDM has not requested an acknowledgement from the UE then step 5 is skipped; and

b) if the selected PLMN is a VPLMN, the security check is not successful and the UE is in automatic network selection mode, then:

- if the UE has a SOR-CMCI stored in the non-volatile memory of the ME, the current PLMN is considered as lowest priority and the UE shall apply the actions in clause C.4.2;

- otherwise, the UE shall wait until it moves to idle mode or 5GMM-CONNECTED mode with RRC inactive indication (see 3GPP TS 24.501 [64]) before attempting to obtain service on a higher priority PLMN as specified in clause 4.4.3.3 by acting as if timer T that controls periodic attempts has expired, with an exception that the current PLMN is considered as lowest priority. If the selected PLMN is a VPLMN and the UE has an established emergency PDU session then the UE shall attempt to perform the PLMN selection after the emergency PDU session is released and after the UE enters idle mode or 5GMM-CONNECTED mode with RRC inactive indication (see 3GPP TS 24.501 [64]).

 Step 5 is skipped;

NOTE 3: When the UE is in the manual mode of operation or the current chosen VPLMN is part of the "User Controlled PLMN Selector with Access Technology" list, the UE stays on the VPLMN.

5) The AMF to the UDM: If the UL NAS TRANSPORT message with an SOR transparent container is received, the AMF uses the Nudm\_SDM\_Info service operation to provide the received SOR transparent container to the UDM. If the HPLMN decided that the UE is to acknowledge successful security check of the received steering of roaming information in step 2, the UDM verifies that the acknowledgement is provided by the UE. The UDM shall store the "ME support of SOR-SNPN-SI" indicator.

 If the present flow was invoked by the UDM after receiving from the SOR-AF the SOR-SNPN-SI for a UE identified by SUPI using an Nudm\_ParameterProvision\_Update request, and the UDM verification of the UE acknowledgement is successful, then the UDM informs the SOR-AF about successful delivery of the SOR-CMCI using Nsoraf\_SoR\_Info (SUPI of the UE, successful delivery); and

6) The UDM to the SOR-AF: Nsoraf\_SoR\_Info (SUPI of the UE, successful delivery, "ME support of SOR-SNPN-SI" indicator). If the HPLMN policy for the SOR-AF invocation is present and the HPLMN UDM received and verified the UE acknowledgement in step 5, then the UDM informs the SOR-AF about successful delivery of the SOR-SNPN-SI to the UE. The UDM shall include the "ME support of SOR-SNPN-SI" indicator.

If the selected PLMN is a VPLMN and:

- the UE in manual mode of operation encounters security check failure of SOR information in DL NAS TRANSPORT message; and

- upon switching to automatic network selection mode the UE remembers that it is still registered on the PLMN where the security check failure of SOR information was encountered;

the UE shall wait until it moves to idle mode or 5GMM-CONNECTED mode with RRC inactive indication (see 3GPP TS 24.501 [64]) before attempting to obtain service on a higher priority PLMN as specified in clause 4.4.3.3, by acting as if timer T that controls periodic attempts has expired, with an exception that the current registered PLMN is considered as lowest priority. If the selected PLMN is a VPLMN and the UE has an established emergency PDU session then the UE shall attempt to perform the PLMN selection after the emergency PDU session is released and after the UE enters idle mode or 5GMM-CONNECTED mode with RRC inactive indication (see 3GPP TS 24.501 [64]).

NOTE 4: The receipt of the steering of roaming information by itself does not trigger the release of the emergency PDU session.

\*\*\* End of changes \*\*\*