**3GPP TSG-CT WG1 Meeting #133-eC1-21xxxx**

**E-meeting, 11-19 November 2021 *revision of C1-216589***

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  | **23.122** | **CR** | **0827** | **rev** | **1** | **Current version:** | **17.4.0** |  |
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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 |  | Radio Access Network |  | Core Network | **X** |

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| ***Title:***  | Correcting when the HPLMN requests ACK while supporting SOR-CMCI |
|  |  |
| ***Source to WG:*** | NTT DOCOMO, Huawei, HiSilicon |
| ***Source to TSG:*** | C1 |
|  |  |
| ***Work item code:*** | eCPSOR\_CON |  | ***Date:*** | 2021-11-15 |
|  |  |  |  |  |
| ***Category:*** | **C** |  | ***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:*** | The specification is not aligned when the HPLMN requests an acknowledgment from the UE in case the HPLMN supports SOR-CMCI.The UE sends the ack to the HPLMN if security check of the SOR information is successful at the UE and the HPLMN has requested the UE to send back an ACK. This has been the case in Rel-15 and Rel-16.In Rel-17, the introduction of SOR-CMCI that is carried over the SOR information should be treated the same way.*Exception is for the initial and emergency registration cases, as the HPLMN must request an ack from the UE to receive the UE capability to support SOR-CMCI*. |
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| ***Summary of change:*** | Correct the mandatory condition in C.3 to ensure that when the HPLMN UDM includes the SOR-CMCI into the steering of roaming information, it *may* request an acknowledgement from the UE as part of the steering of roaming information. This is based on the HPLMN policy.Added a Note in C.2 reflecting that the HPLMN requests the ACK from the UE during mobility registration from EPS to 5GS, unless the HPLMN has already stored the UE capability of supporting SOR-CMCI since the UE registration on the current VPLMN. |
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| ***Consequences if not approved:*** | Misaligned behaviour of the HPLMN, in relation to requesting acknowledgment of the security check of the received SOR information from the UE, for the case when SOR-CMCI is included in the SOR information. |
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| ***Clauses affected:*** | C.2, C.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:*** |  |

## 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

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 4.2.2.2.2 of 3GPP TS 23.502 [63]. As part of the registration procedure:

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. If the UE is performing initial registration or emergency registration, the HPLMN UDM shall delete the stored "ME support of SOR-CMCI" indicator, if any.

NOTE 1: 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 the SOR-CMCI in the ME" indicator.

NOTE 1a: 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 the SOR-CMCI in the 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 the SOR-CMCI in the 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 the SOR-CMCI in the ME" indicator, otherwise the SOR-AF shall provide neither the SOR-CMCI nor the "Store the SOR-CMCI in the ME" indicator.

NOTE 2: 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 3: 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 4: The SOR-AF can include a different list of preferred PLMN/access technology combinations, different SOR-CMCI, if any, and different "Store the SOR-CMCI in the 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 5: 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 5a: 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 5b: The secured packet provided by the SOR-AF can include SOR-CMCI only if the SOR-AF has determined that the ME UE 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 5c: The secured packet provided by the SOR-AF does not include the "Store the SOR-CMCI in the 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 the SOR-CMCI in the 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 the "Store the SOR-CMCI in the 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 6: 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';

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 6a: 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 X: 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 7: 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. The UE shall release the current N1 NAS signalling connection locally subsequently after the emergency PDU session is released; 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. The UE shall release the current N1 NAS signalling connection locally subsequently after the emergency PDU session is released. 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 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.

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, 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]), the UE shall release the current N1 NAS signalling connection locally after the release of the emergency PDU session. 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 9: 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"; and

c) 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; or

- 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;

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.

NOTE 9a: The UDM cannot receive the "ME support of SOR-CMCI" indicator 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). 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; and

NOTE 9b: 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 the N1 NAS signalling connection is not released after implementation dependent time, 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 10: The receipt of the steering of roaming information by itself does not trigger the release of the emergency PDU session.

NOTE 11: The list of available and allowable PLMNs in the area is implementation specific.

## 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 is sent together with the list of preferred PLMN/access technology combinations in plain text or 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 the SOR-CMCI in the ME" indicator otherwise the SOR-AF shall provide neither the SOR-CMCI nor the "Store the SOR-CMCI in the ME" indicator; or

NOTE 0: 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.

NOTE 0a: 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.

- 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, the HPLMN UDM shall obtain the SOR-CMCI and the "Store the SOR-CMCI in the ME" indicator, if available, otherwise the HPLMN UDM shall obtain neither the SOR-CMCI nor the "Store the SOR-CMCI in the ME" indicator.

NOTE 1: Based on operator deployment and policy, if the UDM receives the list of preferred PLMN/access technology combinations, SOR-CMCI, if any, and the "Store the SOR-CMCI in the ME" indicator, if any, 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 2: 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 2a: 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, after registration

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

0) 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 the SOR-CMCI in the ME" indicator, if any, or a secured packet for a UE identified by SUPI.

1) 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 the SOR-CMCI in the ME" indicator was obtained, the HPLMN UDM shall include the "Store the SOR-CMCI in the ME" indicator;

NOTE 2b: 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]).

2) 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.

3) 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:

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, 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"; and

NOTE 3: 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.

- 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".

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

- 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; 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 steps 5 is skipped; and

4) If the selected PLMN is a VPLMN, the security check is not successful and 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 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.

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

NOTE 4: 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.

 If the present flow was invoked by the HPLMN UDM after receiving from the SOR-AF a new list of preferred PLMN/access technology combinations, SOR-CMCI, if any, or a secured packet for a UE identified by SUPI using an Nudm\_ParameterProvision\_Update request, and the HPLMN UDM verification of the UE acknowledgement is successful, 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, using Nsoraf\_SoR\_Info (SUPI of the UE, successful delivery); 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). 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

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

NOTE 6: 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.