**3GPP TSG-CT WG1 Meeting #135-eC1-22xxxx**

**E-Meeting, 6th – 12th April 2022 (was C1-222711)**

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| **CHANGE REQUEST** |
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| ***Proposed change affects:*** | UICC apps |  | ME | **X** | Radio Access Network |  | Core Network | **X** |

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|  |
| ***Title:***  | Signalling UE support for SOR-SNPN-SI in SOR ACK |
|  |  |
| ***Source to WG:*** | Qualcomm Incorporated |
| ***Source to TSG:*** | C1 |
|  |  |
| ***Work item code:*** | eNPN |  | ***Date:*** | 2022-04-08 |
|  |  |  |  |  |
| ***Category:*** |  |  | ***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:*** | TS 24.501 currently contains several instances of the following Editor’s note:Editor's note (WI eNPN, CR#3839): It is FFS whether the UE needs to signal support for SOR-SNPN-SI in the SOR acknowledgement.As explained in DP C1-222709, signalling support for SOR-SNPN-SI in the 5GMM capability IE when registering in the HPLMN or a subscribed SNPN, as currently specified in TS 24.501, does not cover the case when the UE registers in a VPLMN.This case can be addressed by having the UE signal support for SOR-SNPN-SI in the SOR ACK when in a VPLMN, since the SOR-ACK is passed transparently from the VPLMN to the HPLMN.It is thus proposed to add a requirement for the UE supporting access to SNPN using credentials from a credentials holder to signal support for SOR-SNPN-SI in the SOR ACK when the SOR ACK is sent in a VPLMN. |
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| ***Summary of change:*** | A requirement for the UE supporting access to SNPN using credentials from a credentials holder to signal support for SOR-SNPN-SI in the SOR ACK when the SOR ACK is sent in a VPLMN is added. |
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| ***Consequences if not approved:*** | The UE will not be able to signal support for SOR-SNPN-SI in a VPLMN. |
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| ***Clauses affected:*** | C.1.2, C.2, C.3, C.4.3 |
|  |  |
|  | **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:*** |  |

**\*\*\*\*\*\*\***

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

### C.1.2 Steering of roaming over the control plane in an SNPN

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

a) the SOR-SNPN-SI associated with the selected entry of "list of subscriber data" or the selected PLMN subscription in the ME, for a UE which supports access to an SNPN using credentials from a credential holder; and

b) the SOR-CMCI.

The control plane solution for steering of roaming in 5GS procedure in an SNPN can also be used by the HPLMN to update 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 via NAS signalling.

The HPLMN or subscribed SNPN can provide the steering of roaming information to the UE using the control plane mechanism during and after registration. The HPLMN or subscribed SNPN updates the SOR-SNPN-SI based on the HPLMN or subscribed SNPN policies, which can be based on the registered SNPN, the location of the UE, etc. The control plane solution for steering of roaming in 5GS procedure in an SNPN is not applicable for credentials holder with AAA server.

If the UE supports access to an SNPN using credentials from a credentials holder:

a) the UE shall indicate ME's support for SOR-SNPN-SI when registering in a subscribed SNPN or in the HPLMN; and

b) the UE may indicate ME's support for SOR-SNPN-SI when sending an SOR transparent container including a UE acknowledgement in a PLMN.

The HPLMN or subscribed SNPN can configure their subscribed UEs' SNPN configuration parameters associated with the PLMN subscription or the selected entry of the "list of subscriber data", respectively, to expect to receive the steering of roaming information due to initial registration in a non-subscribed SNPN. At the same time the HPLMN or subscribed SNPN will mark the UE as expecting to receive the steering of roaming information due to initial registration in a non-subscribed SNPN, in the subscription information in the UDM. In this case, it is mandatory for the HPLMN or subscribed SNPN to provide the steering of roaming information to the UE during initial registration in a non-subscribed SNPN. Otherwise if such configuration is not provided in the ME, it is optional for the HPLMN or subscribed SNPN to provide the steering of roaming information to the UE during initial registration (based on HPLMN or subscribed SNPN policy). The HPLMN or subscribed SNPN 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 or subscribed SNPN 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 or subscribed SNPN needs to consider certain criteria including the number of customers distributed through multiple SNPNs in the same country or region, the SOR-SNPN-SI is not necessarily the same at all times and for all users.

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 or subscribed SNPN to control the timing of a UE in connected mode to move to idle mode, if the UE decides to perform SNPN selection upon receiving the steering of roaming information. The UE shall support the SOR-CMCI. The support and use of SOR-CMCI by the HPLMN or subscribed SNPN is based on the HPLMN or subscribed SNPN policy.

The following requirements are applicable for the SOR-CMCI:

- The HPLMN or subscribed SNPN 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.

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

NOTE 3: If the credentials holder is the HPLMN, the HPLMN has the knowledge of the USIM's capabilities in supporting SOR-CMCI.

- While performing SOR, the UE shall consider the SOR-SNPN-SI received in the SOR information together with the available SOR-CMCI.

- The HPLMN or subscribed SNPN 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.

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

- obtaining the SOR-SNPN-SI which is or becomes available in the UDM (i.e. retrieved from the UDR);

- obtaining the SOR-SNPN-SI from the SOR-AF; or

- both of the above.

The HPLMN or subscribed SNPN policy for the SOR-AF invocation can be present in the UDM only if the UDM supports obtaining the SOR-SNPN-SI from the SOR-AF.

The UDM discards any SOR-SNPN-SI 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.5) or after registration (as specified in annex C.6), 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 SOR-SNPN-SI after the expiration of the HPLMN or subscribed SNPN specific timer, or if there is no AMF registered for the UE).

The UE maintains a list of "SNPNs where registration was aborted due to SOR" per entry of the "list of subscriber data" or the PLMN subscription. If the UE receives steering of roaming information in the REGISTRATION ACCEPT or DL NAS TRANSPORT message in an SNPN and the security check to verify that the steering of roaming information is provided by the HPLMN or subscribed SNPN is successful, the UE shall remove the current selected SNPN from the list of "SNPNs where registration was aborted due to SOR" for the selected entry of the "list of subscriber data" or the selected PLMN subscription. The UE shall delete the list of "SNPNs where registration was aborted due to SOR" when the selected entry of the "list of subscriber data" is updated or the UICC containind the USIM is removed.

If:

- the UE's ME is configured to indicate that the UE shall expect to receive the steering of roaming information during initial registration procedure for the selected entry of the "list of subscriber data" or the selected PLMN subscription but did not receive it or security check on the steering of roaming information fails;

- the current chosen non-subscribed SNPN is not contained in the list of "SNPNs where registration was aborted due to SOR" for the selected entry of the "list of subscriber data" or the selected PLMN subscription;

- the current chosen non-subscribed SNPN is not part of the user controlled prioritized list of preferred SNPNs for the selected entry of the "list of subscriber data" or the selected PLMN subscription; and

- the UE is not in manual mode of operation;

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

It is mandatory for the non-subscribed SNPN to transparently forward to the UE the steering of roaming information received from the HPLMN or subscribed SNPN and to transparently forward to the HPLMN or subscribed SNPN the acknowledgement of successful reception of the steering of roaming information received from the UE, both while the UE is trying to register onto the non-subscribed SNPN as described in clause C.5, and after the UE has registered onto the non-subscribed SNPN as described in clause C.6.

The ME shall delete the SOR-SNPN-SI stored in the ME when the selected entry of the "list of subscriber data" is updated or the UICC containind the USIM is removed.

Editor's note (WI eNPN, CR#0790): It is FFS whether update of any parameters (or just a subset of the parameters) in the the selected entry of the "list of subscriber data" triggers removal of the SOR-SNPN-SI.

The procedure in this annex for steering of UE in an SNPN can be initiated by the network while the UE is trying to register onto a non-subscribed SNPN as described in clause C.5, or after the UE has registered onto the subscribed SNPN or a non-subscribed SNPN as described in clause C.6 and C.8.

## C.2 Stage-2 flow for steering of UE in VPLMN during registration

The stage-2 flow for the case when the UE registers with VPLMN AMF is described below in figure C.2.1. The selected PLMN is the VPLMN. The AMF is located in the selected VPLMN.

Figure C.2.1: Procedure for providing list of preferred PLMN/access technology combinations and the SOR-CMCI, if any, or secured packet during registration

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

1) The UE to the VPLMN AMF: The UE initiates initial registration, emergency registration or mobility registration update procedure to the VPLMN AMF by sending REGISTRATION REQUEST message with the 5GS registration type IE indicating "initial registration", "emergency registration" or "mobility registration updating";

2) Upon receiving REGISTRATION REQUEST message, the VPLMN AMF executes the registration procedure as defined in clause 4.2.2.2 of 3GPP TS 23.502 [63]. As part of the registration procedure:

a) the AMF provides the registration type to the UDM using Nudm\_UECM\_Registration. As a consequence, in case of the 5GS registration type message indicates "initial registration" or "emergency registration" the UDM shall delete the stored "ME support of SOR-CMCI" indicator, if any, and the stored "ME support of SOR-SNPN-SI" indicator, if any, in UDR using Nudr\_DM\_Update service operation (see 3GPP TS 23.502 [63]).

NOTE 1: Nudr\_DM\_Update service operation corresponds to Nudr\_DR\_Update service operation (see 3GPP TS 29.504 [82] and 3GPP TS 29.505 [83]).

 In addition:

a) if the VPLMN AMF does not have subscription data for the UE, the VPLMN AMF invokes Nudm\_SDM\_Get service operation to the HPLMN UDM to get amongst other information the Access and Mobility Subscription data for the UE (see step 14b in clause 4.2.2.2.2 of 3GPP TS 23.502 [63]); or

b) if the VPLMN AMF already has subscription data for the UE and:

i) the 5GS registration type IE in the received REGISTRATION REQUEST message indicates "initial registration" and the "SoR Update Indicator for Initial Registration" field in the UE context is set to 'the UDM requests the AMF to retrieve SoR information when the UE performs NAS registration type "initial registration"' as specified in table 5.2.2.2.2-1 of 3GPP TS 23.502 [63]); or

ii) the 5GS registration type IE in the received REGISTRATION REQUEST message indicates "emergency registration" and the "SoR Update Indicator for Emergency Registration" field in the UE context is set to 'the UDM requests the AMF to retrieve SoR information when the UE performs NAS registration type "emergency registration"' as specified in table 5.2.2.2.2-1 of 3GPP TS 23.502 [63]);

 then the VPLMN AMF invokes Nudm\_SDM\_Get service operation message to the HPLMN UDM to retrieve the steering of roaming information (see step 14b in clause 4.2.2.2.2 of 3GPP TS 23.502 [63]);

 otherwise the VPLMN AMF sends a REGISTRATION ACCEPT message without the steering of roaming information to the UE and steps 3a, 3b, 3c, 3d, 4, 5, 6 are skipped;

3a) If the user subscription information indicates to send the steering of roaming information due to initial registration in a VPLMN, then the HPLMN UDM shall provide the steering of roaming information to the UE when the UE performs initial registration in a VPLMN, otherwise the HPLMN UDM may provide the steering of roaming information to the UE, based on operator policy.

NOTE 2: Based on operator deployment and policy, if the UDM receives the list of preferred PLMN/access technology combinations from the UDR, and the UDM supports communication with the SP-AF, the UDM can send this list to the SP-AF requesting it to provide this information in a secured packet as defined in 3GPP TS 29.544 [71].

 If the HPLMN UDM is to provide the steering of roaming information to the UE when the UE performs the registration in a VPLMN, and the HPLMN policy for the SOR-AF invocation is absent then steps 3b and 3c are not performed and the HPLMN UDM obtains the available list of preferred PLMN/access technology combinations or the available secured packet (i.e. all retrieved from the UDR). In addition, if the HPLMN UDM obtains the list of preferred PLMN/access technology combinations and the "ME support of SOR-CMCI" indicator is stored for the UE, then the HPLMN UDM shall obtain the SOR-CMCI, if available, otherwise the HPLMN UDM shall not obtain the SOR-CMCI. If the SOR-CMCI is provided then the HPLMN UDM may indicate to the UE to store the SOR-CMCI in the ME by providing the "Store SOR-CMCI in ME" indicator set to "Store SOR-CMCI in ME".

NOTE 3: The secured packet obtained by the UDM can include SOR-CMCI only if the "ME support of SOR-CMCI" indicator is stored for the UE and the USIM of the indicated SUPI supports SOR-CMCI. Otherwise if only the "ME support of SOR-CMCI" indicator is stored for the UE, then SOR-CMCI, if any, cannot be included in the secured packet.

 If the HPLMN UDM is to provide the steering of roaming information to the UE when the UE performs the registration in a VPLMN, and the HPLMN policy for the SOR-AF invocation is present, then the HPLMN UDM obtains the list of preferred PLMN/access technology combinations, SOR-CMCI, if any, or the secured packet from the SOR-AF using steps 3b and 3c;

3b) The HPLMN UDM to the SOR-AF: Nsoraf\_SoR\_Get request (VPLMN ID, SUPI of the UE, access type (see 3GPP TS 29.571 [72])). The VPLMN ID and the access type parameters, indicating where the UE is registering, are stored in the HPLMN UDM;

3c) The SOR-AF to the HPLMN UDM: Nsoraf\_SoR\_Get response (the list of preferred PLMN/access technology combinations, the SOR-CMCI, if any, and the "Store SOR-CMCI in ME" indicator, if any, or the secured packet, or neither of them);

 Based on the information received in step 3b and any operator specific criteria, the SOR-AF may either:

- include the list of preferred PLMN/access technology combinations, the SOR-CMCI, if any, and optionally the "Store SOR-CMCI in ME" indicator, if any;

- provide the secured packet in the Nsoraf\_SoR\_Get response; or

- provide the Nsoraf\_SoR\_Get response with neither of the information above.

 If the SOR-AF includes the list of preferred PLMN/access technology combinations and the ME supports the SOR-CMCI, the SOR-AF may provide the SOR-CMCI and optionally the "Store SOR-CMCI in ME" indicator, otherwise the SOR-AF shall provide neither the SOR-CMCI nor "Store the SOR-CMCI in ME" indicator.

NOTE 4: In this version of the specification, when the access type where the UE is registering indicates 3GPP access, then the UE is registering over the NG-RAN access technology.

NOTE 5: Based on operator deployment and policy, if the UDM receives the list of preferred PLMN/access technology combinations, and the SOR-CMCI, if any, in the Nsoraf\_SoR\_Get response from the SOR-AF, and the UDM supports communication with SP-AF, it can send this list, and the SOR-CMCI, if any, to SP-AF requesting it to provide this information in a secured packet as defined in 3GPP TS 29.544 [71].

NOTE 6: The SOR-AF can include a different list of preferred PLMN/access technology combinations, different SOR-CMCI, if any, and different "Store SOR-CMCI in ME" indicator, if any, or a different secured packet for each Nsoraf\_SoR\_Get request even if the same VPLMN ID, the SUPI of the UE, and the access type are provided to the SOR-AF.

NOTE 7: The SOR-AF can subscribe to the HPLMN UDM to be notified about the changes of the roaming status of the UE identified by SUPI.

NOTE 8: The SOR-AF can determine that the ME supports the SOR-CMCI if the Nsoraf\_SoR\_Info service operation has returned the "ME support of SOR-CMCI" indicator.

NOTE 9: Secured packet provided by the SOR-AF can include SOR-CMCI only if the SOR-AF has determined that the ME supports the SOR-CMCI and the USIM of the indicated SUPI supports SOR-CMCI. Otherwise if only the "ME support of SOR-CMCI" indicator is stored for the UE, then SOR-CMCI, if any, cannot be included in the secured packet.

NOTE 10: Secured packets do not include the "Store SOR-CMCI in ME" indicator.

3d) The HPLMN UDM forms the steering of roaming information as specified in 3GPP TS 33.501 [66] from:

- the list of preferred PLMN/access technology combinations, the SOR-CMCI, if any, and the "Store SOR-CMCI in ME" indicator, if any, or the secured packet obtained in step 3a; or

 the list of preferred PLMN/access technology combinations and the SOR-CMCI, if any, and "Store the SOR-CMCI in ME" indicator, if any, or the secured packet, obtained in step 3c.

 If:

- neither the list of preferred PLMN/access technology combinations nor the secured packet was obtained in steps 3a or 3c; or

- the SOR-AF has not sent to the HPLMN UDM an Nsoraf\_SoR\_Get response (step 3c) within an operator defined time after the HPLMN UDM sending to the SOR-AF an Nsoraf\_SoR\_Get request (step 3b);

NOTE 11: Stage 3 to define the timer needed for the SOR-AF to respond to the HPLMN UDM. The max time needs to be defined considering that this procedure is part of the Registration procedure.

 and the UE is performing initial registration in a VPLMN and the user subscription information indicates to send the steering of roaming information due to initial registration in a VPLMN, then the HPLMN UDM forms the steering of roaming information as specified in 3GPP TS 33.501 [66] from 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';

 If the "Store SOR-CMCI in ME" indicator was not obtained in step 3a or 3c and the "ME support of SOR-CMCI" indicator is stored for the UE in the HPLMN UDM, the HPLMN UDM forms the steering of roaming information with the "Store SOR-CMCI in ME" indicator set to "Do not store SOR-CMCI in ME";

4) The HPLMN UDM to the VPLMN AMF: The HPLMN UDM sends a response to the Nudm\_SDM\_Get service operation to the VPLMN AMF, which includes the steering of roaming information within the Access and Mobility Subscription data. The Access and Mobility Subscription data type is defined in clause 5.2.3.3.1 of 3GPP TS 23.502 [63]).

NOTE 12: The UDM cannot provide the SOR-CMCI, if any, to the VPLMN AMF which does not support receiving SoR transparent container (see 3GPP TS 29.503 [78]).

 If the UE is performing initial registration or emergency registration and the HPLMN UDM supports SOR-CMCI, the HPLMN shall request the UE to acknowledge the successful security check of the received steering of roaming information, by providing the indication as part of the steering of roaming information in the Nudm\_SDM\_Get response service operation. Otherwise, the HPLMN may request the UE to acknowledge the successful security check of the received steering of roaming information, by providing the indication as part of the steering of roaming information in the Nudm\_SDM\_Get response service operation;

NOTE 13: If the UE is performing mobility registration update procedure after inter-system change from S1 mode to N1 mode and the HPLMN UDM supports SOR-CMCI, the HPLMN requests the UE to acknowledge the successful security check of the received steering of roaming information, by providing the indication as part of the steering of roaming information in the Nudm\_SDM\_Get response service operation, unless the HPLMN UDM has already received and stored the "ME support of SOR-CMCI" indicator for the UE during its former registration on the current VPLMN.

5) The VPLMN AMF to the HPLMN UDM: As part of the registration procedure, the VPLMN AMF also invokes Nudm\_SDM\_Subscribe service operation to the HPLMN UDM to subscribe to notification of changes of the subscription data (e.g. received in step 4) including notification of updates of the steering of roaming information included in the Access and Mobility Subscription data (see step 14c in clause 4.2.2.2.2 of 3GPP TS 23.502 [63]);

6) The VPLMN AMF to the UE: The VPLMN AMF shall transparently send the received steering of roaming information to the UE in the REGISTRATION ACCEPT message;

7) If the steering of roaming information is received and the security check is successful, then:

a) if the UDM has not requested an acknowledgement from the UE, then the UE shall send the REGISTRATION COMPLETE message to the serving AMF without including an SOR transparent container;

b) if the steering of roaming information contains a secured packet (see 3GPP TS 31.115 [67]):

- the ME shall upload the secured packet to the USIM using procedures in 3GPP TS 31.111 [41], if the service "data download via SMS Point-to-point" is allocated and activated in the USIM Service Table (see 3GPP TS 31.102 [40]);

NOTE 14: How the ME handles UICC responses and failures in communication between the ME and UICC is implementation specific and out of scope of this release of the specification.

- if the UDM has not requested an acknowledgement from the UE and:

A) the ME receives a USAT REFRESH with command qualifier (3GPP TS 31.111 [41]) of type "Steering of Roaming" and either a SOR-CMCI is included, or the UE is configured with the SOR-CMCI, the UE shall perform items a), b) and c) of the procedure for steering of roaming in clause 4.4.6, and if the UE is in automatic network selection mode then it shall apply the actions in clause C.4.2. In this case steps 8 to 11 are skipped; or

B) the ME receives a USAT REFRESH command qualifier (3GPP TS 31.111 [41]) of type "Steering of Roaming" and neither a SOR-CMCI is included, nor the UE is configured with the SOR-CMCI, it shall perform items a), b) and c) of the procedure for steering of roaming in clause 4.4.6 and if:

i) the UE has a list of available and allowable PLMNs in the area and based on this list or any other implementation specific means the UE determines that there is a higher priority PLMN than the selected VPLMN; or

ii) the UE does not have a list of available and allowable PLMNs in the area and is unable to determine whether there is a higher priority PLMN than the selected VPLMN using any other implementation specific means;

 and the UE is in automatic network selection mode, then the UE shall either:

i) release the current N1 NAS signalling connection locally and then attempt 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. In this case, steps 8 to 11 are skipped. The UE shall suspend the transmission of 5GSM messages until the N1 NAS signalling is released. If the UE has an established emergency PDU session (see 3GPP TS 24.501 [64]), the receipt of the steering of roaming information shall not trigger the release of the N1 NAS signalling connection. If camped on a NG-RAN cell, the UE shall release the current N1 NAS signalling connection locally subsequently after the emergency PDU session is released, otherwise the UE shall not take any further actions; or

ii) not release the current N1 NAS signalling connection locally (e.g. if the UE has established PDU session(s)) and skip steps 8 to 10;

c) if the steering of roaming information contains the list of preferred PLMN/access technology combinations, the ME shall replace the highest priority entries in the "Operator Controlled PLMN Selector with Access Technology" list stored in the ME with the received list of preferred PLMN/access technology combinations, and delete the PLMNs identified by the list of preferred PLMN/access technology combinations from the Forbidden PLMN list and from the Forbidden PLMNs for GPRS service list, if they are present in these lists. Additionally, if:

i) the UE has a list of available and allowable PLMNs in the area and based on this list or any other implementation specific means the UE determines that there is a higher priority PLMN than the selected VPLMN; or

ii) the UE does not have a list of available and allowable PLMNs in the area and is unable to determine whether there is a higher priority PLMN than the selected VPLMN using any other implementation specific means;

 and the UE is in automatic network selection mode:

A) if the UE is configured with the SOR-CMCI or received the SOR-CMCI over N1 NAS signalling, the UE shall apply the actions in clause C.4.2. In this case steps 8 to 11 are skipped;

B) otherwise, the UE shall:

i) release the current N1 NAS signalling connection locally and then attempt 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. In this case, steps 8 to 11 are skipped. The UE shall suspend the transmission of 5GSM messages until the N1 NAS signalling is released. If the UE has an established emergency PDU session (see 3GPP TS 24.501 [64]), the receipt of the steering of roaming information shall not trigger the release of the N1 NAS signalling connection. If camped on a NG-RAN cell, he UE shall release the current N1 NAS signalling connection locally subsequently after the emergency PDU session is released, otherwise the UE shall not take any further actions. If the UE needs to disable the N1 mode capability (see 3GPP TS 24.501 [64]) and there is no emergency service pending, the UE shall first attempt to obtain service on a higher priority PLMN as described in this step, and if no higher priority PLMN can be selected but the last registered PLMN is selected, then the UE shall disable the N1 mode capability; or

ii) not release the current N1 NAS signalling connection locally (e.g. if the UE has established PDU session(s)) and skip steps 8 to 10;

NOTE 15: 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.

8) If the UE's USIM is configured with indication that the UE is to receive the steering of roaming information due to initial registration in a VPLMN, but neither the list of preferred PLMN/access technology combinations nor the secured packet nor 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' is received in the REGISTRATION ACCEPT message, when the UE performs initial registration in a VPLMN or if the steering of roaming information is received but the security check is not successful, then the UE shall:

a) if the SOR transparent container is included in the REGISTRATION ACCEPT message, send the REGISTRATION COMPLETE message to the serving AMF without including an SOR transparent container;

b) if the current chosen VPLMN is not contained in the list of "PLMNs where registration was aborted due to SOR", and is not part of "User Controlled PLMN Selector with Access Technology" list and the UE is not in manual mode of operation:

i) if the steering of roaming information is received but the security check is not successful when the UE performs mobility registration update procedure in a VPLMN and the UE has a SOR-CMCI stored in the non-volatile memory of the ME, the UE shall apply the actions in clause C.4.2. In this case, current PLMN is considered as lowest priority and steps 9 to 11 are skipped;

ii) otherwise, the UE shall release the current N1 NAS signalling connection locally and attempt 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, and skip steps 9 to 11. The UE shall suspend the transmission of 5GSM messages until the N1 NAS signalling is released. If the UE has an established emergency PDU session (see 3GPP TS 24.501 [64]), if camped on a NG-RAN cell, the UE shall release the current N1 NAS signalling connection locally after the release of the emergency PDU session, otherwise the UE shall not take any further actions. If the UE needs to disable the N1 mode capability (see 3GPP TS 24.501 [64]) and there is no emergency service pending, the UE shall first attempt to obtain service on a higher priority PLMN as described in this step, and if no higher priority PLMN can be selected but the last registered PLMN is selected, then the UE shall disable the N1 mode capability; and

c) if the current chosen VPLMN is not contained in the list of "PLMNs where registration was aborted due to SOR", store the PLMN identity in the list of "PLMNs where registration was aborted due to SOR";

NOTE 16: 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.

9) The UE to the VPLMN AMF: If the UDM has requested an acknowledgement from the UE and the UE verified that the steering of roaming information has been provided by the HPLMN in step 7, then:

a) the UE sends the REGISTRATION COMPLETE message to the serving AMF with an SOR transparent container including the UE acknowledgement;

b) the UE shall set the "ME support of SOR-CMCI" indicator in the header of the SOR transparent container to "supported";

c) if the UE supports access to an SNPN using credentials from a credentials holder, the UE may set the "ME support of SOR-SNPN-SI" indicator in the header of the SOR transparent container to "supported"; and

d) if:

- the steering of roaming information contained a secured packet, then when the UE receives the USAT REFRESH command qualifier of type "Steering of Roaming" and neither a SOR-CMCI is included, nor the UE is configured with the SOR-CMCI, it performs items a), b) and c) of the procedure for steering of roaming in clause 4.4.6;

- the steering of roaming information contained a secured packet, then when the UE receives a USAT REFRESH with command qualifier (3GPP TS 31.111 [41]) of type "Steering of Roaming" and either a SOR-CMCI is included, or the UE is configured with the SOR-CMCI, the UE shall perform items a), b) and c) of the procedure for steering of roaming in clause 4.4.6 and if the UE is in automatic network selection mode then it shall apply the actions in clause C.4.2, and step 11 is skipped;

- the steering of roaming information contains the list of preferred PLMN/access technology combinations, the UE is configured with the SOR-CMCI or received the SOR-CMCI over N1 NAS signalling, and the UE is in automatic network selection mode, then the UE shall apply the actions in clause C.4.2, and step 11 is skipped; or

- the steering of roaming information contains an 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', then step 11 is skipped;

10) The VPLMN AMF to the HPLMN UDM: If an SOR transparent container is received in the REGISTRATION COMPLETE message, 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 the successful security check of the received steering of roaming information in step 4, the UDM verifies that the acknowledgement is provided by the UE as specified in 3GPP TS 33.501 [66]. If the "ME support of SOR-CMCI" indicator in the header of the SOR transparent container is set to "supported", then the HPLMN UDM shall store the "ME support of SOR-CMCI" indicator, otherwise the HPLMN UDM shall delete the stored "ME support of SOR-CMCI" indicator, if any. Additionally, if the "ME support of SOR-SNPN-SI" indicator in the header of the SOR transparent container is set to "supported", then the HPLMN UDM shall store the "ME support of SOR-SNPN-SI" indicator, otherwise the HPLMN UDM shall delete the stored "ME support of SOR-SNPN-SI" indicator, if any.

NOTE 17: The UDM cannot receive the "ME support of SOR-CMCI" indicator or the "ME support of SOR-SNPN-SI" from the VPLMN AMF which does not support receiving SoR transparent container (see 3GPP TS 29.503 [78]).

10a) The HPLMN UDM to the SOR-AF: Nsoraf\_SoR\_Info (SUPI of the UE, successful delivery, "ME support of SOR-CMCI" indicator, if any, "ME support of SOR-SNPN-SI" indicator, if any). If the HPLMN policy for the SOR-AF invocation is present and the HPLMN UDM received and verified the UE acknowledgement in step 10, then the HPLMN UDM informs the SOR-AF about successful delivery of the list of preferred PLMN/access technology combinations, or of the secured packet to the UE. If the "ME support of SOR-CMCI" indicator is stored for the UE, the HPLMN UDM shall include the "ME support of SOR-CMCI" indicator. Additionally, if the "ME support of SOR-SNPN-SI" indicator is stored for the UE, the HPLMN UDM shall include the "ME support of SOR-SNPN-SI" indicator; and

NOTE 18: How the SOR-AF determines that the USIM for the indicated SUPI supports SOR-CMCI is implementation specific.

11) If the UE has a list of available PLMNs in the area and based on this list the UE determines that there is a higher priority PLMN than the selected VPLMN and the UE is in automatic network selection mode, then the UE shall attempt 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 after the release of the N1 NAS signalling connection. If within an implementation dependent time the N1 NAS signalling connection is not released, then the UE may locally release the N1 signalling connection except when the UE has an established emergency PDU session (see 3GPP TS 24.501 [64]).

When the UE performs initial registration for emergency services (see 3GPP TS 24.501 [64] and 3GPP TS 23.502 [63]) while the UE has a valid USIM and the AMF performs the authentication procedure, then based on HPLMN policy, the SOR procedure described in this clause may apply.

If:

- the UE in manual mode of operation encounters scenario mentioned in step 8 above; and

- upon switching to automatic network selection mode, the UE remembers that it is still registered on the PLMN where the missing or security check failure of SOR information was encountered as described in clause 8;

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 UE has an established emergency PDU session, then the UE shall attempt to perform the PLMN selection subsequently after the emergency PDU session is released.

NOTE 19: The receipt of the steering of roaming information by itself does not trigger the release of the emergency PDU session.

NOTE 20: The list of available and allowable PLMNs in the area is implementation specific.

NOTE 21: If the UE is served by any access technology other than NG-RAN, the HPLMN can initiate a steering of roaming procedure as specified in clause 4.4.6.

## C.3 Stage-2 flow for steering of UE in HPLMN or VPLMN after registration

The stage-2 flow for the steering of UE in HPLMN or VPLMN after registration is indicated in figure C.3.1. The selected PLMN can be the HPLMN or a VPLMN. The AMF is located in the selected PLMN. In this procedure, the SOR-CMCI, if any, is sent together with the list of preferred PLMN/access technology combinations in plain text or is sent within the secured packet.

The procedure is triggered:

- If the HPLMN 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 HPLMN policy for the SOR-AF invocation is present in the HPLMN UDM and the SOR-AF provides the HPLMN UDM with a new list of preferred PLMN/access technology combinations or a secured packet for a UE identified by SUPI. If the ME supports the SOR-CMCI, the SOR-AF may provide the SOR-CMCI and optionally provides the "Store SOR-CMCI in ME" indicator otherwise the SOR-AF shall provide neither the SOR-CMCI nor the "Store SOR-CMCI in ME" indicator.

 The secured packet provided by the SOR-AF may include SOR-CMCI only if the SOR-AF has determined that the ME supports the SOR-CMCI and the USIM of the indicated SUPI supports SOR-CMCI. Otherwise if only the "ME support of SOR-CMCI" indicator is stored for the UE, then the SOR-AF shall not include the SOR-CMCI, if any, in the secured packet; or

NOTE 1: The SOR-AF can determine that the ME supports the SOR-CMCI if the Nsoraf\_SoR\_Info service operation has returned the "ME support of SOR-CMCI" indicator. How the SOR-AF determines that the USIM for the indicated SUPI supports SOR-CMCI is implementation specific.

- When a new list of preferred PLMN/access technology combinations or a secured packet becomes available in the HPLMN UDM (i.e. retrieved from the UDR).

 If the "ME support of SOR-CMCI" indicator is stored for the UE and the new list of preferred PLMN/access technology combinations becomes available in the HPLMN UDM (i.e. retrieved from the UDR), the HPLMN UDM shall obtain the SOR-CMCI and the "Store SOR-CMCI in ME" indicator, if available, otherwise the HPLMN UDM shall obtain neither the SOR-CMCI nor the "Store SOR-CMCI in ME" indicator.

NOTE 3: Based on operator deployment and policy, if the UDM receives the list of preferred PLMN/access technology combinations, SOR-CMCI, if any, the "Store SOR-CMCI in ME" indicator, if any, and the USIM of the indicated SUPI supports SOR-CMCI from the UDR, and the UDM supports communication with the SP-AF, the UDM can send this list and SOR-CMCI to the SP-AF requesting it to provide this information in a secured packet as defined in 3GPP TS 29.544 [71].

NOTE 4: Before providing the HPLMN UDM with a new list of preferred PLMN/access technology combinations or a secured packet for a UE identified by SUPI, the SOR-AF, based on operator policies or criteria, can obtain the user location information by triggering the unified location service exposure procedure as defined in 3GPP TS 23.273 [70] clause 6.5, or additionally based on implementation specific criteria, by requesting the UE location information from other application function using implementation specific method. This user location information can then be used in the SOR-AF algorithms.

NOTE 5: The secured packet obtained by the UDM can include SOR-CMCI only if the "ME support of SOR-CMCI" indicator is stored for the UE and the USIM of the indicated SUPI supports SOR-CMCI. Otherwise if only the "ME support of SOR-CMCI" indicator is stored for the UE, then the SOR-CMCI, if any, cannot be included in the secured packet.

Figure C.3.1: Procedure for providing list of preferred PLMN/access technology combinations and the SOR-CMCI, if any, or secured packet after registration

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

1) The SOR-AF to the HPLMN UDM: Nudm\_ParameterProvision\_Update request is sent to the HPLMN UDM to trigger the update of the UE with the new list of preferred PLMN/access technology combinations, the SOR-CMCI, if any, and the "Store SOR-CMCI in ME" indicator, if any, or a secured packet for a UE identified by SUPI.

2) The HPLMN 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 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. If the SOR-CMCI was obtained, the HPLMN UDM shall include the SOR-CMCI into the steering of roaming information. If the "Store SOR-CMCI in ME" indicator was obtained, the HPLMN UDM shall include the "Store SOR-CMCI in ME" indicator; otherwise, the HPLMN UDM shall include the "Store SOR-CMCI in ME" indicator set to "Do not store SOR-CMCI in ME";

NOTE 6: The UDM cannot provide the SOR-CMCI, if any, to the VPLMN 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, 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:

- if the security check is successful and:

a) if the steering of roaming information contains a secured packet (see 3GPP TS 31.115 [67]):

- if the service "data download via SMS Point-to-point" is allocated and activated in the USIM Service Table (see 3GPP TS 31.102 [40]), the ME shall upload the secured packet to the USIM using procedures in 3GPP TS 31.111 [41].

 If the UDM has requested an acknowledgement from the UE in the DL NAS TRANSPORT message and the ME receives UICC responses indicating that the UICC has received the secured packet successfully, then 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-CMCI" indicator in the header of the SOR transparent container to "supported". Additionally, if the UE supports access to an SNPN using credentials from a credentials holder, the UE may set the "ME support of SOR-SNPN-SI" indicator in the header of the SOR transparent container to "supported"; and

NOTE 7: How the ME handles UICC responses that do not indicate that the UICC has received the secured packet successfully and failures in communication between the ME and UICC is implementation specific and out of scope of this release of the specification.

- when the ME receives a USAT REFRESH command qualifier (see 3GPP TS 31.111 [41]) of type "Steering of Roaming" and neither a SOR-CMCI is included, nor the UE is configured with the SOR-CMCI, it performs the procedure for steering of roaming in clause 4.4.6 with an exception that if the UE is in automatic network selection mode, then 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 (specified in clause 4.4.6 bullet d); or

- when the ME receives a USAT REFRESH with command qualifier (see 3GPP TS 31.111 [41]) of type "Steering of Roaming" and either a SOR-CMCI is included, or the UE is configured with the SOR-CMCI, the UE shall perform items a), b) and c) of the procedure for steering of roaming in clause 4.4.6. If the UE is in automatic network selection mode it shall apply the actions in clause C.4.2;

b) if the steering of roaming information contains the list of preferred PLMN/access technology combinations, the ME shall replace the highest priority entries in the "Operator Controlled PLMN Selector with Access Technology" list stored in the ME with the received list of preferred PLMN/access technology combinations, and delete the PLMNs identified by the list of preferred PLMN/access technology combinations from the Forbidden PLMN list and from the Forbidden PLMNs for GPRS service list, 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-CMCI" indicator to "supported". Additionally, if the UE supports access to an SNPN using credentials from a credentials holder, the UE may set the "ME support of SOR-SNPN-SI" indicator in the header of the SOR transparent container to "supported".

 If the UE is in automatic network selection mode and the selected PLMN is a VPLMN, then:

- if the UE has a SOR-CMCI stored in the non-volatile memory of the ME or received the SOR-CMCI over N1 NAS signalling, the UE shall apply the actions in clause C.4; or

- 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.

 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 subsequently after the emergency PDU session is released, if the UE is in automatic network selection mode.

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

- 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.

 Step 5 is skipped;

NOTE 8: 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 HPLMN 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 1, the UDM verifies that the acknowledgement is provided by the UE. If the "ME support of SOR-CMCI" indicator in the header of the SOR transparent container is set to "supported", then the HPLMN UDM shall store the "ME support of SOR-CMCI" indicator, otherwise the HPLMN UDM shall delete the stored "ME support of SOR-CMCI" indicator, if any. Additionally, if the "ME support of SOR-SNPN-SI" indicator in the header of the SOR transparent container is set to "supported", then the HPLMN UDM shall store the "ME support of SOR-SNPN-SI" indicator, otherwise the HPLMN UDM shall delete the stored "ME support of SOR-SNPN-SI" indicator, if any; and

6) The HPLMN UDM to the SOR-AF: Nsoraf\_SoR\_Info (SUPI of the UE, successful delivery, "ME support of SOR-CMCI" indicator, if any, "ME support of SOR-SNPN-SI" indicator, if any). 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 HPLMN UDM informs the SOR-AF about successful delivery of the list of preferred PLMN/access technology combinations, SOR-CMCI, if any, or of the secured packet to the UE. If the "ME support of SOR-CMCI" indicator is stored for the UE, the HPLMN UDM shall include the "ME support of SOR-CMCI" indicator. Additionally, if the "ME support of SOR-SNPN-SI" indicator is stored for the UE, the HPLMN 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.

NOTE 9: The receipt of the steering of roaming information by itself does not trigger the release of the emergency PDU session.

NOTE 10: If the selected PLMN is the HPLMN, regardless whether the UE is in automatic network selection mode or manual network selection mode, regardless whether the UE has an established emergency PDU session or not, and regardless whether the security check is successful or not successful, the UE is not required to perform the PLMN selection.

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

### C.4.3 Stage-2 flow for providing UE with SOR-CMCI in HPLMN, VPLMN, subscribed SNPN or non-subscribed SNPN after registration

The stage-2 flow for providing UE with SOR-CMCI in HPLMN, VPLMN, subscribed SNPN or non-subscribed SNPN after registration is indicated in figure C.4.3.1, when the ME supports the SOR-CMCI. The selected PLMN or SNPN can be the HPLMN, a VPLMN, the subscribed SNPN or a non-subscribed SNPN. The AMF is located in the selected PLMN or SNPN. The UDM is located in the HPLMN or the subscribed SNPN.

In this procedure, the SOR-CMCI is sent without the list of preferred PLMN/access technology combinations and the SOR-SNPN-SI. In this procedure, the SOR-CMCI is sent in plain text or is sent within the secured packet.

NOTE 1: The SOR-AF can determine that the ME supports the SOR-CMCI if the Nsoraf\_SoR\_Info service operation has returned the "ME support of SOR-CMCI" indicator. The UDM can determine that the ME supports the SOR-CMCI if the "ME support of SOR-CMCI" indicator is stored for the UE. How the SOR-AF determines that the USIM for the indicated SUPI supports SOR-CMCI is implementation specific.

NOTE 2: The secured packet provided by the SOR-AF can include SOR-CMCI only if the SOR-AF has determined that the ME supports the SOR-CMCI and the USIM of the indicated SUPI supports SOR-CMCI. Otherwise if only the "ME support of SOR-CMCI" indicator is stored for the UE, then SOR-CMCI, if any, cannot be included in the secured packet.

The procedure is triggered:

- If the UDM supports obtaining the parameters of the list of preferred PLMN/access technology combinations, the SOR-SNPN-SI, the SOR-CMCI, and the "Store SOR-CMCI in ME" indicator, if any, or a secured packet from the SOR-AF, the HPLMN or subscribed SNPN policy for the SOR-AF invocation is present in the UDM and the SOR-AF provides the UDM with the SOR-CMCI for a UE identified by SUPI; or

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

Figure C.4.3.1: Procedure for configuring UE with SOR-CMCI 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-CMCI (in plain text or secured packet). In case of providing SOR-CMCI in plain text, include the "Store SOR-CMCI in ME" indicator, if applicable. In case of providing SOR-CMCI in a secured packet, include an indication that "the list of preferred PLMN/access technology combinations is not included in the secured packet".

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. The UDM:

- upon receiving the SOR-CMCI (in plain text), shall:

i) if the UE is registered in the HPLMN or a VPLMN, include the SOR-CMCI, the "Store SOR-CMCI in ME" indicator, if any, 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';

ii) if the UE is registered in a non-subcribed SNPN, include the SOR-CMCI, the "Store SOR-CMCI in ME" indicator, if any, and the HPLMN or subscribed SNPN indication that 'no change of the SOR-SNPN-SI stored in the UE is needed and thus no SOR-SNPN-SI is provided'; and

iii) if the UE is registered in a subcribed SNPN and the AMF has reported to the UDM that the UE supports SOR-SNPN-SI, include the SOR-CMCI, the "Store SOR-CMCI in ME" indicator, if any, and the HPLMN or subscribed SNPN indication that 'no change of the SOR-SNPN-SI stored in the UE is needed and thus no SOR-SNPN-SI is provided'; or

- upon receiving the SOR-CMCI in secured packet, shall include the secured packet into the steering of roaming information;

NOTE 3: The UDM considers "the list of preferred PLMN/access technology combinations is not included in the secured packet" received together with the secured packet from the SOR-AF to indicate that the UE is not expected to perform SOR based on the associated steering of roaming information sent to the UE. However, the SOR-CMCI included in the secured packet can be applied by the UE if the UE has one or more Tsor-cm timers running as described in C.4.2.

NOTE 4: The UDM cannot provide the SOR-CMCI, 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-CMCI 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' or the HPLMN or subscribed SNPN indication that 'no change of the SOR-SNPN-SI stored in the UE is needed and thus no SOR-SNPN-SI is provided', or the secured packet, 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 or subscribed SNPN, and:

a) if the security check is successful, the UE shall store the SOR-CMCI according to clause C.4.1. If the UE has one or more Tsor-cm timers running, the UE shall apply the received SOR-CMCI as described in C.4.2.

 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-CMCI" indicator to "supported". Additionally, if the UE supports access to an SNPN using credentials from a credentials holder and the UE is in a PLMN, the UE may 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 or a non-subscribed SNPN, 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, or before attempting to obtain service on a higher priority SNPN as specified in clause 4.9.3, with an exception that the current registered SNPN is considered as lowest priority. If the selected PLMN or SNPN is a VPLMN or a non-subscribed SNPN 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 5: 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 or the current chosen non-subscribed SNPN is part of the user controlled prioritized list of preferred SNPNs for the selected entry of the "list of subscriber data" the selected PLMN subscription, the UE stays on the VPLMN or non-subscribed SNPN.

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-CMCI" indicator and the "ME support of SOR-SNPN-SI" indicator, if any; and

6) The UDM to the SOR-AF: Nsoraf\_SoR\_Info (SUPI of the UE, successful delivery, "ME support of SOR-CMCI" indicator, "ME support of SOR-SNPN-SI" indicator, if any). 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-CMCI to the UE. The UDM shall include the "ME support of SOR-CMCI" indicator and the "ME support of SOR-SNPN-SI" indicator, if any.

If the selected PLMN is a VPLMN or a non-subscribed SNPN 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 the non-subscribed SNPN 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, or before attempting to obtained service on a higher priority SNPN as specified in clause 4.9.3, with an exception that the current registered SNPN is considered as lowest priority. If the selected PLMN is a VPLMN or the selected SNPN is a non-subscribed SNPN 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 6: The receipt of the steering of roaming information by itself does not trigger the release of the emergency PDU session.

\* \* \* End of Changes \* \* \* \*