**3GPP TSG-CT WG1 Meeting #132-eC1-21argd**

**E-meeting, 11-15 October 2021……………………………………………..(was C1-215837)**

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| *CR-Form-v12.1* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **23.122** | **CR** | **0809** | **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 | **X** | Radio Access Network |  | Core Network | **X** |

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| ***Title:*** | SOR-CMCI configuration for SOR security check failure | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Samsung | | | | | | | | | |
| ***Source to TSG:*** | C1 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | eCPSOR\_CON | | | | |  | ***Date:*** | | | 2021-09-30 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **B** |  | | | | | ***Release:*** | | | Rel-17 |
|  | *Use one of the following categories:* ***F*** *(correction)* ***A*** *(mirror corresponding to a change in an earlier release)* ***B*** *(addition of feature),* ***C*** *(functional modification of feature)* ***D*** *(editorial modification)*  Detailed explanations of the above categories can be 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)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | When SOR security check fails its assumed that the VPLMN is malicious. Further VPLMN can make the UE to remain in connected mode for long duration of time to increase its revenue, which is not desirable to HPLMN.  Thus its proposed that HPLMN can configure as to how long UE should remain in connected mode in the UE as part of SOR-CMCI configuration. | | | | | | | | |
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| ***Summary of change:*** | | Introduce new Tsor timer configuration for the case of SOR security check failure. | | | | | | | | |
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| ***Consequences if not approved:*** | | VPLMN may keep the UE in connected mode for long time which is not desirable to HPLMN. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | C.2, C.3, C.4.1, C.4.2, 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.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;

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:

i) if the steering of roaming information is received but the security check is not successful when the UE performs mobility registration in a VPLMN and the UE has a stored SOR-CMCI., the UE shall apply the actions in clause C.4. In this case current PLMN is considered 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]), 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.

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

## 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 and shall requests an acknowledgement from the UE as part of 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 has stored 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:

- if the UE UE has a stored SOR-CMCI, the current PLMN is considered as lowest priority and 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, 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.

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

### C.4.1 General

The HPLMN, based on operator policy, may provide the UE with SOR-CMCI to control the timing when the UE enters idle mode and perform higher priority PLMN /access technology selection. This is achieved by the HPLMN indicating to the UE the criteria for releasing specific PDU session(s) or services to enter idle mode.

NOTE 1: The released PDU sessions may be re-established by the application once the UE successfully registers on a higher priority PLMN. User interaction is required for some applications.

The HPLMN may configure the SOR-CMCI in the UE, and may also provide the SOR-CMCI to the UE over N1 NAS signalling. The SOR-CMCI received over N1 NAS signalling takes precedence over the SOR-CMCI configured in the UE.

NOTE 2: The SOR-CMCI received over N1 NAS signalling in the SOR information is either the SOR-CMCI in the USAT REFRESH with command qualifier of type "Steering of Roaming" (see 3GPP TS 31.111 [41]) which is received in a secured packet, or the SOR-CMCI received in plain text.

If the UE receives SOR information containing the list of preferred PLMN/access technology combinations without SOR-CMCI, or the ME receives USAT REFRESH with command qualifier (see 3GPP TS 31.111 [41]) of type "Steering of Roaming" without SOR-CMCI, or the security check of the received steering of roaming information is not successful as described in clause C.3 and clause C.4.3, then:

1) if the UE has SOR-CMCI stored in the non-volatile memory of the ME, the UE shall use the SOR-CMCI stored in the non-volatile memory of the ME; and

2) if the UE has no SOR-CMCI stored in the non-volatile memory of the ME, the UE shall use the SOR-CMCI stored in the USIM, if any.

The UE shall delete the stored SOR-CMCI, if any, in the non-volatile memory of the ME and store the received SOR-CMCI in the non-volatile memory of the ME when:

1) the ME receives SOR-CMCI in the USAT REFRESH with command qualifier (see 3GPP TS 31.111 [41]) of type "Steering of Roaming"; or

2) the UE receives the steering of roaming information containing the SOR-CMCI over N1 NAS signalling and the UE receives the "Store the SOR-CMCI in the ME" indicator;

The ME shall not delete the SOR-CMCI when the UE is switched off. The ME shall delete the SOR-CMCI when a new USIM is inserted.

SOR-CMCI consists of SOR-CMCI rules. Each SOR-CMCI rule consists of the following parameters:

i) a criterion of one of the following types:

- PDU session attribute type criterion;

- service type criterion;

- SOR security check criterion; or

- match all type criterion; and

ii) a value for Tsor-cm timer associated with each criterion presented in i) indicating the time the UE shall wait before releasing the PDU sessions or the services and entering idle mode.

SOR-CMCI contains zero, one or more SOR-CMCI rules with PDU session attribute type criterion, zero, one or more SOR-CMCI rules with service type criterion, and zero or one SOR-CMCI rule with match all type criterion.

PDU session attribute type criterion consists of one of the following:

a) DNN of the PDU session;

b) S-NSSAI STT of the PDU session; or

c) S-NSSAI SST and SD of the PDU session.

Service type criterion consists of one of the following:

a) IMS registration related signalling;

b) MMTEL voice call;

c) MMTEL video call; or

d) MO SMS over NAS or MO SMSoIP.

SOR security check criterion consists of:

a) SOR security check not successful.

Match all type criterion consists of:

a) match all.

Editor's note: How to specify handling of the match all criterion to make the lowest priority in the SOR-CMCI criteria is FFS.

If the SOR-CMCI received by the UE contains no SOR-CMCI rules, the UE shall act as if no SOR-CMCI is configured. Additionally, if the SOR-CMCI received by the UE also contains an indication to store the SOR-CMCI in the ME, the UE shall delete any configured SOR-CMCI in the ME.

If there are more than one criterion applicable for a PDU session (ex. a criterion for the PDU session and another one for the service) then the timer Tsor-cm with the highest value shall apply.

If there are more than one criterion applicable to different ongoing PDU sessions or services leading to multiple applicable Tsor-cm timers, then all the applicable Tsor-cm timers shall be started. Further handling of such cases is described in clause C.4.2.

If the value for Tsor-cm timer equals "infinity" then the UE shall wait until the PDU session is released or the service is stopped.

The timer Tsor-cm is applicable only if the UE is in automatic network selection mode.

Upon switching to the manual network selection mode, the UE shall stop any timer Tsor-cm, if running. In this case, the UE is not required to enter idle mode and perform the de-registration procedure.

The UE shall consider the following services as exempted from being forced to release the related established PDU session, if any, enter idle mode and perform high priority PLMN/Access technology selection. These services are known to the UE by default and the UE shall not follow the SOR-CMCI criteria even if configured to interrupt such services:

i) emergency services.

The UE configured with high priority access in the selected PLMN shall consider all services to be exempted from being forced to release or to release the related established PDU session, if any, enter idle mode and perform high priority PLMN/Access technology selection.

The user may configure the UE with a "user controlled list of services exempted from release due to SOR", consisting of one or more of the following:

i) MMTEL voice call;

ii) MMTEL video call; and

ii) SMS over NAS or SMSoIP.

If the UE has a configured "user controlled list of services exempted from release due to SOR" which is stored in the non-volatile memory of the ME, the "user controlled list of services exempted from release due to SOR" shall be deleted when a new USIM is inserted.

The UE shall set the value for Tsor-cm timer for all services included in the "user controlled list of services exempted from release due to SOR" to infinity.

Editor's Note: It is FFS how to ensure that the HPLMN can control if the UE can have a configured "user controlled list of services exempted from release due to SOR" and/or is aware that the UE has a configured "user controlled list of services exempted from release due to SOR", and/or the user is having a service that matches one of the services included in the "user controlled list of services exempted from release due to SOR" during SOR.

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

### C.4.2 Applying SOR-CMCI in the UE

During SOR procedure and while applying SOR-CMCI, the UE shall determine the time to release the PDU session(s) or the services as follows:

- If the UE has a configured "user controlled list of services exempted from release due to SOR" and a matching criterion is found for a service included in the "user controlled list of services exempted from release due to SOR", the UE shall set the Tsor-cm timer associated to the service to infinity and shall ignore the corresponding SOR-CMCI rules for this service;

- If one or more SOR-CMCI rules are included in SOR-CMCI, where for each criterion:

a) DNN of the PDU session:

the UE shall check whether it has a PDU session with a DNN matching to the DNN included in SOR-CMCI, and if any, the UE shall, if the timer value is not zero, start an associated timer Tsor-cm with the value included in the SOR-CMCI;

b) S-NSSAI SST of the PDU session:

the UE shall check whether it has a PDU session with a S-NSSAI SST matching the S-NSSAI SST included in SOR-CMCI, and if any, the UE shall, if the timer value is not zero, start an associated timer Tsor-cm with the value included in the SOR-CMCI;

b1) S-NSSAI SST and SD of the PDU session:

the UE shall check whether it has a PDU session with a S-NSSAI SST and SD matching the S-NSSAI SST and SD included in SOR-CMCI, and if any, the UE shall set the associated timer Tsor-cm to the value included in the SOR-CMCI;

c) IMS registration related signalling:

the UE shall check whether IMS registration related signalling is ongoing as specified in 3GPP TS 24.501 [64], and if it is ongoing, the UE shall, if the timer value is not zero, start an associated timer Tsor-cm with the value included in the SOR-CMCI;

d) MMTEL voice call:

the UE shall check whether MMTEL voice call is ongoing as specified in 3GPP TS 24.501 [64], and if it is ongoing, the UE shall, if the timer value is not zero, start an associated timer Tsor-cm with the value included in the SOR-CMCI;

e) MMTEL video call:

the UE shall check whether MMTEL video call is ongoing as specified in 3GPP TS 24.501 [64], and if it is ongoing, the UE shall, if the timer value is not zero, start an associated timer Tsor-cm with the value included in the SOR-CMCI;

f) MO SMS over NAS or MO SMSoIP:

the UE shall check whether MO SMS over NAS or MO SMSoIP services is ongoing as specified in TS 24.501 [64], and if it is ongoing, the UE shall, if the timer value is not zero, start an associated timer Tsor-cm with the value included in the SOR-CMCI;

g) SOR security check not successful:

the UE shall check whether the security check is not successful on the received steering of roaming information, the UE shall, if the timer value is not zero, start an associated timer Tsor-cm with the value included in the SOR-CMCI; or

g) match all:

the UE shall, if the timer value is not zero, start an associated timer Tsor-cm with the value included in the SOR-CMCI .

If the SOR-CMCI is available, and

- there is no SOR-CMCI rule (the contents of the SOR-CMCI are empty);

- there are one or more SOR-CMCI rules but there is no criterion matched with any ongoing PDU session or service; or

- there are one or more SOR-CMCI rules and there is one or more criteria matched with an ongoing PDU session or service, but the highest timer value associated with the matched criteria is equal to zero;

then there is no Tsor-cm timer started for the PDU session or service.

While one or more Tsor-cm timer(s) are running, the UE shall stop the running Tsor-cm timers(s).if timer Tsor-cm for "SOR security check not successful" is stopped or expired.

If last running Tsor-cm timer is stopped or expired except for Tsor-cm timer for "SOR security check not successful", the UE shall stop the Tsor-cm timer for "SOR security check not successful".

While one or more Tsor-cm timers are running, the UE shall check the newly established PDU session or service for a matching criterion in the SOR-CMCI:

- If the UE has a configured "user controlled list of services exempted from release due to SOR" and a matching criterion is found for a service included in the "user controlled list of services exempted from release due to SOR", the UE shall set the Tsor-cm timer associated to the service to infinity;

- If a matching criterion is found and the applicable Tsor-cm timer indicated the value "infinity" then the UE shall set the Tsor-cm timer associated to the PDU session or the service to infinity; or

- For all other cases, if a matching criterion is found then the UE shall set the Tsor-cm timer associated to the newly established PDU session, or service, with the exception that if the value of the Tsor-cm timer exceeds the highest value among the current values of all running Tsor-cm timers, then the value of the Tsor-cm timer for the new PDU session or service shall be set to the highest value among the current values of all running Tsor-cm timers.

NOTE 1: For newly established PDU session or service as described above, the timer is set irrespective of whether other ongoing PDU sessions or services that match the same criteria exist and for which corresponding Tsor-cm timers are running.

NOTE 2: NAS 5GMM layer will receive an explicit indication from the upper layers that a service is started or stopped. When a service is started, it is handled as a new service in the procedures described in this clause.

NOTE 3: While one or more Tsor-cm timers are running, the UE can trigger any 5GSM procedure or start new services.

While one or more Tsor-cm timers are running, upon receiving a new SOR-CMCI as described in annex C.4.3, the UE shall check if there is a matching criterion found for any ongoing PDU session or service in the new SOR-CMCI:

- if the UE has a configured "user controlled list of services exempted from release due to SOR" and a matching criterion is found for a service included in the "user controlled list of services exempted from release due to SOR", the UE shall set the Tsor-cm timer associated to the service to infinity;

- if a matching criterion is found and the value of Tsor-cm timer in the new SOR-CMCI indicates the value "infinity", then the Tsor-cm timer value for the associated PDU session or service shall be set to infinity;

- if a matching criterion is found and the value of Tsor-cm timer in the new SOR-CMCI is other than infinity and is smaller than the current value of the running Tsor-cm timer for the associated PDU session or service, then the Tsor-cm timer value for the associated PDU session or service shall be replaced with the value in the new SOR-CMCI without stopping and restarting the timer; or

- for all other cases, the running Tsor-cm timers for the associated PDU sessions or services are kept unchanged.

While one or more Tsor-cm timers are running, upon an update of the "user controlled list of services exempted from release due to SOR" by the user, the UE shall check if any ongoing service is included in the updated "user controlled list of services exempted from release due to SOR":

a) if an ongoing service is included in the updated "user controlled list of services exempted from release due to SOR", and the current value of the running Tsor-cm timer for the associated service is not infinity, then the Tsor-cm timer value for the associated service shall be set to infinity;

b) if no ongoing service is included in the updated "user controlled list of services exempted from release due to SOR", and the current value of the running Tsor-cm timer for the associated service was previously set to infinity, then the UE shall check if there is a matching criterion found in the SOR-CMCI:

1) if a matching criterion is found for the service in the SOR-CMCI, and the value of Tsor-cm timer in the SOR-CMCI is other than infinity and does not exceed the highest value of the current values of all running Tsor-cm timers, then the Tsor-cm timer value for the associated service shall be replaced with the value in the SOR-CMCI, without stopping and restarting the timer; or

2) if a matching criterion is not found for the service in the SOR-CMCI, then the Tsor-cm timer value for the associated service shall be set to zero; or

c) for all other cases, the running Tsor-cm timers for the associated services are kept unchanged.

The timer Tsor-cm shall be stopped when the associated PDU session is released or the associated service is stopped.

If the UE, while one or more Tsor-cm timers are running:

a) enters idle mode not due to lower layer failure (see 3GPP TS 24.501 [64]);

b) is not able to successfully recover the N1 NAS signalling connection (see 3GPP TS 24.501 [64]); or

c) enters 5GMM-CONNECTED mode with RRC inactive indication (see 3GPP TS 24.501 [64]);

then the UE shall stop the timer(s). In these cases, if:

a) 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

b) 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;

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.

NOTE 4: When the UE enters idle mode due to lower layer failure while one or more Tsor-cm timers are running, then the UE does not stop Tsor-cm timer(s) as recovery of NAS signalling connection is possible (see 3GPP TS 24.501 [64]).

When the UE determines that no Tsor-cm timer is running, the last running Tsor-cm timer is stopped due to release of the associated PDU sessions or stop of the associated services, or the last running Tsor-cm timer expires, 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;

then if the UE is in 5GMM-CONNECTED mode, the UE shall perform the deregistration procedure (see clause 4.2.2.3 of 3GPP TS 23.502 [63]) that releases all the established PDU sessions and services, if any, and once the UE enters idle mode it 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.

NOTE 5: The list of available and allowable PLMNs in the area is implementation specific.

The UE which has an emergency PDU session, receives a request from the upper layers to establish an emergency PDU session or perform emergency services fallback, registers for emergency services, or is configured for high priority access in the selected PLMN is not required to enter idle mode if the last running Tsor-cm timer for any PDU session or service stops or expires. In this case, the UE shall attempt to perform the PLMN selection after the emergency PDU session or the high priority service is released and after the UE enters idle mode or 5GMM-CONNECTED mode with RRC inactive indication (see 3GPP TS 24.501 [64]).

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

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

The stage-2 flow for providing UE with SOR-CMCI in HPLMN or VPLMN after registration is indicated in figure C.4.3.1, when the ME supports the SOR-CMCI. 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 without the list of preferred PLMN/access technology combinations. In this procedure, the SOR-CMCI is sent in plain text or 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.

The procedure is triggered:

- If the HPLMN UDM supports obtaining the parameters of 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 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 the SOR-CMCI for a UE identified by SUPI; or

- When the SOR-CMCI becomes available in the HPLMN 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 HPLMN UDM: Nudm\_ParameterProvision\_Update request is sent to the HPLMN 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 the SOR-CMCI in the 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 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. The HPLMN UDM:

- upon receiving the SOR-CMCI (in plain text), shall include the SOR-CMCI, the "Store the SOR-CMCI in the 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'; or

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

NOTE 1a: 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 2: 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 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', the UE shall perform a security check on the steering of roaming information included in the DL NAS TRANSPORT message to verify that the steering of roaming information is provided by HPLMN, and:

a) if the security check is successful, the 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".

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

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

- if the UE UE has a stored SOR-CMCI, the current PLMN is considered as lowest priority and 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, with an exception that the current PLMN is considered as lowest priority. If the selected PLMN is a VPLMN and the UE has an established emergency PDU session then the UE shall attempt to perform the PLMN selection after the emergency PDU session is released and after the UE enters idle mode or 5GMM-CONNECTED mode with RRC inactive indication (see 3GPP TS 24.501 [64]).

Step 5 is skipped;

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

5) The AMF to the 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 2, the UDM verifies that the acknowledgement is provided by the UE. The HPLMN UDM shall store the "ME support of SOR-CMCI" indicator.

If the present flow was invoked by the HPLMN UDM after receiving from the SOR-AF the SOR-CMCI 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 SOR-CMCI 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 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 SOR-CMCI to 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 and after the UE enters idle mode or 5GMM-CONNECTED mode with RRC inactive indication (see 3GPP TS 24.501 [64]).

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

\*\*\*\*\* End change \*\*\*\*\*