**3GPP TSG-RAN WG2 Meeting #119 electronic *R2-22xxxxx***

**Online, 17th – 29th August, 2022**

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| *CR-Form-v12.2* | | | | | | | | |
| **CHANGE REQUEST** | | | | | | | | |
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|  | **38.300** | **CR** | **0549** | **rev** | **-** | **Current version:** | **17.1.0** |  |
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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 | **X** | Core Network |  |

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| ***Title:*** | Corrections to TS 38.300 for RAN Slicing | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Huawei, HiSilicon | | | | | | | | | |
| ***Source to TSG:*** | R2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_Slice-Core | | | | |  | ***Date:*** | | | 2022-08-26 |
|  |  | | | |  | |  | | |  |
| ***Category:*** | **F** |  | | | | | ***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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Currently, the RACH configuration selection should consider not only the RAN slicing, but also other features like SDT, RedCap and CE. Only if there is no RA resources associated with any of the features applicable to the current RA procedure, UE will apply the common RACH configuration not associated with any feature, as specified in TS 38.321.    However, as specified in the clause 16.3.3.1 of TS 38.300, from RAN slicing perspective, once there is no slice specific RACH configuration provided, UE shall use the common configuartion, which is conflict with current MAC procedure.  RAN2#119-e agreed to use "slice-based cell reselection" and "slice-based RACH" across the specifications.  Slicing related errors are corrected at RAN2#119:  In CR #0462 agreed at RAN2#118e, the sentence “It is assumed that the slice availability does not change within the UE’s registration area” was deleted (section 16.3.1). As the principle that slice support is homogeneous in the registration area remains unchanged in Rel-17 removing this sentence was incorrect. | | | | | | | | |
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| ***Summary of change:*** | | The following changes are made:   1. In section 16.3.31, remove “i.e., the UE uses the common RACH configuration” from “then the UE does not consider the NSAG for selecting the slice specific RACH configuration, i.e., the UE uses the common RACH configuration”. 2. In this specification, “slice specific/aware cell reselection” is changed into “slice-based cell reselection”, and “slice specific RACH” is changed into “slice-based RACH”. 3. The original sentence “It is assumed that the slice availability does not change within the UE registration area” is re-inserted to the specification, and reference to TS 23.501 is added.   **Impact analysis**  Impacted 5G architecture options:  Standalone NR  Impacted functionality:  Slice-based cell reselection, slice-based random access  Inter-operability:  **For all changes:**  If NW implements according to this CR but UE does not, there is no inter-operability issue.  If UE implements according to this CR but NW does not, there is no inter-operability issue. | | | | | | | | |
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| ***Consequences if not approved:*** | | There are some conflicts with current RACH procedure as specified in TS 38.321, and she descriptions on slice-based cell reselection and slice-based random access are not aligned across specifications.  RAN Stage 2 specification for RAN slicing is not complete and not aligned with other specifications. | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 7.3.1, 8.2, 9.2.1.2, 16.3.1, 16.3.3.1, 16.3.3a | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | |  | **X** | Other core specifications | | | |  | | |
| ***affected:*** | |  | **X** | Test specifications | | | |  | | |
| ***(show related CRs)*** | |  | **X** | O&M Specifications | | | |  | | |
|  | |  | | | | | | | | |
| ***Other comments:*** | |  | | | | | | | | |
|  | |  | | | | | | | | |
| ***This CR's revision history:*** | |  | | | | | | | | |

## 7.3 System Information Handling

### 7.3.1 Overview

System Information (SI) consists of a MIB and a number of SIBs, which are divided into Minimum SI and Other SI:

- **Minimum SI** comprises basic information required for initial access and information for acquiring any other SI. Minimum SI consists of:

- *MIB* contains cell barred status information and essential physical layer information of the cell required to receive further system information, e.g. CORESET#0 configuration. *MIB* is periodically broadcast on BCH.

- *SIB1* defines the scheduling of other system information blocks and contains information required for initial access. SIB1 is also referred to as Remaining Minimum SI (RMSI) and is periodically broadcast on DL-SCH or sent in a dedicated manner on DL-SCH to UEs in RRC\_CONNECTED.

- **Other SI** encompasses all SIBs not broadcast in the Minimum SI. Those SIBs can either be periodically broadcast on DL-SCH, broadcast on-demand on DL-SCH (i.e. upon request from UEs in RRC\_IDLE, RRC\_INACTIVE, or RRC\_CONNECTED), or sent in a dedicated manner on DL-SCH to UEs in RRC\_CONNECTED (i.e., upon request, if configured by the network, from UEs in RRC\_CONNECTED or when the UE has an active BWP with no common search space configured or when the UE configured with inter cell beam management is receiving DL-SCH from a TRP with PCI different from serving cell's PCI). Other SI consists of:

- *SIB2* contains cell re-selection information, mainly related to the serving cell;

- *SIB3* contains information about the serving frequency and intra-frequency neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);

- *SIB4* contains information about other NR frequencies and inter-frequency neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters), which can also be used for NR idle/inactive measurements;

- *SIB5* contains information about E-UTRA frequencies and E-UTRA neighbouring cells relevant for cell re-selection (including cell re-selection parameters common for a frequency as well as cell specific re-selection parameters);

- *SIB6* contains an ETWS primary notification;

- *SIB7* contains an ETWS secondary notification;

- *SIB8* contains a CMAS warning notification;

- *SIB9* contains information related to GPS time and Coordinated Universal Time (UTC);

- *SIB10* contains the Human-Readable Network Names (HRNN) of the NPNs listed in SIB1;

- *SIB11* contains information related to idle/inactive measurements;

- *SIB15* contains information related to disaster roaming;

*- SIB16* contains slice-based cell reselection information;

- *SIB17* contains information related to TRS configuration for UEs in RRC\_IDLE/RRC\_INACTIVE;

- *SIBpos* contains positioning assistance data as defined in TS 37.355 [43] and TS 38.331 [12];

- *SIB18* contains information related to the Group IDs for Network selection (GINs) associated with SNPNs listed in SIB1.

*<Next modification>*

## 8.2 Network Identities

The following identities are used in NG-RAN for identifying a specific network entity:

- AMF Name: used to identify an AMF.

- NR Cell Global Identifier (NCGI): used to identify NR cells globally. The NCGI is constructed from the PLMN identity the cell belongs to and the NR Cell Identity (NCI) of the cell. The PLMN ID included in the NCGI should be the first PLMN ID within the set of PLMN IDs associated to the NR Cell Identity in SIB1, following the order of broadcast.

NOTE 1: How to manage the scenario where a different PLMN ID has been allocated by the operator for an NCGI is left to OAM and/or implementation.

- gNB Identifier (gNB ID): used to identify gNBs within a PLMN. The gNB ID is contained within the NCI of its cells.

- Global gNB ID: used to identify gNBs globally. The Global gNB ID is constructed from the PLMN identity the gNB belongs to and the gNB ID. The MCC and MNC are the same as included in the NCGI.

NOTE 2: It is not precluded that a cell served by a gNB does not broadcast the PLMN ID included in the Global gNB ID.

- Tracking Area identity (TAI): used to identify tracking areas. The TAI is constructed from the PLMN identity the tracking area belongs to and the TAC (Tracking Area Code) of the Tracking Area.

- Single Network Slice Selection Assistance information (S-NSSAI): identifies a network slice.

- Network Slice AS Group (NSAG): identifies a slice or a set of slices. An NSAG is defined within a TA, used for slice-based cell reselection and/or slice-based RACH configuration.

- Network Identifier (NID): identifies an SNPN in combination with a PLMN ID.

- Closed Access Group Identifier: identifies a CAG within a PLMN.

- Local NG-RAN Node Identifier: used as reference to the NG-RAN node in the I-RNTI.

*<Next modification>*

#### 9.2.1.2 Cell Reselection

A UE in RRC\_IDLE performs cell reselection. The principles of the procedure are the following:

- Cell reselection is always based on CD-SSBs located on the synchronization raster (see clause 5.2.4).

- The UE makes measurements of attributes of the serving and neighbour cells to enable the reselection process:

- For the search and measurement of inter-frequency neighbouring cells, only the carrier frequencies need to be indicated.

- Cell reselection identifies the cell that the UE should camp on. It is based on cell reselection criteria which involves measurements of the serving and neighbour cells:

- Intra-frequency reselection is based on ranking of cells;

- Inter-frequency reselection is based on absolute priorities where a UE tries to camp on the highest priority frequency available;

- An NCL can be provided by the serving cell to handle specific cases for intra- and inter-frequency neighbouring cells;

- Exclude-lists can be provided to prevent the UE from reselecting to specific intra- and inter-frequency neighbouring cells;

- Allow-lists can be provided to request the UE to reselect to only specific intra- and inter-frequency neighbouring cells;

- Cell reselection can be speed dependent;

- Service specific prioritisation;

- Slice-based cell reselection information can be provided to facilitate the UE to reselect a cell that supports specific slices.

In multi-beam operations, the cell quality is derived amongst the beams corresponding to the same cell (see clause 9.2.4).

*<Next modification>*

## 16.3 Network Slicing

### 16.3.1 General Principles and Requirements

In this clause, the general principles and requirements related to the realization of network slicing in the NG-RAN for NR connected to 5GC and for E-UTRA connected to 5GC are given.

A network slice always consists of a RAN part and a CN part. The support of network slicing relies on the principle that traffic for different slices is handled by different PDU sessions. Network can realise the different network slices by scheduling and also by providing different L1/L2 configurations.

Each network slice is uniquely identified by a S-NSSAI, as defined in TS 23.501 [3]. NSSAI (Network Slice Selection Assistance Information) includes one or a list of S-NSSAIs (Single NSSAI) where a S-NSSAI is a combination of:

- mandatory SST (Slice/Service Type) field, which identifies the slice type and consists of 8 bits (with range is 0-255);

- optional SD (Slice Differentiator) field, which differentiates among Slices with same SST field and consist of 24 bits.

The list includes at most 8 S-NSSAI(s).

The UE provides NSSAI (Network Slice Selection Assistance Information) for network slice selection in *RRCSetupComplete*, if it has been provided by NAS (see clause 9.2.1.3). While the network can support large number of slices (hundreds), the UE need not support more than 8 slices simultaneously. A BL UE or a NB-IoT UE supports a maximum of 8 slices simultaneously.

Network Slicing is a concept to allow differentiated treatment depending on each customer requirements. With slicing, it is possible for Mobile Network Operators (MNO) to consider customers as belonging to different tenant types with each having different service requirements that govern in terms of what slice types each tenant is eligible to use based on Service Level Agreement (SLA) and subscriptions.

The following key principles apply for support of Network Slicing in NG-RAN:

**RAN awareness of slices**

- NG-RAN supports a differentiated handling of traffic for different network slices which have been pre-configured. How NG-RAN supports the slice enabling in terms of NG-RAN functions (i.e. the set of network functions that comprise each slice) is implementation dependent.

**Selection of RAN part of the network slice**

- NG-RAN supports the selection of the RAN part of the network slice, by NSSAI provided by the UE or the 5GC which unambiguously identifies one or more of the pre-configured network slices in the PLMN.

**Resource management between slices**

- NG-RAN supports policy enforcement between slices as per service level agreements. It should be possible for a single NG-RAN node to support multiple slices. The NG-RAN should be free to apply the best RRM policy for the SLA in place to each supported slice.

**Support of QoS**

- NG-RAN supports QoS differentiation within a slice, and per Slice-Maximum Bit Rate may be enforced per UE, if feasible. How NG-RAN enables UE-Slice-MBR enforcement and rate limitation (see TS 23.501 [3]) is up to network implementation.

**RAN selection of CN entity**

- For initial attach, the UE may provide NSSAI to support the selection of an AMF. If available, NG-RAN uses this information for routing the initial NAS to an AMF. If the NG-RAN is unable to select an AMF using this information or the UE does not provide any such information the NG-RAN sends the NAS signalling to one of the default AMFs.

- For subsequent accesses, the UE provides a Temp ID, which is assigned to the UE by the 5GC, to enable the NG-RAN to route the NAS message to the appropriate AMF as long as the Temp ID is valid (NG-RAN is aware of and can reach the AMF which is associated with the Temp ID). Otherwise, the methods for initial attach applies.

**Resource isolation between slices**

- The NG-RAN supports resource isolation between slices. NG-RAN resource isolation may be achieved by means of RRM policies and protection mechanisms that should avoid that shortage of shared resources in one slice breaks the service level agreement for another slice. It should be possible to fully dedicate NG-RAN resources to a certain slice. Some RACH resources can be associated to specific NSAG(s). Other aspects how NG-RAN supports resource isolation is implementation dependent.

**Access control**

- By means of the unified access control (see clause 7.4), operator-defined access categories can be used to enable differentiated handling for different slices. NG-RAN may broadcast barring control information (i.e. a list of barring parameters associated with operator-defined access categories) to minimize the impact of congested slices.

**Slice Availability**

- Some slices may be available only in part of the network. The NG-RAN supported S-NSSAI(s) is configured by OAM. Awareness in the NG-RAN of the slices supported in the cells of its neighbours may be beneficial for inter-frequency mobility in connected mode. It is assumed that the slice availability does not change within the UE’s registration area (see TS 23.501 [3]).

- The NG-RAN and the 5GC are responsible to handle a service request for a slice that may or may not be available in a given area. Admission or rejection of access to a slice may depend by factors such as support for the slice, availability of resources, support of the requested service by NG-RAN.

**Support for UE associating with multiple network slices simultaneously**

- In case a UE is associated with multiple slices simultaneously, only one signalling connection is maintained and for intra-frequency cell reselection, the UE always tries to camp on the best cell. For inter-frequency cell reselection, dedicated priorities can be used to control the frequency on which the UE camps.

**Granularity of slice awareness**

- Slice awareness in NG-RAN is introduced at PDU session level, by indicating the S-NSSAI corresponding to the PDU Session, in all signalling containing PDU session resource information.

**Validation of the UE rights to access a network slice**

- It is the responsibility of the 5GC to validate that the UE has the rights to access a network slice. Prior to receiving the Initial Context Setup Request message, the NG-RAN may be allowed to apply some provisional/local policies, based on awareness of which slice the UE is requesting access to. During the initial context setup, the NG-RAN is informed of the slice for which resources are being requested.

### 16.3.2 AMF and NW Slice Selection

#### 16.3.2.1 CN-RAN interaction and internal RAN aspects

NG-RAN selects AMF based on a Temp ID or NSSAI provided by the UE over RRC as specified in TS 38.410 [16]. The mechanisms used in the RRC protocol are described in the next clause.

Table 16.3.2.1-1 AMF selection based on Temp ID and NSSAI

|  |  |  |
| --- | --- | --- |
| Temp ID | NSSAI | AMF Selection by NG-RAN |
| not available or invalid | not available | One of the default AMFs is selected (NOTE) |
| not available or invalid | present | Selects AMF which supports UE requested slices |
| valid | not available, or present | Selects AMF per CN identity information in Temp ID |
| NOTE: The set of default AMFs is configured in the NG-RAN nodes via OAM. | | |

#### 16.3.2.2 Radio Interface Aspects

When triggered by the upper layer, the UE conveys the NSSAI over RRC in the format explicitly indicated by the upper layer.

### 16.3.3 Resource Isolation and Management

#### 16.3.3.1 General

Resource isolation enables specialized customization and avoids one slice affecting another slice.

Hardware/software resource isolation is up to implementation. Each slice may be assigned with either shared, prioritized or dedicated radio resource up to RRM implementation and SLA as in TS 28.541 [49].

To enable differentiated handling of traffic for network slices with different SLA:

- NG-RAN is configured with a set of different configurations for different network slices by OAM;

- To select the appropriate configuration for the traffic for each network slice, NG-RAN receives relevant information indicating which of the configurations applies for this specific network slice.

Slice-based RACH configuration for RA isolation and prioritization can be included in SIB1 messages. The slice-based RACH configurations are associated to specific NSAG(s), and if not provided for a NSAG that UE considers for selecting the RACH configuration, then the UE does not consider the NSAG for selecting the slice-based RACH configuration. In the UE, NAS provides the NSAG to be considered during RA to AS.

#### 16.3.3.2 Handling of Slice Resources

The NG-RAN node may use Multi-Carrier Resource Sharing or Resource Repartitioning to allocate resources to a slice during the procedures described in 16.3.4 to support the slice service continuity in case of slice resources shortage.

In Multi-Carrier Resource Sharing the RAN node can setup the dual connectivity or carrier aggregation with different frequency and overlapping coverage where the same slice is available.

The Resource Repartitioning allows a slice to use resources from the shared pool or/and prioritized pool when its own dedicated or prioritized resources are not available and the use of unused resources in the prioritized pool is as specified in TS 28.541 [49].

Slice RRM policies/restrictions associated with Resource Repartitioning are configured from O&M.

Measurements of RRM policy utilization according to resource types defined in TS 28.541 [49] are reported from RAN nodes to O&M and may lead O&M to update the configuration of the Slice RRM policies/restrictions.

### 16.3.3a Slice-based cell reselection

Slice-based cell reselection information can be included in SIB16 and in *RRCRelease* messages. The slice-based cell reselection information may include reselection priorities per NSAG per frequency and corresponding list(s) of cells where the slices of the NSAG are supported or not supported. In the UE, NAS provides the NSAG(s) and their priorities to be considered during cell reselection.

When a UE supports slice aware cell reselection, and when slice-based cell reselection information is provided to the UE, then the UE uses the slice-based cell reselection information. Valid cell reselection information provided in *RRCRelease* always has a priority over cell reselection information provided in SIB messages. When no slice-based reselection information is provided for any NSAG that UE AS received from NAS to be considered during cell reselection, then the UE uses the general cell reselection information, i.e., without considering the NSAG(s) and their priorities.