3GPP TSG-RAN WG2 Meeting #109 electronic R2- 2001680

24 February – 6 March 2020

**Agenda item: 6.18.2**

**Source: Qualcomm**

**Title: Summary of [PRN] Cell Selection and selection**

**WID/SID: Private Network Support for NG-RAN**

**Document for: Discussion**

# 1 Introduction

This document is for the following email discussion:

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| * [AT109e][117][PRN] Cell Selection and selection aspects (Qualcomm)   Scope: Continue the discussion on cell selection and reselection aspects, trying to conclude on proposals from [R2-2001676](file:///C:\Data\3GPP\RAN2\Docs\R2-2001676.zip) not concluded online.  Initial intended outcome:   * + - Initial set of proposals with full consensus (agreeable over email)   Initial intermediate deadline (for companies' feedback): Thursday 2020-02-27 23:59 CET  Initial intermediate deadline (for rapporteur's list of proposals): Friday 2020-02-28 12:00 CET  Proposed agreements not challenged until Monday 2020-03-02 12:00 CET will be declared as agreed by the session chair.  Final intended outcome: summary of the offline discussion in R2-2001680 with:   * + - (Further) set of proposals with full consensus, if any (agreeable over email)     - Set of proposals with almost full consensus to discuss in the follow up conference call     - Set of open issues and proposals to postpone to next meeting     - Open issues that should no longer be pursued   Final deadline (for companies' feedback): Monday 2020-03-02 23:59 CET  Final deadline (for rapporteur's summary): Tuesday 2020-03-03 12:00 CET  Status: Started |

Proposals from R2-2001676 that were concluded online and those that were not concluded online are pointed out in Appendix A.

Note that following agreements have already been made in RAN2#109e:

Agreements:

1. RAN2 understanding is that all mandatory features apply to NPN (we might check this again for Rel-16 features if any problems are found)
2. Proposal 2: Remove the following Editor’s Notes without introducing any other changes

Editor's Note: The need for list of NIDs depends on the RAN sharing scenarios to be supported.

Editor's Note: The support of sharing logical cells is FFS.

1. No PCI range of SNPN cells will be signalled
2. Clarify in Stage 2 that a 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 "not allowed" (e.g. by use of PLMN ID for which all registration attempts are rejected such that the PLMN ID becomes not allowed). Discuss wording as part of the Stage 2 discussion
3. Proximity indication is not supported CAGs
4. EN-DC is not supported for NPN

# 2 Discussion

## 2.1 PCI range signaling for CAGs

Following options for signalling of PCI range for CAGs was proposed in [8], [10]. [13], [16] and [17] (**companies are encouraged to confirm that all their proposed options are captured below in the condensed list of options**), and discussed in proposal 9c of R2-2001676:

**Question 1: Please indicate preferred option for signalling of PCI range for CAGs:**

1. **Signal PCI range(s) for all CAGs. Number of ranges FFS.**
2. **Signal PCI range(s) per PLMN per frequency. Number of ranges FFS.**
3. **Signal PCI range(s) per CAG ID per frequency. Number of ranges FFS.**
4. **CAG PCI range is introduced as a list of blacklisted/whitelisted cells (no changes required to ASN.1 and NR-U CRs are the baseline).**

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| **Company** | **Preferred option(s)** | **comments** |
| Huawei | Option 3 | The reserved PCIs could be different across different CAGs. Considering the PCI range could be non-contiguous, a list of PCI ranges is preferred.  This question is also related to Q5a. If the UE is unaware of the reserved PCIs and associated CAG ID for neighbour cells, UE could not determine whether a neighbour cell is a CAG member cell or not (UE needs to know the CAG ID of the neighbour cell to check if it’s in Allowed CAG list or not), thus could not exclude non-CAG member cells. |
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## 2.2 Overriding *cellReservedForOtherUse* in NPN cells

Setting cellReservedForOtherUse = true excludes Rel-15 UEs from accessing a cell. We also need to allow Rel-16 UEs to access such a cell. Next question is aimed at addressing this and is based on proposals 4 and 19 in R2-2001676. Note that “cell does not broadcast any CAG-IDs or NIDs” check is similar to that in a previous agreement copied below:

1. All the R16 UEs will treat the cell as barred when the legacy IE cellReservedForOtherUse is set to “True” and this cell does not broadcast any CAG-IDs or NIDs.

**Question 2: Do you agree with the following:**

1. **When cell broadcasts any CAG IDs or NIDs, NPN-capable Rel-16 UE can treat a cell with cellReservedForOtherUse = true as a candidate during cell selection and cell reselection.**
2. **When cell broadcasts any CAG IDs or NIDs, non-NPN-capable Rel-16 UE can treat a cell with cellReservedForOtherUse = true as a candidate during cell selection and cell reselection.**

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| **Company** | **(a)**  **Yes/no** | **(b)**  **Yes/no** | **comments** |
| Huawei | Yes | Yes | For a): Since the cell broadcasts NPN information, NPN UEs will ignore the R15 *cellReservedForOtherUse* and refer to the R16 *cellReservedForFutureUse* to check if the cell is reserved or not.  For b): The described cell could an NPN-only cell or PLMN + NPN mixed cell. If it’s a PLMN + NPN mixed cell that wants to prevent the access attempts of R15 UEs but allows the access attempts of R16 UEs, it could only set *cellReservedForOtherUse* to *true*, and in this case the cell should not be viewed as barred for R16 non-NPN capable UEs. |
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## 2.3 Emergency calls for Rel-16 UEs

Following agreement has already been made in RAN2#109e

1. Clarify in Stage 2 that a 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 "not allowed" (e.g. by use of PLMN ID for which all registration attempts are rejected such that the PLMN ID becomes not allowed). Discuss wording as part of the Stage 2 discussion

Following question is based on [7] and [9] and discusses a related issue of enabling emergency calls for Rel-16 UEs in CAG-Only Cells.

**Question 3a: Do you agree that emergency calls for Rel-16 UEs in a CAG-only cell can be supported in the same way as for Rel-15 Ues (as described in the above agreement)?**

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| **Company** | **Yes/no** | **comments** |
| Huawei | Yes | [9] proposed two ways of supporting emergency calls for Rel-16 UEs in a CAG-only cell:  (1) by setting *cellReservedForOtherUse* = *true* and allowing the Rel-16 UEs to override this flag and access the PLMNs in the NPN list in limited service state;  (2) by setting *cellReservedForOtherUse* = *false* and broadcasting a dummy PLMN in the legacy PLMN list.  We prefer (2). If the operator wants to provide emergency service in a CAG-only cell only to R16 CAG capable UEs, not to R16 non-CAG capable UEs, it cannot be achieved by (1). The current agreement allows emergency service for R16 non-CAG capable UEs, but it is not mandatory. In other words, operators should be able to decide for each CAG-only cell whether to allow emergency service to non-CAG capable UEs.  In this sense, (2) is better. |
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The next question discusses another mechanism from [9] for supporting emergency calls for Rel-16 UEs in CAG-only cell (which cannot be used to support emergency calls for Rel-15 UEs).

**Question 3b: For CAG-capable Rel-16 UE, can emergency calls in a CAG-only cell be supported by setting *cellReservedForOtherUse=true* and allowing the Rel-16 UEs to override this flag and access the PLMNs in the NPN list in limited service state?**

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| **Company** | **Yes/no** | **comments** |
| Huawei | Yes | CAG-capable UEs can override *cellReservedForOtherUse* since the role of checking whether a cell is reserved is taken over by the R16 *cellReservedForFutureUse*. |
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**Question 3c: For non-CAG-capable Rel-16 UE, can emergency calls in a CAG-only cell be supported by setting *cellReservedForOtherUse=true* and allowing the Rel-16 UEs to override this flag and access the PLMNs in the NPN list in limited service state?**

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| **Company** | **Yes/no** | **comments** |
| Huawei | No | As commented in Q3a, we prefer option (2) in [9] for non-CAG-capable UEs. |
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## 2.4 Excluding SNPN cells during cell reselection

Following question is based on proposal 8c in R2-2001676.

**Question 4a: Do you agree with the following for unlicensed spectrum:**

**For a UE in SNPN AM, if the highest ranked cell or best cell according to absolute priority reselection rules is a cell which is not suitable due to not broadcasting the registered or selected SNPN ID, the UE shall not consider this cell as candidate for cell reselection but should continue to consider other cells on the same frequency for cell reselection.**

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| **Company** | **Yes/no** | **comments** |
| Huawei | Yes | We could not understand why the differentiation between licensed spectrum and unlicensed spectrum is needed.  For both licensed and unlicensed spectrum, it is possible that multiple operators deploy NPN cells on the same frequency, so other cells on the same frequency should be considered as candidate cells. |
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**Question 4b: Do you agree with the following for licensed spectrum:**

**For a UE in SNPN AM, if the highest ranked cell or best cell according to absolute priority reselection rules is a cell which is not suitable due to not broadcasting the registered or selected SNPN ID, the UE shall not consider this cell as candidate for cell reselection but should continue to consider other cells on the same frequency for cell reselection.**

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| **Company** | **Yes/no** | **comments** |
| Huawei | Yes | Same as Q4a. |
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The following discusses the role of *intraFreqReselection* in a barred SNPN cell. Note that there is a related open issue about whether unsuitable SNPN cell should be treated as a barred cell or not, and LS R2-1916345 was sent to SA1/SA2 to clarify a related aspect, and we are awaiting a reply on the matter.

**Question 4c: Should the field** ***intraFreqReselection* in MIB message broadcast by a SNPN cell be ignored or not by a UE in SNPN AM in (a) licensed spectrum, (b) not in licensed spectrum?**

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| **Company** | **(a)**  **Yes/no** | **(b)**  **Yes/no** | **comments** |
| Huawei | No | No | As pointed out in [21], *intraFreqReselection*only appliesifhighest ranked cell is barred, or treated as barred and not always when it is not suitable.  We do not see a strong need to add extra requirement to UEs in SNPN AM. |
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## 2.5 Excluding CAG cells during cell reselection

Following three questions are based on inter-related proposals 7, 8a and 8b in R2-2001676.

**Question 5a: Do you agree with the following: UE shall perform ranking of all cells that fulfil the cell selection criterion S, which is defined in 5.2.3.2, but may exclude CAG cells that are known by the UE not to be CAG member cells.**

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| **Company** | **Yes/no** | **comments** |
| Huawei | Yes | As commented in Q1, if the answer in Q5a is “Yes”, we need to figure out how the UE can decide whether a neighbour CAG cell is a CAG member cell or not.  In this sense, we think CAG IDs need to be broadcast along with reserved PCIs. |
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**Question 5b: Should the field *intraFreqReselection* in MIB message broadcast by a CAG cell be ignored or not by a UE not in SNPN AM in (a) licensed spectrum, (b) not in licensed spectrum?**

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| **Company** | **(a)**  **Yes/no** | **(b)**  **Yes/no** | **comments** |
| Huawei | No | No | As pointed out in [21], *intraFreqReselection*only appliesifhighest ranked cell is barred, or treated as barred and not always when it is not suitable.  We do not see a strong need to add extra requirement to CAG UEs.  Also, we could not understand why the differentiation between licensed spectrum and unlicensed spectrum is needed.  For both licensed and unlicensed spectrum, it is possible that multiple operators deploy NPN cells on the same frequency, so other cells on the same frequency should be considered as candidate cells. |
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**Question 5c: Do you agree with the following for unlicensed spectrum:**

**for a UE with non-empty allowed CAG list, if the highest ranked cell or best cell according to absolute priority reselection rules is a CAG cell which is not suitable due to not being a CAG member cell, the UE shall not consider this cell as candidate for cell reselection but shall continue considering other cells on the same frequency for cell reselection.**

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| **Company** | **Yes/no** | **comments** |
| Huawei | Yes | We could not understand why the differentiation between licensed spectrum and unlicensed spectrum is needed.  For both licensed and unlicensed spectrum, it is possible that multiple operators deploy NPN cells on the same frequency, so other cells on the same frequency should be considered as candidate cells. |
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**Question 5d: Do you agree with the following for licensed spectrum:**

**for a UE with non-empty allowed CAG list, if the highest ranked cell or best cell according to absolute priority reselection rules is a CAG cell which is not suitable due to not being a CAG member cell, the UE shall not consider this cell as candidate for cell reselection but shall continue considering other cells on the same frequency for cell reselection.**

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| **Company** | **Yes/no** | **comments** |
| Huawei | Yes | Same as Q5c. |
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## 2.6 Manual CAG selection

Following question tries to establish a baseline for manual CAG selection based on proposal in [20]. *Please note the updated wording for step #7.*

**Question 6a: Do you agree with the following: AS and NAS operate as discussed below during *manual* CAG selection:**

* **#1. As part of AS-NAS interface, NAS provides AS with *allowed CAG list*.**
* **#2. Upon triggering of manual CAG selection by NAS, AS scans *all* carrier frequencies and obtains PLMNs and CAG IDs broadcast by found cells. Note that UE does not take *allowed CAG list* into accountin this step.**
* **#3. AS provides the found PLMNs and CAGs to NAS.**
* **#4. NAS selects a CAG ID and provides AS with the selected CAG ID (and the selected CAG ID is separate from allowed CAG list provided before).**
* **#5. With cell selection, the UE select a cell belonging to the selected PLMN and the selected CAG ID. Note that UE does not take *allowed CAG list* into accountin this step.**
* **#6. As an outcome of the manual CAG selection procedure the UE is allowed to access a cell which fulfils the cell selection criteria and is not barred or reserved for operator use for UEs not belonging to Access Identities 11 or 15 and inform NAS that access is possible (for location registration procedure).**

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| **Company** | **Yes/No** | **comments** |
| Huawei | Yes | The procedures are generally in line with our understanding, but we have one concern on Step#2.  We understands that Step#2 is mimicking LTE CSG’s behaviour: AS should be able to find all available CSG *without any restriction* to allow the UE to attempt registration towards a non-member CSG cell [20].  However, LTE CSG allows the UE to attempt to register to a non-member CSG cell, which is not supported by R16 CAG. Maybe onboarding will be supported in R17 NPN, we are not sure. In this sense, maybe AS should consider allowed CAG list in Step#2. We have no strong preference on this. |
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**Question 6b: After performing access on the manual selected CAG, which one of following two UE behaviours is used:**

**a. UE reselects a cell belong to allowed CAG list.**

**b. UE shall prioritize to reselect a cell supporting selected CAG ID, but also can consider cells belonging to allowed CAG list in case that cells supporting selected CAG ID is not available.**

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| **Company** | **Preferred option** | **comments** |
| Huawei | a | We are not sure how to capture the “prioritize” behaviour, which may complicate the spec, thus option a) is preferred. |
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Following question is based on a proposal in [8].

**Question 6c: For RRC\_IDLE/RRC\_INACTIVE UE in manual CAG/SNPN mode, should UE AS inform the NAS if UE AS can’t search for an acceptable or suitable cell belonging to the selected CAG/SNPN?**

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| **Company** | **Yes/No** | **comments** |
| Huawei | No | We don’t see why NAS cares about this. If reported, what is the intended behaviour of NAS? |
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## 2.7 NPN-only cell definition update

Next question is based on proposal 11 from R2-2001676.

**Question 7: Should NPN-only cell definition be updated as follows: A cell that is only available for NPNs’ subscriber. This is indicated by setting the *cellReservedForOtherUse* IE to true while the *npn-IdentityInfoList-r16* IE is present in *CellAccessRelatedInfo*.**

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| **Company** | **Yes/No** | **comments** |
| Huawei |  | The definition given seems to be identical to the definition in the current 331 running CR (R2-2001035):  NPN-only Cell: A cell that is only available for NPNs’ subscriber. This is indicated by setting the *cellReservedForOtherUse* IE to true while the *npn-IdentityInfoList-r16* IE is present in *CellAccessRelatedInfo*.  We think the definition is ok, but didn’t see the updates. |
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## 2.8 High quality SNPNs

Next question is related to the following proposal 14 in R2-2001676 (from [19]). Introducing notion of high quality SNPNs will likely have CT1 impacts as current TS 23.122 does not use it.

**Question 8: Should high quality criteria be applicable to SNPNs?**

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| **Company** | **Yes/No** | **comments** |
| Huawei | No | We think this issue can be postponed. |
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## 2.9 Grouping CAG identities of same PLMN identity

Next question is related to issue of restrictions on grouping CAG identities of same PLMN identity discussed in [11], [21] and [28].

**Question 9: Should all CAG identities associated to the same PLMN identity be listed in the same *cag-IdentityList*?**

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| **Company** | **Yes/No** | **comments** |
| Huawei | Yes | This is in line with our understanding of the following agreement from #107b:   1. SIB1 allows indication of TAC, RANAC, cellIdentity for each CAG. FFS on other IEs. The fields are indicated per PLMN-ID. FFS whether Rel-15 IEs or Rel-16 IEs are used for the indication. |
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## 2.10 Prioritization of CAG cells

Next question is related to the proposal 16 in R2-2001676 from [15].

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| **Proposal 16: To facilitate the cell reselection from a non-CAG cell to a CAG cell, the highest ranked cell or best cell acc. to absolute priority reselection rules should not be applied by the CAG-capable UE.** |

**Question 10: Should CAG-capable UE be able to reselect to a CAG member cell ignoring highest ranked cell or best cell acc. to absolute priority reselection rules?**

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| **Company** | **Yes/No** | **comments** |
| Huawei | No | This is contradicting the agreements from #108:   1. UE follows dedicated frequency priorities as in legacy behaviour. If UE run autonomous cell search and at the same time have dedicated frequency priorities, the result from autonomous cell search should not go against that indicated by dedicated frequency priorities (when they are valid). |
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## 2.11 More granularity for inter-frequency carrier info in SIB4

Next question is related to the proposal 17 in R2-2001676 based on (opposing views in) proposals in [8] and [18]:

**Question 11: Should NID/CAG ID or network type indicator be broadcast along with the inter-frequency carrier info in SIB4?**

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| **Company** | **Yes/No** | **comments** |
| Huawei | Yes | We think it can help UE determine whether the neighbour cell is a CAG member cell or not. The question is also related to Q5a. |
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## 2.12 ASN.1 reading and processing capabilities

Next question is based on proposal 20 in R2-2001676 related to ASN.1 reading and processing capabilities. It is related to some of the previous questions (e.g., 2, 3c).

**Question 2: Please indicate your preferred option(s):**

1. **Rel-16 UEs that are not NPN-capable can read and act on all NPN related IEs in Rel-16 ASN.1**
2. **Rel-16 UEs that are not NPN-capable can read all NPN related IEs in Rel-16 ASN.1 but cannot take actions based on some IEs. Actionable IEs and related actions FFS.**
3. **Rel-16 UEs that are not NPN-capable can read all NPN related IEs in Rel-16 ASN.1 but cannot take actions based on it.**
4. **Other**

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| **Company** | **Preferred option(s)** | **comments** |
| Huawei | a | We think a) is simple. |
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# 3 Rapporteur's list of proposals (initial intermediate deadline)

TBD

# 4 Summary

## (Further) set of proposals with full consensus, if any (agreeable over email)

TBD

## Set of proposals with almost full consensus to discuss in the follow up conference call

TBD

## Set of open issues and proposals to postpone to next meeting

TBD

## Open issues that should no longer be pursued

TBD

# 5 References

[*1] R2-2000025 Reply LS on Sending CAG ID in NAS layer (R3-197591; contact: Ericsson) RAN3 LS in Rel-16 NG\_RAN\_PRN To:SA3, SA2, RAN2 Cc:CT1*

*[2] R2-2000051 Reply LS on NPN clarifications (S1-193605; contact: Qualcomm) SA1 LS in Rel-16 Vertical\_LAN, NG\_RAN\_PRN To:SA2, RAN3 Cc:RAN2, SA3*

*[3] R2-2001310 PRN Running CR for TS 38.304 Qualcomm Incorporated CR Rel-16 38.304 15.6.0 0148 - B NG\_RAN\_PRN*

*[4] R2-2001311 Report for email discussion [108#71][PRN] Running 38.304 CR (Qualcomm) Qualcomm Incorporated discussion*

*[5] R2-2001035 Introducing the support of Non-Public Networks Nokia Hungary CR Rel-16 38.331 15.8.0 1468 - B NG\_RAN\_PRN-Core*

[6] R2-2000570 Emergency Calls in CAG-Only Cells Nokia (Rapporteur), China Telecom, Ericsson, Intel, Nokia Shanghai Bell, Vodafone, ZTE discussion Rel-16 NG\_RAN\_PRN-Core

[7] R2-2000003 Access Control about NPN CATT discussion Rel-16 NG\_RAN\_PRN-Core

[8] R2-2000004 Idle and Inactive Open Issues for NPN CATT discussion Rel-16 NG\_RAN\_PRN-Core

[9] R2-2000132 Support of emergency calls in NPN-only cells Ericsson discussion Rel-16 NG\_RAN\_PRN-Core

[10] R2-2000357 Remaining issues on the cell reselection ZTE Corporation, Sanechips discussion Rel-16 NG\_RAN\_PRN-Core

[11] R2-2000400 Proposals on Editor’s Notes of running RRC CR Nokia, Nokia Shanghai Bell discussion Rel-16 NG\_RAN\_PRN-Core

[12] R2-2000402 Handling of selected CAG ID in Idle/Inactive mode Nokia, Nokia Shanghai Bell discussion Rel-16 NG\_RAN\_PRN-Core

[13] R2-2000829 Blacklist/whitelist for PCI range signaling and stage-3 details Sony discussion Rel-16 NG\_RAN\_PRN-Core

[14] R2-2001170 Remaining mobility issues for idle mode and connected mode Intel Corporation discussion Rel-16 NG\_RAN\_PRN-Core

[15] R2-2001174 Open issues in the specification of NPN in TS 38.304 Lenovo, Motorola Mobility discussion Rel-16 NG\_RAN\_PRN-Core

[16] R2-2001376 General considerations on idle and inactive mode for NPN Huawei, HiSilicon discussion Rel-16 NG\_RAN\_PRN

[17] R2-2001423 Signalling Design on the PCI Range CMCC discussion Rel-16 NG\_RAN\_PRN-Core

[18] R2-2001526 Resolving miscellaneous issues LG Electronics France discussion NG\_RAN\_PRN-Core

[19] R2-2001527 High Quality Criterion for SNPN LG Electronics France discussion NG\_RAN\_PRN-Core

[20] R2-2001528 Manual CAG selection LG Electronics France discussion NG\_RAN\_PRN-Core

[21] R2-2001331 Open issues in NPN Qualcomm Incorporated discussion

[22] R2-2000005 Connected Mode Open Issues for NPN CATT discussion Rel-16 NG\_RAN\_PRN-Core

[23] R2-2000358 Consideration on the remaining Connected State Issues ZTE Corporation, Sanechips discussion Rel-16 NG\_RAN\_PRN-Core

[24] R2-2001071 Discussion on the proximity indication in connected mode vivo discussion R2-1916098

[25] R2-2001377 General considerations on connected mode for NPN Huawei, HiSilicon, China Telecom discussion Rel-16 NG\_RAN\_PRN

[26] R2-2001430 Access and mobility control for NPN CMCC discussion Rel-16 NG\_RAN\_PRN-Core

[27] R2-2001586 Remaining issues discussion on NPN China Telecom discussion Rel-16 NG\_RAN\_PRN-Core

[28] R2-2000130 Remaining RRC aspects of NPN Ericsson discussion Rel-16 NG\_RAN\_PRN-Core

# 6 Appendix

## Proposals from R2-2001676

Listed below are proposals from including proposals marked in ~~striked-out-green~~ font that were addressed already during online discussion.

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| Potential easy agreement  **~~Proposal 1: RRC\_INACTIVE state is supported for SNPN and CAG.~~**  **~~Proposal 2: Remove the following Editor’s Notes without introducing any other changes:~~**  ~~Editor's Note: The need for list of NIDs depends on the RAN sharing scenarios to be supported.~~  ~~Editor's Note: The support of sharing logical cells is FFS.~~  **Proposal 3: RAN2 confirm that For SNPN, *cellReservedForOperatorUse* is configured per SNPN, while for CAG, *cellReservedForOperatorUse* is configured per PLMN.**  **Proposal 4: When cell broadcasts any CAG IDs or NIDs and the cell status is indicated as "not barred" and "not reserved" for operator use and "true" for other use, and *cellReservedForFutureUse* IEis not indicated as “*true”*, all UEs shall treat this cell as candidate during the cell selection and cell reselection procedures. FFS on how to capture this in the specification accounting for whether a Rel-16 UE non-NPN capable UE is required to be able to read the NPN info broadcasted in the cell.**  **~~Proposal 5: ASN.1 and RRC design shall be such that a 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 PLMN ID for which all registration attempts are rejected such that the PLMN ID becomes forbidden).~~**  **~~Proposal 9a: PCI range of SNPN cells can be optionally signalled to UEs.~~**  B) need further discussion  **Proposal 6a: Emergency calls for Rel-16 UEs (and Rel-15 UEs) in a CAG-only cell can be supported by setting cellReservedForOtherUse = false, and if a PLMN ID without CAG list is broadcast and that PLMN is forbidden (e.g. by use of PLMN ID for which all registration attempts are rejected such that the PLMN ID becomes forbidden). FFS whether/how NPN capability of UE impacts this.**  **Proposal 6b: Emergency calls for Rel-16 UEs in a CAG-only cell can be supported by setting cellReservedForOtherUse=true and and allowing the Rel-16 UEs to override this flag and access the PLMNs in the NPN list in limited service state. FFS whether/how NPN capability of UE impacts this.**  It is recommended that proposals 7, 8a-8c are discussed together given they are related.  **Proposal 7: The UE shall perform ranking of all cells that fulfil the cell selection criterion S, which is defined in 5.2.3.2, but may exclude CAG-only cells that are known by the UE not to be CAG member cells. FFS whether this applies to CAG-cells other than CAG-only cells.**  **Proposal 8a: RAN2 to discuss if the field *intraFreqReselection* in MIB message is ignored or not for a cell in (a) licensed spectrum, (b) not in licensed spectrum.**  **Proposal 8b: For a UE with non-empty allowed CAG list, if the highest ranked cell or best cell according to absolute priority reselection rules is a CAG cell which is not suitable due to not being a CAG member cell and the cell is not in licensed spectrum, the UE shall not consider this cell as candidate for cell reselection but shall continue considering other cells on the same frequency for cell reselection. It is FFS whether this behaviour is applicable to licensed spectrum.**  **Proposal 8c: For a UE in SNPN AM, if the highest ranked cell or best cell according to absolute priority reselection rules is a cell which is not suitable due to not broadcasting the registered or selected SNPN ID or the CAG ID and the cell is not in licensed spectrum, the UE shall not consider this cell as candidate for cell reselection but should continue to consider other cells on the same frequency for cell reselection. It is FFS whether this behaviour is applicable to licensed spectrum.**  **~~Proposal 9b: RAN2 to the following options for how PCI range of SNPN is signalled:~~**   1. **~~The White list introduced in the NR-U and the Legacy black list can be used to indicate PCI range info for the SNPN [10, 13]~~** 2. **~~PCI-range signalled to UEs is defined as the legacy way, e.g. a single PCI list is signalled to UEs without any info associated to NPN ID/NPN type. [8]~~** 3. **~~PCI-range signalled to UEs is defined per NPN type, e.g. PCI-range signalled to UEs is indicated separately for SNPN/PNI-NPN [8]~~** 4. **~~PCI-range signalled to UEs is defined per NPN ID [8]~~** 5. **~~Separate PCI range list for CAG/SNPN cells, rather than black/white cell list. The PCI list contain one or a list of PCI range of RPN (mixed the CAG Cells and SNPN Cells) for a PLMN. [17]~~**   **Proposal 9c: RAN2 to the following options for how PCI range of CAG is signalled:**   1. **Both the PCI range list and related CAG ID can be signalled to UEs. [8, 16]** 2. **PCI-range signalled to UEs is defined as the legacy way, e.g. a single PCI list is signalled to UEs without any info associated to NPN ID/NPN type [8]** 3. **PCI-range signalled to UEs is defined per NPN type, e.g. PCI-range signalled to UEs is indicated separately for SNPN/PNI-NPN [8]** 4. **Reserve a list of PCI range per PLMN per frequency [10]** 5. **Reserve only one PCI range per PLMN per frequency [10]** 6. **Reserve only one PCI range per CAG ID per frequency [10]** 7. **Reserve a list of PCI range per CAG ID per frequency [10]** 8. **CAG PCI range is introduced as a list of blacklisted/whitelisted cells. No changes required to ASN.1 and NR-U CRs are the baseline.[13]** 9. **Separate PCI range list for CAG/SNPN cells, rather than black/white cell list. The PCI list contain one or a list of PCI range of RPN (mixed the CAG Cells and SNPN Cells) for a PLMN. [17]** 10. **Principles from E-UTRA can be inherited (cp. csg-PhysCellIdRange IE)**   **Proposal 10: RAN2 should discuss whether following can be used as a baseline:**  **AS and NAS operate as discussed below during *manual* CAG selection:**   * **#1. As part of AS-NAS interface, NAS provides AS with *allowed CAG list*.** * **#2. Upon triggering of manual CAG selection by NAS, AS scans *all* carrier frequencies and obtains PLMNs and CAG IDs broadcast by found cells. Note that UE does not take *allowed CAG list* into accountin this step.** * **#3. AS provides the found PLMNs and CAGs to NAS.** * **#4. NAS selects a CAG ID and provides AS with the selected CAG ID (and the selected CAG ID is separate from allowed CAG list provided before).** * **#5. With cell selection, the UE select a cell belonging to the selected PLMN and the selected CAG ID. Note that UE does not take *allowed CAG list* into accountin this step.** * **#6. As an outcome of the manual CAG selection procedure the UE is allowed to access a cell which fulfils the cell selection criteria and is not barred or reserved for operator use for UEs not belonging to Access Identities 11 or 15 and inform NAS that access is possible (for location registration procedure).** * **#7. After the completion of the manual CAG selection, RAN2 should select one from the following two UE behaviors:**   + **#7a. UE reselects a cell belong to allowed CAG list.**   + **#7b. UE shall prioritize to reselect a cell supporting selected CAG ID, but also can consider cells belonging to allowed CAG list in case that cells supporting selected CAG ID is not available.**   **Proposal 11: RAN2 to discuss if NPN-only cell definition needs to be updated as follows: A cell that is only available for NPNs’ subscriber. This is indicated by setting the *cellReservedForOtherUse* IE to true while the *npn-IdentityInfoList-r16* IE is present in *CellAccessRelatedInfo*.**  **Proposal 20: RAN2 to discuss whether a Rel-16 non-NPN capable UE is required to read the NPN identifier information broadcasted in SIB1 by a cell.**  C) a candidate for immediate postpone(at least to the second phase of the e-meeting), is contentious such that it is unlikely to converge at e-Meeting.  **~~Proposal 12: RAN2 to discuss if proximity indication is supported or not for CAGs.~~**  **~~Proposal 13: RAN2 to discuss whether EN-DC is supported in NPNs. If not, trackingAreaCode should be mandatory in NPN-IdentityInfo.~~**  **Proposal 14: It is FFS if high quality criteria applies to SNPNs.**  **Proposal 15: All CAG identities associated to the same PLMN identity shall be listed in the same *cag-IdentityList*.**  **Proposal 16: To facilitate the cell reselection from a non-CAG cell to a CAG cell, the highest ranked cell or best cell acc. to absolute priority reselection rules should not be applied by the CAG-capable UE.**  **Proposal 17: It if FFS whether the supported NID/CAG ID or network type indicator is broadcast along with the inter-frequency carrier info in SIB4.**  **Proposal 18: For RRC\_IDLE/RRC\_INACTIVE UE in manual CAG/SNPN mode, it is FFS whether the UE AS should inform the NAS if UE AS can’t search for an acceptable or suitable cell belonging to the selected CAG/SNPN.**  **Proposal 19: To confirm that all R16 UEs and onward are required to support identification of NPN cell that broadcasts NPN identity and thus be able to consider a cell broadcasting reservedForOtherUse set to TRUE and NPN ID as mobility candidate.** |

## Incoming LSs

Reply LS ‘Reply LS on Sending CAG ID in NAS layer‘ [1] from RAN3 replied as follows:

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| **1. Overall Description:**  RAN3 thanks SA3 for the LS on Sending CAG ID in NAS Layer.  RAN3 has discussed the SA3 proposal to protect the transfer of the selected CAG ID between the UE and the network and concluded that it is feasible from RAN3 point of view to perform initial access control without the UE providing any selected CAG ID to the network.  Further access control during mobility will be performed by NG-RAN based on PNI-NPN specific information provided in the mobility restriction list.  **2. Actions:**  **To SA3, SA2, RAN2 group.**  **ACTION: RAN3 asks SA3, SA2 and RAN2 to take RAN3’s finding into account and provide information about a final decision.** |

Reply LS ‘Reply LS on NPN clarifications’ [2] from SA1 replied as follows:

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| **1. Overall Description:**  SA1 thanks SA2 for their LS and query about private networks and CAG Identifiers.  Some highlights from the LS, relevant to SA1, are copied here:  …  SA2 would like to provide the following answers to the RAN3 questions:  For S-NPN:  Q1: RAN3 noticed that in TS 23.502 section 4.9.1.2.2 during Xn handover the target NG-RAN is specified to include the selected NID together with the selected PLMN in the NGAP Path Switch Request message.  RAN3 would like to ask what is the intended behaviour of the AMF upon receiving this information?  *SA2 Answer: The PLMN ID is included in the NGAP Path Switch Request message corresponding to the serving PLMN due to the possibility for 5GC to support multiple equivalent PLMNs. However, as equivalent SNPNs are not supported, i.e. the "PLMN ID and NID" do not change in case of Xn handover, SA2 agreed the attached CR to remove the NID from the Xn HO procedure.*  **For PNI-NPN**:  Q2: should we consider the case that the size of the UE allowed CAG ID could be so large that the AMF may need to filter it based on the CAG IDs supported in the (registration) area where UE is located?  *SA2 Answer: SA2 assumes that RAN3 is referring to the AMF signaling a UE's Allowed CAG list to NG-RAN as part of the Mobility Restrictions. As per current Stage 2 specifications, SA2 does not assume AMF to perform any filtering.*  ***However, SA2 invites SA1 to provide additional guidance on*** ***the number of CAG Identifiers per PLMN per UE to be supported.***  *…<skip text>…*  **To SA1 group. ACTION:** SA2 kindly ask SA1 to provide further guidance related to question 2, if possible.  Regarding PNI-NPNs and CAG IDs, the following SA1 considerations can be provided.  As documented in TS 22.261 clause 6.25.1, "Non-public networks are intended for the sole use of a private entity such as an enterprise".  Based on the use cases in the TRs (22.804, 22.830, 22.821 etc.) driving the normative requirements, for PNI-NPNs, typical enterprise deployment scenarios include NPNs for small-/medium sized enterprises (SMEs), e.g. factories, or NPNs deployed in the different branches of larger corporations.  These use cases suggest that a given UE might be a member of a small number of PNI-NPNs.  SA1 cannot provide an exact quantitative answer to the SA2’s question (on the number of CAG identifiers per PLMN per UE), since SA1 specifications do not define a maximum number of PNI-NPNs per PLMN to which UE is subscribed to. An estimation could be in the order of a few dozens. |

## Proposals from email discussion for Running 38.304 CR

Following proposals were identified as part of email discussion [108#71][PRN] Running 38.304 CR:

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| **Proposal 1: Void.**  **Proposal 2: RAN2 should discuss the following related to manual CAG selection:**   1. **Selected CAG ID is indicated from NAS to AS as a parameter separate from Allowed CAG list.** 2. **Selected CAG ID is used for cell selection immediately after manual CAG selection and not used subsequently (except if it is part of Allowed CAG list).** 3. **As an outcome of the manual CAG selection procedure the UE is allowed to access an acceptable cell which fulfils the cell selection criteria and is not barred or reserved for operator use for UEs not belonging to Access Identities 11 or 15 and inform NAS that access is possible (for location registration procedure).**   **Proposal 3: RAN2 should discuss the following two options about terminology:**   1. **Use “UEs not operating in SNPN access mode”.** 2. **Define PLMN access mode, and use “UEs operating in PLMN access mode” instead of “UEs not operating in SNPN access mode”.**   **Proposal 4: Void.**  **Proposal 5: RAN2 should discuss the following:**  **For a UE not operating in SNPN access mode, the AS need not report CAG-IDs to NAS in case UE does not have any non-empty “allowed CAG list”.**  **Proposal 6: RAN2 should discuss the following:**  **If a CAG ID is provided by NAS as part of PLMN selection, the UE shall search for an acceptable or suitable cell belonging to the provided CAG ID to camp on. When the UE is no longer camped on a cell with the provided CAG ID, AS shall inform NAS.**  **Proposal 7: RAN2 should discuss the following:**  **If a SNPN ID is provided by NAS as part of PLMN selection, the UE shall search for an acceptable or suitable cell belonging to the provided SNPN ID to camp on. When the UE is no longer camped on a cell with the provided SNPN ID, AS shall inform NAS.**  **Proposal 8: RAN2 should discuss the following two options:**  **Optoin a)** **UE shall exclude cells on the same frequency as the barred cell for cell selection/reselection based on *IntraFrequencyReselection* in the MIB.**  **Option b) If the highest ranked cell or best cell according to absolute priority reselection rules is a CAG cell which is not suitable due to not being a CAG member cell, the UE shall not consider this cell as candidate for cell reselection but shall continue considering other cells on the same frequency for cell reselection.**  **Proposal 9: RAN2 should discuss the following:**  **For a UE operating in SNPN AM, if the highest ranked cell or best cell according to absolute priority reselection rules is an intra-frequency or inter-frequency cell which is not suitable due to being part of the "list of 5GS forbidden TAs for roaming" or belonging to the selected SNPN or belonging to the registered SNPN, the UE shall not consider this cell and other cells on the same frequency, as candidates for reselection for a maximum of 300 seconds.**  **Proposal 10: RAN2 should discuss whether the exclusion below is mandatory or optional:**  **The UE shall perform ranking of all cells that fulfil the cell selection criterion S, which is defined in 5.2.3.2, but may exclude CAG cells that are known by the UE not to be CAG member cells.** |

## Agreements from RAN2#108 (Nov 2019)

Agreements:

1. Access attempts by Rel-15 UEs for emergency services on CAG cell could be allowed based on operator's preference
2. cellReservedForOtherUse is used to prevent Rel-15 UEs to access the cell.
3. NPN information is outside PLMN-IdentityInfoList as a new Rel-16 IE for NPN-only cell and PLMN+NPN cell (the total number of network IDs is still 12)

Working assumption:

1. The new Rel-16 IE with a role similar to role of cellReservedForOtherUse for Rel-15 UEs is cell specific.

Agreements:

1. At least one of the following conditions must be satisfied for a cell to be considered as suitable by a Rel-16 UE not in SNPN AM:

a. Cell is part of either the selected PLMN or the registered PLMN or PLMN of the Equivalent PLMN list of the UE for which the PLMN-ID is broadcast by the cell with no associated CAG-IDs and for which CAG-only indication is absent or false;

b. Cell is part of either the selected PLMN or the registered PLMN or PLMN of the Equivalent PLMN list of the UE for which Allowed CAG list includes a CAG-ID broadcast by the cell.

2. Each SNPN-only cell is treated by Rel-16 UEs not in SNPN AM as if cell status is barred.

3. A CAG cell which is not considered as suitable can be an acceptable cell for a Rel-16 UE not in SNPN AM.

4. A PLMN-only cell or an SNPN+PLMN cell be an acceptable cell for a Rel-16 UE not in SNPN AM for which CAG-only indication is true for any PLMN-ID broadcast by the cell.

5. The following are necessary conditions for an SNPN cell to be considered as a suitable cell by a Rel-16 UE in SNPN AM:

a. the cell is part of either the selected SNPN or the registered SNPN of the UE;

b. the cell is part of at least one TA that is not part of the list of "Forbidden Tracking Areas" which belongs to either the selected SNPN or the registered SNPN of the UE

c. the cell is not barred,

d. the cell selection criteria in clause 5.2.3.2 are fulfilled.

Agreements:

1. Add the following note in TS 38.304 :

NOTE: UE is not required to support manual search and selection of PLMN or CAG or SNPN while in RRC CONNECTED state. The UE may use local release of RRC connection to perform manual search if it is not possible to perform the search while RRC connected.

2. In the UE on request of NAS, the AS shall scan all RF channels in the NR bands according to its capabilities to find available CAGs. On each carrier, the UE shall at least search for the strongest cell, read its system information and report available CAG ID(s) together with their HRNN (if broadcast) and PLMN(s) to the NAS. The search for available CAGs may be stopped on request of the NAS.

If NAS has selected a CAG and provided this selection to AS, the UE shall search for an acceptable or suitable cell belonging to the selected CAG to camp on.

3. In the UE on request of NAS, the AS shall scan all RF channels in the NR bands according to its capabilities to find available SNPNs. On each carrier, the UE shall at least search for the strongest cell, read its system information and report available SNPN identifiers together with their HRNN (if broadcast) to the NAS. The search for available SNPNs may be stopped on request of the NAS.”

1. All the R16 UEs will treat the cell as barred when the legacy IE cellReservedForOtherUse is set to “True” and this cell does not broadcast any CAG-IDs or NIDs.

Agreements:

1. Allow autonomous cell search even in situations when frequency priorities are broadcast in system information.
2. UE follows dedicated frequency priorities as in legacy behaviour. If UE run autonomous cell search and at the same time have dedicated frequency priorities, the result from autonomous cell search should not go against that indicated by dedicated frequency priorities (when they are valid).

Agreements:

1. From RAN2 point of view there is no requirement for CAG ID to be included in RRC signalling at RRC connection establishment.
2. For SNPN, include the SNPN ID in the RRCSetupComplete message. Stage 3 detalls are FFS
3. For SNPN, there is no need to include SNPN ID in the RRCResumeComplete message since the UE context is known to the network.
4. Send a LS to SA3 with Agreement#1 with SA2 and RAN3 in To.

## Agreements from RAN2#107bis (Oct 2019)

Agreements:

1. no new mechanism is introduced to handle the priority of a frequency layer of a CAG cell on which the UE is camped (beyond what cellReselectionPriority provides in SIB4 and in RRCRelease).
2. the UE can optionally implement an autonomous search function of CAG cells. FFS on the relationship with dedicated priorities.
3. reserving a PCI range for CAG cells is purely a deployment issue (does not need to be reflected in the spec)
4. the PCI list of CAG cells can optionally be signalled to UEs. FFS on details of the list
5. FFS whether proximity indication in CONNECTED mode is needed
6. no preliminary access check for CAG cells in CONNECTED mode. The Allowed CAG list is provided to the gNB by the AMF.
7. no new mechanism is introduced to handle the priority of a frequency layer of an SNPN cell on which the UE is camped (beyond what cellReselectionPriority provides in SIB4 and in RRCRelease).
8. There is no autonomous search function of SNPN cells.
9. reserving a PCI range for SNPN cells is purely a deployment issue (does not need to be reflected in the spec)
10. FFS whether PCI range of SNPN cells can optionally be signalled to UEs.
11. No proximity indication in CONNECTED mode is needed for SNPN.
12. no preliminary access check for SNPN cells in CONNECTED mode.

Agreements:

1. SIB1 of NPN-only cell prevents access attempts by Rel-15 UEs for normal services.
2. SIB1/MIB supports prevention of access attempts by Rel-15 UEs on a SNPN-only cell for emergency services.
3. SIB1/MIB supports prevention of access attempts by Rel-15 UEs on a CAG-only cell for emergency services (this does not mean that access attempts by Rel-15 UEs for emergency services on CAG-only cell are always not allowed. This is still FFS.The feasibility of allowing emergency services on CAG-only for Rel-15 UEs will be discussed in the email discussion on RRC aspects/SIB1 design)
4. Access attempts by Rel-15 UEs for emergency services on SNPN-only cell are not allowed.
5. In a NPN-only cell, access attempts for normal services by Rel-16 UEs without support for NPN is not allowed.
6. In a SNPN-only cell, access attempts for emergency services by Rel-16 UEs without support for SNPNs is not allowed.
7. For a PLMN+NPN cell, Rel-15 UEs should be able to access PLMNs associated with the cell for normal and/or limited service.
8. A new Rel-16 IE is needed with a role similar to role of *cellReservedForOtherUse*for Rel-15 UEs (FFS whether this will be PLMN specific)
9. SIB1 allows indication of TAC, RANAC, cellIdentity per SNPN (per PLMN ID + NID). FFS on other IEs. FFS whether Rel-15 IEs or Rel-16 IEs are used for the indication.
10. SIB1 allows indication of TAC, RANAC, cellIdentity for each CAG. FFS on other IEs. The fields are indicated per PLMN-ID. FFS whether Rel-15 IEs or Rel-16 IEs are used for the indication.

Working assumptions:

1. NPN information is outside PLMN-IdentityInfoList as a new Rel-16 IE for NPN-only cell and PLMN+NPN cell (the total number of network IDs is still 12)
2. Access attempts by Rel-15 UEs for emergency services on CAG-only cell could be allowed based on operator's preference

## Agreements from RAN2#107 (Aug 2019)

Agreements

1 The SNPNs (identified by PLMN ID + NID) are broadcasted in SIB1,

FFS whether this is achieved by extending the legacy network list or by introducing a new SNPN specific network list or both.

2 The size and format of the NID will not be discussed in RAN2 (we will be informed by other groups)

3 Up to 12 different SNPNs can be broadcasted in a cell.

4 If “mixed” network sharing is allowed (i.e. a cell can contain both PLMNs and NPNs), the total number of networks indicated in SIB1 (i.e. #PLMN + #SNPN + #PNI-NPN) shall not exceed 12.

5 If HRNN are broadcast then the HRNN should a be broadcasted in a separate SIB (i.e. different from SIB1).

6 SNPN selection functions similar to normal PLMN selection: AS reports the found SNPNs (identified by PLMN ID + NID) to NAS which selects the network. In case of manual selection, the human readable network name (if broadcasted) may also be provided from AS to NAS.

7 Once the UE has selected an SNPN, cell selection/re-selection is only performed within the SNPN, i.e. a cell is only considered suitable if the broadcasted SNPN identifier matches the selected SNPN.

Agreements

1 The PNI-NPNs (identified by PLMN ID + CAG ID) are broadcasted in SIB1

FFS whether this is achieved by extending the legacy network list or by introducing a new PNI-NPN specific network list or both

2 The size and format of the CAG ID will not be discussed in RAN2 (we will be informed by other groups)

3 Up to 12 different PNI-NPNs can be broadcasted in a cell.

4 If HRNN are broadcast then the HRNN should a be broadcasted in a separate SIB (i.e. different from SIB1).

5 Network selection is triggered by NAS whereby AS reports the available PNI-NPNs (identified by PLMN ID + CAG ID) to NAS which selects the network to use. In case of manual network selection, the human readable network name (if broadcasted) may also be provided from AS to NAS.

6 The Allowed CAG list and “CAG only” indication received from upper layers are taken into account in the cell suitability check during cell selection/re-reselection.

Agreements

1 There is no issue identified to support E1 for Rel-16 UEs.

2 (Regarding question E2) Rel-16 UEs not supporting the CAG feature can camp on a CAG cell as an acceptable cell to obtain limited service

3 There is no issue identified to support RS1 for Rel-16 UEs

4 RS2 and RS3 can be supported from RAN2 point of view

Excerpt from SA2 LS S2-1906814 [1] describing scenarios E1-E2 and RS1-RS3 mentioned in the above agreements are copied below:

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| SA2 discussed support of the following features for Rel-16 UEs:  1. Support for Emergency services in CAG cells.  2. RAN sharing between PLMNs and Non-Public Networks, including both Standalone NPNs (SNPNs) and Public Network Integrated Non-Public Networks (PNI-NPNs).  Regarding Emergency service in CAG cells:  E1: SA2 concluded that the UE should be allowed to camp for Emergency services for the case where UE supports the CAG feature, but is not authorized for any of the advertised CAG IDs.  E2: SA2 could not conclude whether Rel-16 UEs not supporting the CAG feature should be allowed to camp in a CAG cell in limited service state. There is no SA2 consensus to support this scenario.  Regarding RAN sharing:  RS1: SA2 concluded that the system architecture should support RAN sharing between a PLMN and an SNPN. This feature should be applicable to Rel-16 UEs that do not support the SNPN feature.  RS2: SA2 discussed support for RAN sharing between a PNI-NPN (with CAG) and an SNPN. This feature would be applicable to Rel-16 UEs that support either PNI-NPN with CAG or SNPN or both. However, concerns were raised about the additional complexity in the access stratum to support this scenario.  RS3: SA2 could not conclude whether the system architecture should support RAN sharing between a PLMN and a PNI-NPN with CAG i.e. RAN sharing in a cell that acts as a CAG cell for PLMN1 and as a non-CAG cell for PLMN2. There is no SA2 consensus to support this scenario. |