**3GPP TSG-RAN WG2 Meeting #118 Electronic *R2-2205491***

**09 – 20 May 2022**

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| *CR-Form-v12.2* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **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 | **X** | Radio Access Network | **X** | Core Network |  |

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| ***Title:***  | Updates for RAN Slicing from RAN2#118 |
|  |  |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell,  |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** | NR\_Slice-Core |  | ***Date:*** | 2022-05 |
|  |  |  |  |  |
| ***Category:*** | ***C*** |  | ***Release:*** | 17 |
|  | *Use one of the following categories:****F*** *(correction)****A*** *(mirror corresponding to a change in an earlier release)****B*** *(addition of feature),* ***C*** *(functional modification of feature)****D*** *(editorial modification)*Detailed explanations of the above categories canbe found in 3GPP [TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm). | *Use one of the following releases:Rel-8 (Release 8)Rel-9 (Release 9)Rel-10 (Release 10)Rel-11 (Release 11)…Rel-15 (Release 15)Rel-16 (Release 16)Rel-17 (Release 17)Rel-18 (Release 18)Rel-19 (Release 19)* |
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| ***Reason for change:*** | 1. At SA2#150e SA2 agreed in the concept of slice groups (NSAG) to be used for slice aware cell reselection and for slice specific RA configuration (see CR3539 and CR3317 for TS 23.501). 38.300 should be aligned with SA2 agreements.
2. The description of SIB16, which carries the slice specific cell reselection information, is missing from 38.300.
3. There are some minor wording issues that should be corrected.
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| ***Summary of change:*** | The following changes are proposed:1. NSAG abbreviation is introduced and its use is clarified (slice or slice group is changed everywhere to NSAG). The slice group related Editor's Notes are removed.
2. Description of SIB16 is introduced
3. Minor wording corrections.
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| ***Consequences if not approved:*** | RAN Stage 2 specification for RAN slicing is not complete and not aligned with SA2 specifications |
|  |  |
| ***Clauses affected:*** | 3.1, 7.3.1, 8.2, 16.3.1, 16.3.3.1, 16.3.3a |
|  |  |
|  | **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 ...  |
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| ***Other comments:*** |  |
|  |  |
| ***This CR's revision history:*** | This CR includes the changes agreed from R2-2205077, R2-2205492, and R2-2205975. |

*First Modified Subclause*

## 3.1 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1], in TS 36.300 [2] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1] and TS 36.300 [2].

5GC 5G Core Network

5GS 5G System

5QI 5G QoS Identifier

A-CSI Aperiodic CSI

AKA Authentication and Key Agreement

AMBR Aggregate Maximum Bit Rate

AMC Adaptive Modulation and Coding

AMF Access and Mobility Management Function

ARP Allocation and Retention Priority

BA Bandwidth Adaptation

BCCH Broadcast Control Channel

BCH Broadcast Channel

BFD Beam Failure Detection

BH Backhaul

BL Bandwidth reduced Low complexity

BPSK Binary Phase Shift Keying

C-RNTI Cell RNTI

CAG Closed Access Group

CAPC Channel Access Priority Class

CBRA Contention Based Random Access

CCE Control Channel Element

CD-SSB Cell Defining SSB

CFRA Contention Free Random Access

CG Configured Grant

CHO Conditional Handover

CIoT Cellular Internet of Things

CLI Cross Link interference

CMAS Commercial Mobile Alert Service

CORESET Control Resource Set

CP Cyclic Prefix

CPC Conditional PSCell Change

DAG Directed Acyclic Graph

DAPS Dual Active Protocol Stack

DFT Discrete Fourier Transform

DCI Downlink Control Information

DCP DCI with CRC scrambled by PS-RNTI

DL-AoD Downlink Angle-of-Departure

DL-SCH Downlink Shared Channel

DL-TDOA Downlink Time Difference Of Arrival

DMRS Demodulation Reference Signal

DRX Discontinuous Reception

E-CID Enhanced Cell-ID (positioning method)

EHC Ethernet Header Compression

ETWS Earthquake and Tsunami Warning System

FS Feature Set

FSA ID Frequency Selection Area Identity

G-CS-RNTI Group Configured Scheduling RNTI

G-RNTI Group RNTI

GFBR Guaranteed Flow Bit Rate

GIN Group ID for Network selection

GSO Geosynchronous Orbit

H-SFN Hyper System Frame Number

HAPS High Altitude Platform Station

HRNN Human-Readable Network Name

IAB Integrated Access and Backhaul

IFRI Intra Frequency Reselection Indication

I-RNTI Inactive RNTI

INT-RNTI Interruption RNTI

KPAS Korean Public Alarm System

L2 Layer-2

L3 Layer-3

LDPC Low Density Parity Check

LEO Low Earth Orbit

MBS Multicast/Broadcast Services

MCE Measurement Collection Entity

MCCH MBS Control Channel

MDBV Maximum Data Burst Volume

MEO Medium Earth Orbit

MIB Master Information Block

MICO Mobile Initiated Connection Only

MFBR Maximum Flow Bit Rate

MMTEL Multimedia telephony

MNO Mobile Network Operator

MPE Maximum Permissible Exposure

MRB MBS Radio Bearer

MT Mobile Termination

MTCH MBS Traffic Channel

MTSI Multimedia Telephony Service for IMS

MU-MIMO Multi User MIMO

Multi-RTT Multi-Round Trip Time

MUSIM Multi-Universal Subscriber Identity Module

NB-IoT Narrow Band Internet of Things

NCD-SSB Non Cell Defining SSB

NCGI NR Cell Global Identifier

NCR Neighbour Cell Relation

NCRT Neighbour Cell Relation Table

NGAP NG Application Protocol

NGSO Non-Geosynchronous Orbit

NID Network Identifier

NPN Non-Public Network

NR NR Radio Access

NSAG Network Slice AS Group

NTN Non-Terrestrial Network

P-MPR Power Management Maximum Power Reduction

P-RNTI Paging RNTI

PCH Paging Channel

PCI Physical Cell Identifier

PDC Propagation Delay Compensation

PDCCH Physical Downlink Control Channel

PDSCH Physical Downlink Shared Channel

PEI Paging Early Indication

PH Paging Hyperframe

PLMN Public Land Mobile Network

PNI-NPN Public Network Integrated NPN

PO Paging Occasion

PRACH Physical Random Access Channel

PRB Physical Resource Block

PRG Precoding Resource block Group

PRS Positioning Reference Signal

PS-RNTI Power Saving RNTI

PSS Primary Synchronisation Signal

PTM Point to Multipoint

PTP Point to Point

PTW Paging Time Window

PUCCH Physical Uplink Control Channel

PUSCH Physical Uplink Shared Channel

PWS Public Warning System

QAM Quadrature Amplitude Modulation

QFI QoS Flow ID

QMC QoE Measurement Collection

QoE Quality of Experience

QPSK Quadrature Phase Shift Keying

RA Random Access

RA-RNTI Random Access RNTI

RACH Random Access Channel

RANAC RAN-based Notification Area Code

REG Resource Element Group

RIM Remote Interference Management

RLM Radio Link Monitoring

RMSI Remaining Minimum SI

RNA RAN-based Notification Area

RNAU RAN-based Notification Area Update

RNTI Radio Network Temporary Identifier

RQA Reflective QoS Attribute

RQoS Reflective Quality of Service

RS Reference Signal

RSRP Reference Signal Received Power

RSRQ Reference Signal Received Quality

RSSI Received Signal Strength Indicator

RSTD Reference Signal Time Difference

RTT Round Trip Time

SCS SubCarrier Spacing

SD Slice Differentiator

SDAP Service Data Adaptation Protocol

SDT Small Data Transmission

SFI-RNTI Slot Format Indication RNTI

SIB System Information Block

SI-RNTI System Information RNTI

SLA Service Level Agreement

SMC Security Mode Command

SMF Session Management Function

S-NSSAI Single Network Slice Selection Assistance Information

SNPN Stand-alone Non-Public Network

SNPN ID Stand-alone Non-Public Network Identity

SPS Semi-Persistent Scheduling

SR Scheduling Request

SRAP Sidelink Relay Adaptation Protocol

SRS Sounding Reference Signal

SRVCC Single Radio Voice Call Continuity

SS Synchronization Signal

SSB SS/PBCH block

SSS Secondary Synchronisation Signal

SST Slice/Service Type

SU-MIMO Single User MIMO

SUL Supplementary Uplink

TA Timing Advance

TB Transport Block

TCE Trace Collection Entity

TNL Transport Network Layer

TPC Transmit Power Control

TRP Transmit/Receive Point

TRS CSI-RS for Tracking

U2N UE-to-Network

UCI Uplink Control Information

UDC Uplink Data Compression

UE-Slice-MBR UE Slice Maximum Bit Rate

UL-AoA Uplink Angles of Arrival

UL-RTOA Uplink Relative Time of Arrival

UL-SCH Uplink Shared Channel

UPF User Plane Function

URLLC Ultra-Reliable and Low Latency Communications

VR Virtual Reality

V2X Vehicle-to-Everything

Xn-C Xn-Control plane

Xn-U Xn-User plane

XnAP Xn Application Protocol

*Next Modified Subclause*

### 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 specific 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.

For sidelink, Other SI also includes:

- *SIB12* contains information related to NR sidelink communication;

- *SIB13* contains information related to *SystemInformationBlockType21* for V2X sidelink communication as specified in TS 36.331 clause 5.2.2.28 [29];

- *SIB14* contains information related to *SystemInformationBlockType26* for V2X sidelink communication as specified in TS 36.331 clause 5.2.2.33 [29].

For non-terrestrial network, Other SI also includes:

- *SIB19* contains NTN-specific parameters for serving cell and/or neighbour cells as defined in TS 38.331 [12].

For MBS broadcast, Other SI also includes:

- *SIB20* contains of MCCH configuration;

- *SIB21* contains information related to service continuity for MBS broadcast reception.

Figure 7.3.1-1 below summarises System Information provisioning.



Figure 7.3.1-1: System Information Provisioning

For a cell/frequency that is considered for camping by the UE, the UE is not required to acquire the contents of the minimum SI of that cell/frequency from another cell/frequency layer. This does not preclude the case that the UE applies stored SI from previously visited cell(s).

If the UE cannot determine the full contents of the minimum SI of a cell by receiving from that cell, the UE shall consider that cell as barred.

In case of BA, the UE only acquires SI on the active BWP.

If the UE is configured with inter cell beam management:

- the UE is not required to acquire the SI from the serving cell while it is receiving DL-SCH from a TRP with PCI different from serving cell's PCI.

*Next Modified Subclause*

## 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 slice(s). An NSAG is defined within a TA, used for slice specific cell reselection and/or slice specific 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 Modified Subclause*

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.

- 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*

#### 16.3.3.1 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 specific RACH configuration for RA isolation and prioritization can be included in SIB1 messages. The slice specific 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 slice(s) for selecting the slice specific RACH configuration, i.e., the UE uses the common RACH configuration. In the UE, NAS provides the NSAG to be considered during RA to AS.

*Next Modified Subclause*

### 16.3.3a Slice aware cell reselection

Slice specific cell reselection information can be included in SIB16 and in *RRCRelease* messages. The slice specific 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 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 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.

*End of Changes*