**3GPP TSG- Meeting #**

**, , 20-23 April 2020**

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| *CR-Form-v12.0* |
| **CHANGE REQUEST** |
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|  |  | **CR** | **2255** | **rev** | **-** | **Current version:** |  |  |
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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 | **x** | Core Network | **x** |

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| ***Title:***  |  |
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| ***Source to WG:*** | , Samsung |
| ***Source to TSG:*** | SA 2 |
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| ***Work item code:*** |  |  | ***Date:*** | 2020-04-09 |
|  |  |  |  |  |
| ***Category:*** |  |  | ***Release:*** |  |
|  | *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-12 (Release 12)**Rel-13 (Release 13)Rel-14 (Release 14)Rel-15 (Release 15)Rel-16 (Release 16)* |
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| ***Reason for change:*** | The format of the UE radio capability Information is RAT dependent (i.e. there is a 36.331 format and a 38.331 format) |
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| ***Summary of change:*** | The clause introduicing RACS is updated to take into account the different formats. |
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| ***Consequences if not approved:*** | RACS misoperation in PLMNs supporting RAN nodes and systems using both formats  |
|  |  |
| ***Clauses affected:*** | 5.4.4.1a; 6.2.21; 7.2.8; 7.2.18 |
|  |  |
|  | **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

#### 5.4.4.1a UE radio capability signalling optimisation (RACS)

With the increase of the size of UE radio capabilities driven e.g. by additional frequency bands and combinations thereof for E-UTRA and NR, an efficient approach to signal UE Radio Access Capability Information over the radio interface and other network interfaces is defined with RACS.

In this Release of the specification, RACS does not apply to NB-IOT.

RACS works by assigning an identifier to represent a set of UE radio capabilities. This identifier is called UE Radio Capability ID. A UE Radio Capability ID can be either UE manufacturer-assigned or PLMN-assigned, as specified in clause 5.9.10. The UE Radio Capability ID is an alternative to the signalling of the radio capabilities container over the radio interface, within NG-RAN, from NG-RAN to E-UTRAN, from AMF to NG-RAN and between CN nodes supporting RACS.

PLMN-assigned UE Radio Capability ID is assigned to the UE using the UE Configuration Update Command, or Registration Accept as defined in TS 23.502 [3]. The UCMF shall be configured with a Version ID for PLMN-assigned UE Radio Capability IDs, defined in clause 6.2.21.

The UCMF (UE radio Capability Management Function) stores all UE Radio Capability ID mappings in a PLMN and is responsible for assigning every PLMN-assigned UE Radio Capability ID in this PLMN, see clause 6.2.21. The UCMF stores the UE Radio Capability IDs alongside the UE Radio Capability information they map to. Each UE Radio Capability ID stored in the UCMF can be associated to one or both UE radio capabilities formats specified in TS 36.331 [51] and TS 38.331 [28]. The two UE radio capabilities formats shall be identifiable by the AMF and UCMF and the AMF shall store the TS 38.331 [28] format only.

An NG-RAN which supports RACS can be configured to operate with one of two modes of operation when providing the UE radio capabilities to the AMF when the NG-RAN executes a UE Radio Capability Enquiry procedure (see TS 38.331 [28]) to retrieve UE radio capabilities from the UE.

* Mode of operation A): The NG-RAN provides to the AMF both formats (i.e the TS 38.331 [28] format and TS 36.331 [51] format). The NG-RAN derives one of the formats using local transcoding of the other format it receives from the UE.
* Mode of operation B): The NG-RAN provides to the AMF the TS 38.331 [28] format only.

In a PLMN supporting RACS only in 5GS, Mode of Operation B shall be configured.

If the PLMN supports RACS in both EPS and 5GS:

* If RAN nodes in the EPS and 5GS are configured in Mode of operation B, then the UCMF shall be capable to transcode between TS 36.331 [51] and TS 38.331 [28] formats.
* If the NG-RAN is configured to operate according to Mode A, then also the E-UTRAN shall be configured to operate according to mode A and the UMCF is not required to transcode between TS 36.331 [51] and TS 38.331 [28] formats.

When the NG-RAN updates the AMF with new UE radio capabilities information, the AMF provides the information obtained from the NG-RAN to the UCMF even if the AMF already has a UE Radio Capability ID for that UE. The UCMF then returns a value of UE Radio Capability ID. If the value is different from the one stored in the AMF, the AMF updates the UE Radio Capability ID it stores and provides this new value to the NG-RAN (if applicable) and to the UE.

In order to be able to interpret the UE Radio Capability ID a Network Function or node may store a local copy of the mapping between the UE Radio Capability ID and its corresponding UE Radio Capability information i.e. a dictionary entry. When no mapping is available between a UE Radio Capability ID and the corresponding UE Radio Capability information in a Network Function or node, this Network Function or node shall be able to retrieve this mapping and store it.

- An AMF which supports RACS shall store such UE Radio Capability ID mapping at least for all the UEs that it serves that have a UE Radio Capability ID assigned.

- The NG-RAN performs local caching of the UE Radio Access Capabilities for the UE Radio Capability IDs for the UEs it is serving, and potentially for other UE Radio Capability IDs according to suitable local policies.

- When the NG-RAN needs to retrieve the mapping of a UE Radio Capability ID to the corresponding UE Radio Capability information, it queries the AMF using N2 signalling defined in TS 38.413 [34].

- When the AMF needs to obtain a PLMN-assigned UE Radio Capability ID for a UE from the UCMF, it provides the UE Radio Capability information it has for the current radio configuration of the UE and the IMEI/TAC for the UE. The AMF shall provide to the UCMF the UE Radio Capability information obtained from the NG-RAN in one or both the TS 36.331 [51] and TS 38.331 [28] formats depending on how the RAN is configured. The UCMF stores the association of this IMEI/TAC with this UE Radio Capability ID and the UE Radio Capability information in all the formats it receives. The UE Radio Capability information formats the AMF provides shall be identifiable at the UCMF.

- When the AMF needs to obtain the UE Radio Capability information associated to a UE Radio Capability ID it provides the UE Radio Capability ID to the UCMF with an indication that it is requesting the TS 38.331 [28] format, and the UCMF returns a mapping of the UE Radio Capability ID to the corresponding UE Radio Capability information in TS 38.331 [28] format to the AMF.

- UEs, AMFs and RAN nodes which support RACS learn the current value of the Version ID when a new PLMN-assigned UE Radio Capability ID is received from the UCMF and the Version ID it contains is different from the ones in their PLMN Assigned UE Radio Capability ID cache. PLMN-assigned UE Radio Capability IDs related to old values of the Version ID can be removed from cache with priority.

A network may utilise the PLMN-assigned UE Radio Capability ID, without involving the UE, e.g. for use with legacy UEs.

Mutual detection of the support of the RACS feature happens between NG-RAN nodes at Xn setup and between NG-RAN and AMF at N2 setup time. To allow for a mix of RACS-supporting and non-RACS-supporting RAN nodes over the Xn interfaces, the UE Radio Capability ID should be included in the Path Switch signalling during Xn based handover and Handover Request during N2 based handover between AMF and NG-RAN. In addition, RACS-supporting RAN nodes can be discovered across inter-CN node boundaries e.g. using the Configuration Transfer procedure. The support of RACS by peer AMFs or MMEs is based on configuration in a PLMN or across PLMNs.

A UE that supports WB-E-UTRA and/or NR indicates its support for RACS to AMF using UE MM Core Network Capability as defined in clause 5.4.4a.

A UE that supports RACS and stores an applicable UE Radio Capability ID for the current UE Radio Configuration in the PLMN, shall signal the UE Radio Capability ID in the Initial Registration procedure as defined in TS 23.502 [3]. If both PLMN-assigned for the current PLMN and UE manufacturer-assigned UE Radio Capability IDs are stored in the UE and applicable in the PLMN, the UE shall signal the PLMN-assigned UE Radio Capability ID in the Registration Request message.

When a PLMN decides to switch to request a particular type of UE to use UE manufacturer-assigned UE Radio Capability ID(s):

- The UCMF sends a Nucmf\_UECapabilityManagement\_Notify message to the AMF including either a list of UE Radio Capability IDs (if the UE was previously using any PLMN-assigned IDs) or the IMEI/TAC values corresponding to UE types that are requested to use UE manufacturer-assigned UE Radio Capability ID. These values are stored in a "UE Manufacturer Assigned operation requested list" in the AMF.

- The AMF uses the Registration Accept message or the UE Configuration Update command message to request the UE to delete all the PLMN-assigned UE Radio Capability ID(s) for this PLMN if the UE is, respectively, registering or is registered with PLMN-assigned ID or IMEI/TAC values matching one value in the "UE Manufacturer Assigned operation requested list".

NOTE 1: It is expected that in a given PLMN the UCMF and AMFs will be configured to either use a UE manufacturer-assigned operation requested list based on a list of PLMN-assigned UE Radio Capability IDs or a list of IMEI/TACs, but not both.

NOTE 2: The strategy for triggering of the deletion of PLMN-assigned UE Radio Capability ID(s) in the UE by the AMF is implementation-specific (e.g. can be used only towards UEs in CM\_Connected state).

- a UE that receives indication to delete all the PLMN-assigned UE Radio Capability IDs in the Registration Accept message, or UE Configuration Update command message, shall delete any PLMN-assigned UE Radio Capability IDs for this PLMN. The UE proceeds to register with a UE manufacturer-assigned UE Radio Capability ID that is applicable to the current UE Radio configuration.

- When the "UE Manufacturer Assigned operation requested list" contains PLMN-assigned UE Radio Capability IDs, the UCMF shall avoid re-assigning PLMN-assigned UE Radio Capability IDs that were added to the "UE Manufacturer Assigned operation requested list" in the AMFs to any UE.

- The AMF stores a PLMN-assigned ID in the "UE Manufacturer Assigned operation requested list" for a time duration that is implementation specific, but IMEI/TACs are stored until the UCMF require to remove certain TACs from the list (i.e. the list of IMEI/TACs which are requested to use UE manufacturer-assigned IDs in the AMF and UCMF is synchronised at all times).

- The UCMF can request at any time the AMF to remove PLMN-assigned ID(s) or IMEI/TAC(s) values from the UE manufacturer-assigned operation requested list.

NOTE 3: The AMF can decide to remove a UE Radio Capability ID from the "UE Manufacturer Assigned operation requested list" list e.g. because no UE with that UE Radio Capability ID has connected to the network for long time. If later a UE with such UE Radio Capability ID connects to the network, the AMF contacts the UCMF to resolve the UE Radio Capability ID, and at this point the UCMF can trigger again the deletion of the UE Radio Capability ID by including this in the "UE Manufacturer Assigned operation requested list" of the AMF.

The serving AMF stores the UE Radio Capability ID for a UE in the UE context and provides this UE Radio Capability ID to NG-RAN as part of the UE context information using N2 signalling. During inter PLMN mobility, the new AMF shall delete the UE Radio Capability ID received from the old AMF, unless the operator policy indicates that all UE Radio Capability IDs used in the old PLMN is also valid in the new PLMN.

The UE stores the PLMN-assigned UE Radio Capability ID in non-volatile memory when in RM-DEREGISTERED state and can use it again when it registers in the same PLMN.

NOTE 4: It is assumed that UE does not need to store the access stratum information (i.e. UE-E-UTRA-Capability and UE-NR-Capability specified in TS 36.331 [51] and TS 38.331 [28], respectively) that was indicated by the UE to the network when the PLMN-assigned UE Radio Capability ID was assigned by the network. However, it is assumed that the UE does store the related UE configuration (e.g. whether or not GERAN or UTRAN or MBMS is enabled/disabled).

At any given time at most one UE Radio Capability ID is stored in the UE context in CN and RAN.

The number of PLMN-assigned UE Radio Capability IDs that the UE stores in non-volatile memory is left up to UE implementation. However, to minimise the load (e.g. from radio signalling) on the Uu interface and to provide smoother inter-PLMN mobility (e.g. at land borders) the UE shall be able to store at least the latest 16 PLMN-assigned UE Radio Capability IDs (along with the PLMN that assigned them). This number is independent of the UE manufacturer-assigned UE Radio Capability ID(s) the UE may store.

It shall be possible for a UE to change, e.g. upon change in its usage settings, the set of UE Radio Capabilities in time and signal the associated UE Radio Capability ID, if available. The UE stores the mapping between the UE Radio Capability ID and the corresponding UE Radio Capability Information for every UE Radio Capability ID it stores.

If the UE's Radio Capability Information changes and there is no the associated UE Radio Capability ID for the updated Radio Capability, the UE shall perform capability update procedure as defined in clause 5.4.4.1.

The NG-RAN may apply RRC filtering of UE radio capabilities when it retrieves the UE Radio Capability Information from the UE as defined in TS 38.331 [28].

NOTE 5: In a RACS supporting PLMN, the filter of UE radio capabilities configured in NG-RAN is preferably as wide in scope as possible (e.g. PLMN-wide). In this case, it corresponds e.g. to the super-set of bands, band-combinations and RATs the PLMN deploys and not only to the specific NG-RAN node or region.

NOTE 6: If the filter of UE radio capabilities configured in two NG-RAN nodes is different, during handover between these two nodes, it is possible that the target NG-RAN node might need to enquire the UE for its UE Radio Capability Information again and trigger re-allocation of a PLMN-assigned UE Radio Capability ID leading to extra signalling. Additionally, a narrow filter might reduce the list of candidate target nodes.

If a UE supports both NB-IoT and other RATs that do support RACS (e.g. WB-E-UTRA and/or NR) then (since there is no support for RACS in NB-IoT) the UE handles the RACS procedures as follows:

- NB-IoT specific UE Radio Capability Information is handled in UE, NG-RAN and AMF according to clause 5.4.4.1 and in EPS according to TS 23.401 [26].

- when the UE is not camping on NB-IoT, the RAN provides UE radio capabilities for other RATs but not NB-IoT UE radio capabilities, according to TS 38.300 [27] and TS 36.300 [30]. As a result the UE Radio Capability ID that is assigned by the network corresponds only to the UE Radio Capabilities of the non-NB-IoT RATs. The UE uses the UE Radio Capability IDs assigned only in Mobility Registration Update procedures performed over non-NB-IoT RATs.

Support for RACS in EPS is defined in TS 23.401 [26].

More CHANGES

### 6.2.21 UE radio Capability Management Function (UCMF)

The UCMF is used for storage of dictionary entries corresponding to either PLMN-assigned or Manufacturer-assigned UE Radio Capability IDs. An AMF may subscribe with the UCMF to obtain from the UCMF new values of UE Radio Capability ID that the UCMF assigns for the purpose of caching them locally.

Provisioning of Manufacturer-assigned UE Radio Capability ID entries in the UCMF is performed from an AF that interacts with the UCMF either directly or via the NEF (or via Network Management) using a procedure defined in TS 23.502 [3]. A UCMF that serves both EPS and 5GS shall require provisioning the UE Radio Capability ID with the TS 36.331 [51] format or TS 38.331 [28] format or both the formats of the UE radio capabilities.

The UCMF also assigns the PLMN-assigned UE Radio Capability ID values.

Each PLMN-assigned UE Radio Capability ID is also associated to the TAC of the UE model(s) that it is related to. When an AMF requests the UCMF to assign a UE Radio Capability ID for a set of UE Radio Capabilities, it indicates the TAC of the UE that the UE Radio Capabilities are related to.

The UCMF stores a Version ID value for the PLMN assigned UE Radio Capability IDs so it is included in the PLMN assigned UE Radio Capability IDs it assigns. This shall be configured in the UCMF.

The UCMF may be provisioned with a dictionary of Manufacturer-assigned UE Radio Capability IDs which include a "Vendor ID" that applies to the Manufacturers of these UE, and a list of TACs for which the PLMN has obtained-Manufacturer-assigned UE Radio Capability IDs.

A PLMN-assigned UE Radio Capability IDs is kept in the UCMF storage as long as it is associated with at least a TAC value. When a TAC value is related to a UE model that is earmarked for operation based on Manufacturer assigned UE radio capability IDs, this TAC value is disassociated in the UCMF from any PLMN assigned UE Radio Capability IDs.

For the case that the PLMN is configured to store PLMN assigned IDs in the Manufacturer Assigned operation requested list defined in clause 5.11.3a 5.4.4.1a, the UCMF does not remove from storage any PLMN assigned UE radio Capability ID no longer used, and rather quarantines it to avoid any future reassignment.

More CHANGES

### 7.2.8 NEF Services

The following NF services are specified for NEF:

Table 7.2.8-1: NF Services provided by NEF

| Service Name | Description | Reference in TS 23.502 [3] |
| --- | --- | --- |
| Nnef\_EventExposure | Provides support for event exposure. | 5.2.6.2 |
| Nnef\_PFDManagement | Provides support for PFDs management. | 5.2.6.3 |
| Nnef\_ParameterProvision | Provides support to provision information which can be used for the UE in 5GS. | 5.2.6.4 |
| Nnef\_Trigger | Provides support for device triggering. | 5.2.6.5 |
| Nnef\_BDTPNegotiation | Provides support for background data transfer policy negotiation and optionally notification for the renegotiation. | 5.2.6.6 |
| Nnef\_TrafficInfluence | Provide the ability to influence traffic routing. | 5.2.6.7 |
| Nnef\_ChargeableParty | Requests to become the chargeable party for a data session for a UE. | 5.2.6.8 |
| Nnef\_AFsessionWithQoS | Requests the network to provide a specific QoS for an AS session. | 5.2.6.9 |
| Nnef\_MSISDN-less\_MO\_SMS | Used by the NEF to send MSISDN-less MO SM to the AF. | 5.2.6.10 |
| Nnef\_ServiceParameter | Provides support to provision service specific information. | 5.2.6.11 |
| Nnef\_APISupportCapability | Provides support for awareness on availability or expected level of a service API. | 5.2.6.12 |
| Nnef\_NIDDConfiguration | Used for configuring necessary information for data delivery via the NIDD API. | 5.2.6.13 |
| Nnef\_NIDD | Used for NEF anchored MO and MT unstructured data transport. | 5.2.6.14 |
| Nnef\_SMContext | Provides the capability to create, update or release the SMF-NEF Connection. | 5.2.6.15 |
| Nnef\_AnalyticsExposure | Provides support for exposure of network analytics. | 5.2.6.16 |
| Nnef\_UCMFProvisioning | Provides the ability to configure the UCMF with dictionary entries consisting of UE manufacturer-assigned UE Radio Capability IDs, the corresponding UE radio capabilities and the (list of) associated IMEI/TAC value(s) via the NEF. The UE radio capabilities the NEF provides for a UE radio Capability ID can be in TS 36.331 [51] format, TS 38.331 [28] format or both formats. Also used for deletion (e.g. as no longer used) or update (e.g. to add or remove a (list of) IMEI/TAC value(s) associated to an entry) of dictionary entries in the UCMF. | 5.2.6.17 |
| Nnef\_ECRestriction | Provides support for queuing status of enhanced coverage restriction, or enable/disable enhanced coverage restriction per individual UEs. | 5.2.6.18 |
| Nnef\_ApplyPolicy | Provides the capability to apply a previously negotiated Background Data Transfer Policy to a UE or a group of UEs. | 5.2.6.19 |
| Nnef\_Location | Provides the capability to deliver UE location to AF. | 5.2.6.21 |

More CHANGES

### 7.2.18 UCMF Services

The following NF services are specified for UCMF:

Table 7.2.18-1: NF Services provided by UCMF

| Service Name | Description | Reference in TS 23.502 [3] |
| --- | --- | --- |
| Nucmf\_Provisioning | Allows the NF consumer to provision a dictionary entry in the UCMF consisting of a Manufacturer-assigned UE Radio Capability ID and the corresponding UE radio capabilities and the (list of) associated IMEI/TAC value(s). The UE radio capabilities the NEF provides for a UE radio Capability ID can be in TS 36.331 [51] format, TS 38.331 [28] format or both formats. Also used for deletion (e.g. as no longer used) or update (e.g. to add or remove a (list of) IMEI/TAC value(s) associated to an entry) of dictionary entries in the UCMF. | 5.2.18.2 |
| Nucmf\_UECapabilityManagement | Allows the NF consumer to resolve UE Radio Capability ID (either Manufacturer-assigned or PLMN-assigned) into the corresponding UE radio capabilities. The consumer shall indicate whether it requests a TS 36.331 [51] format or a TS 38.331 [28] format to be provided.Allows the NF consumer to obtain a PLMN-assigned UE Radio Capability ID for a specific UE radio capabilities. The consumer shall indicate whether the UE radio capabilities sent to UCMF are in TS 36.331 [51] format, TS 38.331 [28], or both.Allows the NF consumer to subscribe or unsubscribe for notifications of UCMF dictionary entries.Allows the NF consumer to be notified about creation and deletion of UCMF dictionary entries. | 5.2.18.3 |

END OF CHANGES