**3GPP TSG-RAN WG2 Meeting #116bis Electronic *R2-2203588***

21 February – 03 March 2022 R2-2203069

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| *CR-Form-v12.2* | | | | | | | | |
| CHANGE REQUEST | | | | | | | | |
|  | | | | | | | | |
|  | **38.300** | **CR** | **0413** | **rev** | **1** | **Current version:** | **16.8.0** |  |
|  | | | | | | | | |
| *For* [***HELP***](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:*** | RAN enhancements in the support of slicing | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell | | | | | | | | | |
| ***Source to TSG:*** | RAN2 | | | | | | | | | |
|  |  | | | | | | | | | |
| ***Work item code:*** | NR\_Slice-Core | | | | |  | ***Date:*** | | | 2022-03-10 |
|  |  | | | |  | |  | | |  |
| ***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-16 (Release 16) Rel-17 (Release 17) Rel-18 (Release 18) Rel-19 (Release 19)* | |
|  |  | | | | | | | | | |
| ***Reason for change:*** | | Introduction of enhancements in slicing support in RAN, see RP-212534 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Summary of change:*** | | 1) Introduction of slice specific cell reselection in 9.2.1.2, and 16.3.X  2) Introduction of the support of Slice-Maximum Bit Rate in 16.3.1  3) Introduction of slice specific RACH resources in 16.3.1, and 16.3.3 | | | | | | | | |
|  | |  | | | | | | | | |
| ***Consequences if not approved:*** | | Rel-17 slicing enhancments in RAN are not supported | | | | | | | | |
|  | |  | | | | | | | | |
| ***Clauses affected:*** | | 9.2.1.2, 16.3.1, 16.3.3, 16.3.X (New Clause to be added between 16.3.3 and 16.3.4) | | | | | | | | |
|  | |  | | | | | | | | |
|  | | **Y** | **N** |  | | | |  | | |
| ***Other specs*** | | **X** |  | Other core specifications | | | | TS 38.304 CR 0235  TS 38.306 CR in R2-2204029  TS 38.331 CR 2921  TS 38.331 CR in R2-2204028 | | |
| ***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 Modified Subclause*

#### 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;

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

- White 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 specific 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 Modified Subclause*

## 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 slice(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.

- 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.

*Next Modified Subclause*

### 16.3.3 Resource Isolation and Management

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 or dedicated radio resource up to RRM implementation and SLA.

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 specific RACH configuration for RA isolation and prioritization can be included in SIB1 messages. The slice specific RACH configurations are associated to specific slice groups, and if not provided for a slice or slice group that UE considers for selecting the RACH configuration, then the UE does not consider the slice(s) for selecting the slice specific RACH configuration, i.e., the UE uses the common RACH configuration. In the UE, NAS provides the slice group(s) to be considered during RA to AS.

Editor's Note: Details of slice grouping and how it is provided to the UE are FFS, depends on SA2.

*New Subclause (to be added between 16.3.3 and 16.3.4)*

### 16.3.X Slice aware cell reselection

Slice specific cell reselection information can be included in SIB messages and in *RRCRelease* message. The slice specific cell reselection information provides information about the frequencies where slice group(s) are supported. It may include reselection priorities per slice group per frequency and corresponding list(s) of cells where the slice group(s) are supported or not supported. In the UE, NAS provides the slice(s) or slice group(s) and their priorities to be considered during cell reselection.

When a UE supports slice aware cell reselection, and when slice specific cell reselection information is provided to the UE, then the UE uses the slice specific 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 specific reselection information is provided for any slice or slice group 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 slice priorities.

Editor's Note: Details of slice grouping and how it is provided to the UE are FFS, depends on SA2.

*End of Changes*