**3GPP TSG-RAN WG2 Meeting #114 Electronic *R2-210XXXX***

19 – 27 May 2021

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| *CR-Form-v12.1* |
| **CHANGE REQUEST** |
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|  |  | **CR** |  | **rev** |  | **Current version:** | **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:***  | Draft Stage 2 CR: Non-Public Network enhancements |
|  |  |
| ***Source to WG:*** | Nokia, Nokia Shanghai Bell |
| ***Source to TSG:*** | R2 |
|  |  |
| ***Work item code:*** |  |  | ***Date:*** | 2021-05 |
|  |  |  |  |  |
| ***Category:*** | **Cat B** |  | ***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)* |
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| ***Reason for change:*** | Introduce the stage 2 changes for Non-Public Network enhancements |
|  |  |
| ***Summary of change:*** | This is the running stage 2 CR. This version captures the following agreements from RAN2#113 and RAN2#113bis and RAN2#114:* A new indicator that "access using credentials from a separate entity is supported" is broadcasted, and the indicator is broadcasted per SNPN in network sharing scenarios.
* RAN2 assumes that the new indicator that "access using credentials from a separate entity is supported" is broadcasted in SIB1.
* A new indicator that "whether the SNPN allows registration attempts from UEs that are not explicitly configured to select the SNPN" is broadcasted, and the indicator is broadcasted per SNPN in network sharing scenario.
* RAN2 assumes that the new indicator that "whether the SNPN allows registration attempts from UEs that are not explicitly configured to select the SNPN" is broadcasted in SIB1.
* In the UE, AS reports to NAS about the following broadcasted new parameters:

Indicator that "access using credentials from a separate entity is supported" in the cell per SNPNSupported Group IDsIndicator that "whether the SNPN allows registration attempts from UEs that are not explicitly configured to select the SNPN" per SNPN.* GIDs are broadcasted per SNPN in network sharing scenarios.
* RAN2 to revise the previous agreement as following:

In the UE, AS reports broadcast Group IDs per SNPN to NAS.* Broadcast a 1-bit indication for onboarding per O-SNPN.
* R2 assumes that the 1-bit indication for onboarding is in SIB1.
* The UE sends an indication for onboarding to the gNB at RRC Connection Establishment (intention to support AMF selection).
* UE AS forwards the onboarding indication (and Group IDs if Proposal#1 is agreed) per SNPN to UE NAS for onboarding network selection.
* Group IDs per SNPN for onboarding purpose is broadcast in the SIB. FFS whether the Group IDs for onboarding purpose and for credential by separate entity are different.
* GIN for access using CH is broadcst only if Indication of accessing using CH is broadcast.
* GIN is broadcasted by new SIB
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|  |  |
| ***Consequences if not approved:*** | NPN enhancements are supported. |
|  |  |
| ***Clauses affected:*** |  |
|  |  |
|  | **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 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). 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;

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

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].

Figure 7.3-1 below summarises System Information provisioning.



Figure 7.3-1: 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.

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

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

- Group ID for Network selection (GIN) identifies a group of Credentials Holders that are available from an SNPN.

*Next Modified Subclause*

## 9.4 Roaming and Access Restrictions

The roaming and access restriction information for a UE includes information on restrictions to be applied for subsequent mobility action during CM-CONNECTED state. It may be provided by the AMF and also may be updated by the AMF later.

It includes the forbidden RAT, the forbidden area and the service area restrictions as specified in TS 23.501 [3]. It also includes serving PLMN/SNPN and may include a list of equivalent PLMNs. It may also include PNI-NPN mobility restrictions (i.e. list of CAGs allowed for the UE and whether the UE can also access non-CAG cells).

Upon receiving the roaming and access restriction information for a UE, if applicable, the gNB should use it to determine whether to apply restriction handling for subsequent mobility action, e.g., handover, redirection.

If the roaming and access restriction information is not available for a UE at the gNB, the gNB shall consider that there is no restriction for subsequent mobility actions.

Only if received over NG or Xn signalling, the roaming and access restriction information shall be propagated over Xn by the source gNB during Xn handover. If the Xn handover results in a change of serving PLMN (to an equivalent PLMN), the source gNB shall replace the serving PLMN with the identity of the target PLMN and move the serving PLMN to the equivalent PLMN list, before propagating the roaming and access restriction information.

If NG-RAN nodes with different versions of the XnAP or NGAP protocol are deployed, information provided by the 5GC within the NGAP Mobility Restriction List may be lost in the course of Xn mobility. In order to avoid such loss of information at Xn handover or UE context retrieval due to a source NG-RAN node or an old NG-RAN node not able to recognise the entire content, the source NG-RAN node or the old NG-RAN node may provide an 5GC Mobility Restriction List Container to the target NG-RAN node or the new NG-RAN node, containing the Mobility Restriction List as received from the 5GC. The target NG-RAN node or the new NG-RAN node shall use the information contained in the 5GC Mobility Restriction List Container as the Mobility Restriction List, except for the Serving PLMN and the Equivalent PLMNs, which the NG-RAN node shall use from the XnAP Mobility Restriction List. The 5GC Mobility Restriction List Container may be propagated at future Xn handover and UE context retrieval.

Editor's Note: GIN and onboarding related text to be added if needed.

*Next Modified Subclause*

## 16.6 Stand-Alone NPN

### 16.6.1 General

A SNPN is a network deployed for non-public use which does not rely on network functions provided by a PLMN (see clause 4.8). An SNPN is identified by a PLMN ID and NID (see clause 8.2) broadcast in SIB1.

An SNPN-capable UE supports the SNPN access mode. When the UE is set to operate in SNPN access mode, the UE only selects and registers with SNPNs. When the UE is not set to operate in SNPN access mode, the UE performs normal PLMN selection procedures.

Emergency services and ETWS /CMAS are not supported in SNPN. Editor's Note: Support of Emergency services and ETWS /CMAS to be updated.

NR-NR Dual Connectivity within a single SNPN is supported.

### 16.6.2 Mobility

#### 16.6.2.1 General

The same principles as described in 9.2 apply to SNPN except for what is described below.

UEs operating in SNPN access mode only (re)select cells within the selected/registered SNPN and a cell can only be considered as suitable if the PLMN and NID broadcast by the cell matches the selected/registered SNPN.

An SNPN-only cell can only be suitable for its subscribers, the subscribers of the CHs supported by the SNPN, and for onboarding devices if onboarding is supported.

In addition, manual selection of SNPN(s) is supported, for which HRNN(s) can be optionally provided.

The roaming and access restrictions applicable to SNPN are described in clause 9.4.

#### 16.6.2.2 Inactive Mode

The mobility of a UE in inactive mode builds on existing functionality described in clause 9.2.2 and is limited to the SNPN identified within the mobility restrictions received in the UE context.

#### 16.6.2.3 Connected Mode

The NG-RAN node is aware of the SNPN ID(s) supported by neighbour cells.

At the time of handover, cells that do not support the serving SNPN ID are not considered as candidate target cells by the source NG-RAN node.

The target NG-RAN node performs access control. In case it cannot accept the handover for the serving SNPN the target NG-RAN node fails the handover including an appropriate cause value.

16.6.3 Self-Configuration for SNPN

Self-configuration is described in clause 15. In addition, on NG, the NG-RAN node signals the SNPN ID(s) supported per tracking area and the AMF signals the SNPN ID(s) supported per node; on Xn, NG-RAN nodes exchange SNPN ID(s) supported per cell.

16.6.4 Access Control

During the establishment of the UE-associated logical NG-connection towards the 5GC, the AMF checks whether the UE is allowed to access the cell for the signalled SNPN ID as specified in TS 23.501 [3].

If the check is successful, the AMF sets up the UE-associated logical NG-connection and provides the NG-RAN node with the mobility restrictions applicable for the SNPN.

If the check is not successful, the AMF shall reject setting up the UE-associated NG connection and inform the NG-RAN node with an appropriate cause value as specified in TS 23.501 [3].

16.6.x Access with subscription/credentials owned by a separate entity

Editor’s Note: The general architecture description will be discussed in RAN3.

The following information is broadcast to support SNPN access with subscription of a Credentials Holder:

- An indication per SNPN in SIB1 whether access using credentials from a Credentials Holder is supported.

- A list of supported Group IDs for Network Selection (GINs) per SNPN in SIBXY. The list for a specific SNPN can only be broadcast if the above indication is broadcast for the corresponding SNPN.

- An indication per SNPN in SIB1 whether the SNPN allows registration attempts from UEs that are not explicitly configured to select the SNPN.

The above listed items are forwarded to the UE NAS layer that use them for SNPN selection.

Editor’s Note: To be updated based on new agreements.

16.6.y Support of UE onboarding and remote provisioning

Editor’s Note: The general architecture description will be discussed in RAN3.

The following information is broadcast to support onboarding and remote provisioning:

- An indication per O-SNPN in SIB1 whether onboarding is supported;

- A list of supported Group IDs for Network Selection (GINs) per O-SNPN;

The above listed items are forwarded to theUE NAS layer that uses them for O-SNPN selection. When a UE intends to perform onboarding, it sends the onboarding indication to the gNB during RRC connection establishment.

Editor’s Note: To be updated based on new agreements.

## 16.7 Public Network Integrated NPN

### 16.7.1 General

A PNI-NPN is a network deployed for non-public use which relies on network functions provided by a PLMN (see clause 4.8). In PNI-NPN, a Closed Access Groups (CAG) identifies a group of subscribers who are permitted to access one or more CAG cells associated to the CAG. A CAG is identified by a CAG identifier broadcast in SIB1.

A CAG-capable UE can be configured with the following per PLMN (see clause 5.30.3.3 of TS 23.501 [3]):

- an Allowed CAG list containing the CAG identifiers which the UE is allowed to access; and

- a CAG-only indication if the UE is only allowed to access 5GS via CAG cells.

NR-NR Dual Connectivity is supported within PNI-NPN and across PLMN and PNI-NPN.

### 16.7.2 Mobility

#### 16.7.2.1 General

The same principles as described in 9.2 apply to CAG cells except for what is described below.

Cell selection/reselection to CAG cells may be based on a UE autonomous search function, which determines itself when/where to search, but cannot contradict the dedicated cell reselection priority information if any is stored.

A range of PCI values reserved by the network for use by CAG cells may be broadcast.

A CAG Member Cell for a UE is a cell broadcasting the identity of the selected PLMN, registered PLMN or equivalent PLMN, and for that PLMN, a CAG identifier belonging to the Allowed CAG list of the UE for that PLMN. The UE checks the suitability of CAG cells based on the Allowed CAG list provided by upper layers and a CAG-only cell can only be suitable for its subscribers but can be acceptable for the rest.

NOTE: A non-CAG-capable UE (e.g. Rel-15 UE) considers a CAG-only cell as acceptable cell if the cell is not barred to Rel-15 UEs, and if a PLMN ID without CAG list is broadcast and that PLMN is forbidden (e.g. by use of a PLMN ID for which all registration attempts are rejected such that the PLMN ID becomes forbidden).

When the UE is configured with a CAG-only indication, only CAG Member Cells can be suitable. A non-suitable cell can be acceptable though if the UE is configured with a CAG-only indication for one of the PLMN broadcast by the cell.

In addition, manual selection of CAG cell(s) is supported, for which an HRNN(s) can be optionally provided.

The roaming and access restrictions applicable to PNI-NPN are described in clause 9.4.

#### 16.7.2.2 Inactive Mode

The mobility of a UE in inactive mode builds on existing functionality described in clause 9.2.2 according to the mobility restrictions received in the UE context.

#### 16.7.2.3 Connected Mode

The source NG-RAN node is aware of the list of CAG IDs supported by the candidate target cells which are CAG cells.

At the time of handover, the source NG-RAN node determines a target cell among the candidates which is compatible with the received PNI-NPN restrictions.

At incoming handover, the target NG-RAN node receives the PNI-NPN mobility restrictions and checks that the selected target cell is compatible with the received mobility restrictions.

### 16.7.3 Self-Configuration for PNI-NPN

Self-configuration is described in clause 15.

In addition, each NG-RAN node informs the connected neighbour NG-RAN nodes of the list of supported CAG ID(s) per CAG cell in the appropriate Xn interface management procedures.

### 16.7.4 Access Control

During the establishment of the UE-associated logical NG-connection towards the 5GC, the AMF checks whether the UE is allowed to access the cell as specified in TS 23.501 [3].

If the check is successful, the AMF sets up the UE-associated logical NG-connection and provides the NG-RAN node with the list of CAGs allowed for the UE and, whether the UE is allowed to access non-CAG cells. This information is used by the NG-RAN for access control of subsequent mobility.

If the check is not successful, the AMF shall reject setting up the UE-associated NG connection and inform the NG-RAN node with an appropriate cause value as specified in TS 23.501 [3].

### 16.7.5 Paging

The NG-RAN node may receive a paging message including the list of CAGs allowed for the UE, and whether the UE is allowed to access non-CAG cells. The NG-RAN node may use this information to avoid paging in cells on which the UE is not allowed to camp.

For UEs in RRC\_INACTIVE state, the NG-RAN node may page a neighbour NG-RAN node including the list of CAGs allowed for the UE, and whether the UE is allowed to access non-CAG cells. The neighbour NG-RAN node may use this information to avoid paging in cells on which the UE is not allowed to camp.

*End of Changes*

# Annex A: RAN2 Agreements (to be removed when the CR is submitted)

## A.1 RAN2#113

Agreements on Support SNPN with subscription or credentials by a separate entity were as follows:

* A new indicator that "access using credentials from a separate entity is supported" is broadcasted, and the indicator is broadcasted per SNPN in network sharing scenarios.
* RAN2 assumes that the new indicator that "access using credentials from a separate entity is supported" is broadcasted in SIB1.
* The supported Group IDs are broadcasted
* A new indicator that "whether the SNPN allows registration attempts from UEs that are not explicitly configured to select the SNPN" is broadcasted, and the indicator is broadcasted per SNPN in network sharing scenario.
* RAN2 assumes that the new indicator that "whether the SNPN allows registration attempts from UEs that are not explicitly configured to select the SNPN" is broadcasted in SIB1.
* In the UE, AS reports to NAS about the following broadcasted new parameters:

Indicator that "access using credentials from a separate entity is supported" in the cell per SNPN

Supported Group IDs

Indicator that "whether the SNPN allows registration attempts from UEs that are not explicitly configured to select the SNPN" per SNPN.

Agreements on Support UE onboarding and provisioning for NPN were as follows:

* Broadcast a 1-bit indication for onboarding per O-SNPN.
* R2 assumes that the 1-bit indication for onboarding is in SIB1.
* The UE sends an indication for onboarding to the gNB at RRC Connection Establishment (intention to support AMF selection).
* Focus on the O-SNPN scenario. Wait for SA2 further conclusion on how a PLMN can be used as onboarding network.

Agreements on IMS voice and emergency services for SNPN were as follows:

* Extend the ims-EmergencySupport field to SNPN cells (it is FFS whether to reuse the existing IE or add new IEs indicating the support for IMS emergency).
* For reserved cells specified in TS 38.304, all acceptable cells of an SNPN supporting emergency services are treated as suitable when the UE has an ongoing emergency call.
* R17 UEs in SNPN Access Mode can camp on an acceptable SNPN cell supporting emergency services to obtain emergency services.
* The voiceFallbackIndication field in RRCRelease and MobilityFromNRCommand is not applicable to SNPN cells.

## A.2 RAN2#113bis Agreements

General agreements were as follows:

support of PWS over SNPN:

* It seems feasible to do this in R17 from R2 persepctive. Very small impact foreseen

Agreements on Support SNPN with subscription or credentials by a separate entity were as follows:

* Use the term "Credentials Holder (CH)" in future RAN2 discussions for the external entity providing subscription or credential for SNPNs.
* Use the term "Group IDs for Network Selection (GINs)" in future RAN2 discussions for the service provider Group IDs.
* The following assumptions in last meeting are confirmed as agreements,

The new indicator that "access using credentials from a separate entity is supported" is broadcasted in SIB1.

The new indicator that "whether the SNPN allows registration attempts from UEs that are not explicitly configured to select the SNPN" is broadcasted in SIB1.

* GIDs are broadcasted per SNPN in network sharing scenarios.
* RAN2 to revise the previous agreement as following:

In the UE, AS reports broadcast Group IDs per SNPN to NAS.

* To supporting SNPN with subscription or credentials by a separate entity, R2 assumes that there is no impact on cell (re)selection (e.g. no need to change suitable cell criteria).

Agreements on Support UE onboarding and provisioning for NPN were as follows:

* UE AS forwards the onboarding indication (and Group IDs if Proposal#1 is agreed) per SNPN to UE NAS for onboarding network selection.
* No UE impact on connected mode mobility for onboarding.
* A new onboarding indication is included in *RRCSetupComplete* message.
* R2 assumes that no enhancement is needed to support onboarding for provisioning the PNI-NPN credentials to UE.
* There is no need to introduce an onboarding request indication in RRC messages for UEs in RRC\_INACTIVE.
* Group IDs per SNPN for onboarding purpose is broadcast in the SIB. FFS whether the Group IDs for onboarding purpose and for credential by separate entity are different.
* R2 assumes that onboarding will not impact cell reselection.

## A.3 RAN2#114 Agreements

General agreements were as follows:

Reply for LS on limited service availability of an SNPN (C1-21212601/R2-2104704):

* We reply “YES” (to Q1 of the LS), but need to discuss the details of the additional info and the alternatives.

Agreements on Support SNPN with subscription or credentials by a separate entity were as follows:

* GIN for access using CH is broadcst only if Indication of accessing using CH is broadcast.
* RAN2 assumes that NAS does not send selected GINs and two indications related to external credentials to AS.
* There is no impact on cell (re)selection to support SNPN with subscription or credentials by a separate entity.
* RAN2 assume there is no RAN2 UE impact of connected mode mobility for separate credential.
* RAN2 assumes the selected SNPN ID is enough for AMF selection for separate credential.
* GIN is broadcasted by new SIB

Agreements on Support UE onboarding and provisioning for NPN were as follows:

* No additional information except for the already agreed broadcast parameters is needed, unless requested by other WG.
* There is no need to introduce the 1-bit onboarding indication in SIB1 and optional GINs for PLMNs acting as onboarding networks.
* Toggling the 1-bit onboarding indication in SIB1 allows to control congestion due to onboarding request.
* RAN2 confirms that onboarding does not impact the cell reselection procedure.
* For AMF routing, no extra information is needed in addition to the already agreed onboarding request indication in RRCSetupComplete, unless explicitly requested by other WGs.
* Any limitation to a selected set of UEs using uSIM tags is out of RAN2 scope.
* Send an LS to SA2 to ask about separate or joint GIN list for onboarding and separate credentials and GIN encoding.