**3GPP TSG-RAN WG2 Meeting #119bis-e** **R2-22xxx**

**Electronic, 10th – 19th October, 2022**

**Source: Huawei, HiSilicon**

**Title: [AT119bis-e][014][NR18] SENSE**

**Document for: Discussion and Decision**

# 1 Introduction

This document aims at gathering and summarizing companies views for the following offline discussion:

* [AT119bis-e][014][NR18] SENSE (Huawei)

Scope: Treat R2-2209304, R2-2209917, R2-2209918, R2-2210098, R2-2210099, R2-2210100, R2-2210515, R2-2210532, R2-2210529, R2-2210618, R2-2210631. Determine agreeable parts, Open points etc., based on agreeable parts, progress LS out. If applicable progress TP / Draft CRs.

Intended outcome: Report, Agreeable LS out, agreeable TP/Draft CR if applicable.

Deadline: For CB W1 Fri

The following contributions are considered in this email discussion according to Chair indication.

By Email [014] (11)

LS-in from CT1:

R2-2209304 LS on SENSE feature (C1-225338, contact: Huawei, Hislicon)

LS-out draft:

R2-2209917 Reply LS on SENSE feature (vivo)

R2-2210532 Reply LS on SENSE feature (Huawei, Hisilicon)

R2-2210631 Draft Reply LS on SENSE feature (Deutsche Telekom)

Discussion paper:

R2-2209918 Discussion on SENSE feature (vivo)

R2-2210098 Discussion on RAN2’s impact of SENSE (OPPO)

R2-2210529 Discussion on RAN Aspects of Signal Level Enhanced Network Selection (Huawei, Hisilicon)

R2-2210618 Discussion on SENSE feature (Deutsche Telekom, Thales, Ericsson, Telecom Italia)

CR:

R2-2210099 36.304 CR on SENSE (OPPO)

R2-2210100 38.304 CR on SENSE (OPPO)

R2-2210515 38.304 CR on SENSE feature (vivo)

# 2 Company contact details

|  |  |  |
| --- | --- | --- |
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| Deutsche Telekom |  |  |
| Qualcomm | Ozcan Ozturk | oozturk@qti.qualcomm.com |

# 3 Discussion

**Question 1: Do you have any comment on the LS-in (R2-2209304)?**

Companies please to provide comment and answer on Question 1 in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Answer (Yes/No) | Comment |
| Vodafone | no |  |
| Huawei | No |  |
| Apple | No |  |
| Samsung | No |  |
| CATT | No |  |
| Deutsche Telekom | No |  |
|  |  |  |

**Question 2: whether the UE-AS needs to be aware of the SENSE-threshold? If “Yes”, what does the UE-AS do with the SENSE-threshold?**

Related text quoted from contributions is provided in the following table for discussion reference.

|  |  |
| --- | --- |
| Contribution | Related text |
| R2-2209918  (vivo) | From our understanding, Operator controlled signal threshold are visible for both UE AS layer and upper layers. The upper layers and AS layer can use this signal threshold for PLMN selection and cell selection, respectively. |
| R2-2210515  (vivo) | If Operator controlled signal threshold per access technology is configured, it’s up to UE implementation how to derive cell measurement quantity (e.g., derived by the highest beam measurement quantity value or the linear average of the power values of up to nrofSS-BlocksToAverage of highest beam measurement quantity values above absThreshSS-BlocksConsolidation). |
| R2-2210098  (OPPO) | To realize this feature, UE AS layer needs to be aware of the new threshold and report those PLMNs which have met the operator control signal threshold independently of high-quality PLMNs. |
| R2-2210100  (OPPO)  Note: similar proposal in R2-2210099 | If the Operator controlled signal threshold for NR is provided by NAS and if the UE can read one or several PLMN identities in the strongest cell or the multiple strongest cell(s) in case of operation with shared spectrum channel access, each found PLMN (see the PLMN reading in TS 38.331 [3]) shall be reported to the NAS as an Operator controlled quality PLMN (but without the RSRP value) and any associated CAG-ID, provided that the following Operator controlled signal threshold criterion is fulfilled:  1. For an NR cell, the measured RSRP value shall be greater than or equal to the Operator controlled signal threshold. |
| R2-2210529  (Huawei) | Proposal 3: SENSE capable UE needs to consider the “Operator controlled signal threshold per access technology” during the cell selection procedure. |
| R2-2210618 (Deutsche Telekom) | From this, it is clear that in case the “Operator controlled signal threshold” is set on the USIM, the UE additionally applies the Operator controlled signal threshold as an additional criterion in each step of the selection process inside NAS, with no RAN2 impact expected on the current support for PLMN selection process as defined in TS 36.304.  Observation 1: Having analysed the SENSE feature, it is clear that, for this feature to work, there is no impact on legacy interfaces between upper layers and AS layer for support of PLMN selection. Hence there is no need to discuss or change any RAN2 specifications to support of the SENSE feature or any further optimisation in RAN2 for cell selection. |

Companies please to provide answer on Question 2 in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Answer (Yes/No) | If “Yes”, what does the UE-AS do with the SENSE-threshold? |
| Vodafone | no | In our understanding the sense feature is based on NAS and AS would just provide RSRP values to NAS where the sense threshold will be applicable |
| Ericsson | No | SENSE is for **network selection** and is using the SENSE-threshold which is e.g. on the SIM card. **NAS** uses the threshold when performing network selection. NAS will get a list of PLMNs from AS (both high quality PLMNs (above -110 dBm) and other PLMNs (below -110 dBm) for which the measured RSRP will also be provided) and will select network considering the SENSE-threshold.  AS will (and should) report PLMNs to NAS in the same way as today, even if SENSE is applied in NAS. AS does not even need to know that NAS is having a SENSE-threshold.  It seems some propose that AS should get the SENSE-threshold to do some filtering (e.g. avoid reporting some low-quality PLMNs). But that does not bring any benefits in our view. NAS can (completely on its own) filter PLMNs using the threshold, it doesn’t bring any benefits that AS is doing some pre-filtering. |
| Huawei | Yes | Technically, stop at the PLMN selection phase and ignore the subsequent cell selection cannot make the SENSE feature really work.  SENSE-threshold is larger than the S-criterion, If UE-AS does not know the SENSE-threshold but select a cell according to the S-criterion, then the SENSE UE camping on that selected cell may still fail to get desired connection. And cell-reselection may not work if there is no SENSE-satisfied cell in higher priority frequency. |
| Vivo | Maybe | After PLMN is selected by the NAS, the UE AS needs to perform cell selection to find a suitable cell to camp on. If the SENSE-threshold is set on the SIM card or configured by the NAS, the UE AS can use this threshold to find a suitable cell.  But, as the UE should find a suitable cell to camp on ASAP during initial cell selection, it would be better not to enforce the UE AS to use this threshold for cell selection. If there is a neighbouring cell who quality satisfies the SENSE-threshold, the UE is able to reselect to this cell according to the cell reselection procedure, since the RSRP level, UE power class and RRC connection failure attempt times are already considered in the current criteria. So, whether the UE use this SENSE-threshold for cell selection can be left to UE implementation. |
| Apple | No | We prefer leaving the whole SENSE feature to NAS layer. To our understanding, the scenario trying to address is multiple cells belonging to different PLMN(s) are above S-Criteria but the cells with higher prioritized PLMN (PLMN A) cannot meet the Operator controlled signal threshold thus UE would select a cell with lower prioritized PLMN (PLMN B) which meets the Operator controlled signal threshold. Since this feature is only to address stationary devices, it is not likely UE can find another cell of the PLMN with lower priority (PLMN B) which does not meet the Operator controlled signal threshold. Thus we think we do not need to worry about cell re-selection where UE may get stuck with a cell above S-Criteria but lower than the Operator controlled signal threshold. |
| Lenovo | No | Agree with Ericsson, please see the current normative text from TS 38.304:  *If the UE can read one or several PLMN identities in the strongest cell or the multiple strongest cell(s) in case of operation with shared spectrum channel access, each found PLMN (see the PLMN reading in TS 38.331 [3]) shall be reported to the NAS as a high quality PLMN (but without the RSRP value) and any associated CAG-ID, provided that the following high-quality criterion is fulfilled:*   1. *For an NR cell, the measured RSRP value shall be greater than or equal to -110 dBm.*   ***Found PLMNs that do not satisfy the high-quality criterion but for which the UE has been able to read the PLMN identities are reported to the NAS together with their corresponding RSRP values*** *and any associated CAG-ID.* |
| OPPO | Yes | AS layer needs to be aware the SENSE-threshold because for high-quality criterion, there are no RSRP reported to NAS therefore NAS has no idea which PLMN has fulfilled the SENSE-threshold. |
| Samsung | No | The network selection is up to NAS, rather than AS. |
| China Telecom | Yes | If the UE-AS can be aware of the SENSE-threshold, the UE can use the threshold to select a better cell to camp on. |
| CMCC | Maybe | We understand the intention that if UE-AS does not know the SENSE-threshold, then the selected cell may still fail to satisfy SENSE requirements. The details can be further discussed. |
| CATT | See comments | Before we further discuss this question, it is better to first align the root issue of SENSE solving. We think the issue is multiple cells belonging to different PLMN(s) are above S-Criteria but the cells with higher prioritized PLMN (PLMN A) cannot meet the Operator controlled signal threshold thus UE would select a cell with lower prioritized PLMN (PLMN B) which meets the Operator controlled signal threshold.  Next, for PLMN selection, there will be AS&NAS combined procedure consists of 3 parts: AS->NAS; NAS PLMN selection; AS cell selection. When we talk about the solution, we should clarify which procedure what we are talking about.  Finally, potential solutions can be further discussed combined with spec impact analysis. |
| LGE | No | For now, we do not see outstanding issue to change existing AS behaviors by SENSE-threshold. If SENSE-threshold is configured to NAS, NAS can select a lower priority PLMN with better signal quality than a higher priority PLMN with worse signal quality. Then, AS can select/reselect a cell belonging/relevant to the selected PLMN as per legacy.  However, we consider the following case to see if there should be some impact to AS. The case is here: UE is camping on a cell of a lower priority PLMN selected based on SENSE-threshold. Assume that the cell quality is initially above the SENSE-threshold. But due to UE mobility or cell reselection to e.g., inter-frequency cell (higher reselection priority cell), UE then happens to camp on a cell whose quality is lower than SENSE-threshold. For now we do not think this is frequent or very problematic, but we may have to discuss if it is a problem or not. If it is considered problematic, we can simply let UE AS to report the quality of the current cell (PLMN) to NAS such that NAS can possibly trigger PLMN selection, rather than letting UE AS consider the threshold for cell selection/reselection. For this approach, UE suffices to periodically report the current PLMN(cell) quality to NAS (i.e., no need for awareness of SENSE-threshold value). |
| Deutsche Telekom | No | SENSE feature, proposed to address problems experienced by stationary IoT devices with data connectivity, refers to network selection procedure that is up to NAS. |
| Qualcomm | No | All the selection should be done by NAS. A proper UE implementation will pass all the cell measurements to NAS for this purpose. There shouln’t be any decision making at AS. |

**Question 3: whether the NAS→AS interface needs to be enhanced? If “yes”, what enhancements are needed and whether such enhancements need to be specified?**

Related text quoted from contributions is provided in the following table for discussion reference.

|  |  |
| --- | --- |
| Contribution | Related text |
| R2-2209918  (vivo) | If there is any interaction between upper layers and AS layer on forwarding this signal threshold, this is totally the internal implementation of the device, as what we have done for IMSI. IMSI is NAS parameter but also used at AS layer for paging occasion calculation, while there is no text indicating NAS forwards IMSI to AS layer.  …  Proposal 1 No need to specify the interaction between AS layer and upper layers for PLMN selection for SENSE feature. |
| R2-2210100  (OPPO)  Note: similar proposal in R2-2210099 | If the Operator controlled signal threshold for NR is provided by NAS and if the UE can read one or several PLMN identities in the strongest cell or the multiple strongest cell(s) in case of operation with shared spectrum channel access, each found PLMN (see the PLMN reading in TS 38.331 [3]) shall be reported to the NAS as an Operator controlled quality PLMN (but without the RSRP value) and any associated CAG-ID, provided that the following Operator controlled signal threshold criterion is fulfilled:  1. For an NR cell, the measured RSRP value shall be greater than or equal to the Operator controlled signal threshold. |
| R2-2210529  (Huawei) | We believe the interface between the UE AS and NAS needs a certain enhancement, the “Operator controlled signal threshold per access technology” should be provided along with the selected PLMN ID in step 4.  Proposal 2: the UE NAS provides the “Operator controlled signal threshold per access technology” with the selected PLMN ID to the UE AS, and updates the “Operator controlled signal threshold per access technology” when the previously delivered “Operator controlled signal threshold per access technology” changed. |
| R2-2210618 (Deutsche Telekom) | Observation 1: Having analysed the SENSE feature, it is clear that, for this feature to work, there is no impact on legacy interfaces between upper layers and AS layer for support of PLMN selection. Hence there is no need to discuss or change any RAN2 specifications to support of the SENSE feature or any further optimisation in RAN2 for cell selection. |

Companies please to provide view and answer on Question 3 in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Answer (Yes/No) | If “Yes”, what enhancements are needed and whether need to specify the enhancements? |
| Vodafone | No | We currently do not see a reason to enhance this interface.  If my understanding is correct: Also the step 4 of R2-2210529 is in our view probably not really needed. I guess the functionality discussed here is described in DT document under: “In the unlikely case that the “Operator controlled signal threshold” is set, but no PLMN is above the defined threshold, NAS may perform a second iteration of the process, i.e., without applying the “Operator controlled signal threshold” (Figure 3), which is the legacy PLMN selection process defined in TS 22.011. |
| Ericsson | Np | Agree with Vodafone |
| Huawei | Yes | The interface needs to be enhanced for delivering the SENSE-threshold from NAS to AS, since AS needs the SENSE-threshold for cell selection.  SENSE-threshold can be updated, so whenever the delivered SENSE-threshold changes, NAS needs to inform AS of the lasted SENSE-threshold.  We think above enhancements need to be specified, since current clause 4.1 of TS 38.304 already specifies NAS to provide the selected PLMN, associated RAT(s), EPLMNs etc. to AS. |
| Vivo | No | This is the internal implementation of the device, we do not see the need to specify this interaction. |
| Apple | No | As said above, we don’t think cell reselection should be enhanced based on the Operator controlled signal threshold. |
| Lenovo | No |  |
| OPPO | Yes | NAS needs to inform the SENSE-threshold to AS. |
| Samsung | No | It’s optimization resulting in AS impact, and it is not required |
| China Telecom | Yes | NAS needs to inform the SENSE-threshold to AS. |
| CMCC | Yes | It is beneficial that NAS informs the SENSE-threshold to AS. |
| CATT | See comment | Before we further discuss this question, it is better to first align the root issue of SENSE solving.We think the issue is multiple cells belonging to different PLMN(s) are above S-Criteria but the cells with higher prioritized PLMN (PLMN A) cannot meet the Operator controlled signal threshold thus UE would select a cell with lower prioritized PLMN (PLMN B) which meets the Operator controlled signal threshold.  Next, for PLMN selection, there will be AS&NAS combined procedure consists of 3 parts: AS->NAS; NAS PLMN selection; AS cell selection. When we talk about the solution, we should clarify which procedure what we are talking about.  Finally, potential solutions can be further discussed combined with spec impact analysis. |
| LGE | No for now but | As said for Q3, we consider the following case to see if there should be some impact to AS. The case is here: UE is camping on a cell of a lower priority PLMN selected based on SENSE-threshold. Assume that the cell quality is initially above the SENSE-threshold. But due to UE mobility or cell reselection to e.g., inter-frequency cell (higher reselection priority cell), UE then happens to camp on a cell whose quality is lower than SENSE-threshold.  For now we do not think this is frequent or very problematic, but we may have to discuss if it is a problem or not. If it is considered problematic, we can simply let UE AS to report the quality of the current cell (PLMN) to NAS such that NAS can possibly trigger PLMN selection, rather than letting UE AS consider the threshold for cell selection/reselection. For this approach, UE suffices to periodically report the current PLMN(cell) quality to NAS (i.e., no need for awareness of SENSE-threshold value). |
| Deutsche Telekom | No | Agree with Vodafone’s comments. No enhancement is required as explained in the unlikely example of Figure 3 of R2-2210618. |
| Qualcomm | No | Agree with VDF |

**Question 4: whether the AS→NAS interface needs to be enhanced? If “yes”, what enhancements are needed and whether such enhancements need to be specified?**

Related text quoted from contributions is provided in the following table for discussion reference.

|  |  |
| --- | --- |
| Contribution | Related text |
| R2-2209918  (vivo) | When *Operator controlled signal threshold per access technology* is configured and this is visible for AS layer, the AS layer can only report the PLMNs which ulfil *Operator controlled signal threshold per access technology*. However, this does not bring much benefit but may result in NAS layer cannot know the reported PLMN is high-quality PLMN or the PLMN just satisfies *Operator controlled signal threshold*, which may impact the PLMN selection scheme in NAS layer. So, there is no need to specify anything on the UE interaction between AS layer and upper layers. |
| R2-2210100  (OPPO)  Note: similar proposal in R2-2210099 | If the Operator controlled signal threshold for NR is provided by NAS and if the UE can read one or several PLMN identities in the strongest cell or the multiple strongest cell(s) in case of operation with shared spectrum channel access, each found PLMN (see the PLMN reading in TS 38.331 [3]) shall be reported to the NAS as an Operator controlled quality PLMN (but without the RSRP value) and any associated CAG-ID, provided that the following Operator controlled signal threshold criterion is fulfilled:  1. For an NR cell, the measured RSRP value shall be greater than or equal to the Operator controlled signal threshold. |
| R2-2210529  (Huawei) | Proposal 1: SENSE capable UE needs to report the full band scan results for each frequency with RAT indication. |
| R2-2210618 (Deutsche Telekom) | Observation 1: Having analysed the SENSE feature, it is clear that, for this feature to work, there is no impact on legacy interfaces between upper layers and AS layer for support of PLMN selection. Hence there is no need to discuss or change any RAN2 specifications to support of the SENSE feature or any further optimisation in RAN2 for cell selection. |

Companies please to provide view and answer on Question 4 in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Answer (Yes/No) | If “Yes”, what enhancements are needed and whether need to specify the enhancements? |
| Vodafone | No |  |
| Huawei | Yes | SENSE-threshold is configured per access technology, current sub-clauses 5.1.1.2 and 5.1.1.3 of TS 38.304 specify UE-AS to report only PLMN ID and RSRP value/high-quality to UE-NAS, so UE-NAS does not know the reported RSRP value/high-quality is for which access technology, consequently the UE-NAS does know which SENSE-threshold (per access technology) should be used to filter out the PLMN ID(s). So associated RAT info also need to be reported with the RSRP/high-quality & PLMN ID.  We think above enhancements need to be specified. |
| Vivo | No |  |
| Apple | No |  |
| Lenovo | No |  |
| OPPO | Yes | AS need to provide the PLMN list that fulfilled the SENSE-threshold. |
| Samsung | No | It’s optimization resulting in AS impact, and it is not required |
| China Telecom | Yes |  |
| CMCC | Yes |  |
| CATT | See comment | Before we further discuss this question, it is better to first align the root issue of SENSE solving.We think the issue is multiple cells belonging to different PLMN(s) are above S-Criteria but the cells with higher prioritized PLMN (PLMN A) cannot meet the Operator controlled signal threshold thus UE would select a cell with lower prioritized PLMN (PLMN B) which meets the Operator controlled signal threshold.  Next, for PLMN selection, there will be AS&NAS combined procedure consists of 3 parts: AS->NAS; NAS PLMN selection; AS cell selection. When we talk about the solution, we should clarify which procedure what we are talking about.  Finally, potential solutions can be further discussed combined with spec impact analysis. |
| LGE | No for now but | As said for Q3, we consider the following case to see if there should be some impact to AS. The case is here: UE is camping on a cell of a lower priority PLMN selected based on SENSE-threshold. Assume that the cell quality is initially above the SENSE-threshold. But due to UE mobility or cell reselection to e.g., inter-frequency cell (higher reselection priority cell), UE then happens to camp on a cell whose quality is lower than SENSE-threshold.  For now we do not think this is frequent or very problematic, but we may have to discuss if it is a problem or not. If it is considered problematic, we can simply let UE AS to report the quality of the current cell (PLMN) to NAS such that NAS can possibly trigger PLMN selection, rather than letting UE AS consider the threshold for cell selection/reselection. |
| Deutsche Telekom | No |  |
| Qualcomm | No |  |

**Question 5: whether SENSE feature can be applied to all UEs (include RedCap Ues)?**

Related text quoted from contributions is provided in the following table for discussion reference.

|  |  |
| --- | --- |
| Contribution | Related text |
| R2-2210098  (OPPO) | In NR, industrial sensors are a typical use case for RedCap Ues and RAN2/4 have defined measurement relaxation for stationary RedCap Ues. In our understanding, SENSE feature can be applied to all these Ues. |

Companies please to provide view and answer on Question 5 in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Answer (Yes/No) | View |
| Vodafone | Yes | In my view, the new threshold should be applicable to all Ues. The relaxation and specific of the measurements is one thing the applicability of the threshold is in my view totally different and should be UE cat agnostic |
| Ericsson | - | Not a RAN2 discussion. |
| Huawei | Yes | No specific requirement for RedCap UE to support SENSE feature, agree with Vodafone |
| vivo | - | We should only discuss the questions asked in CT1 LS. Whether to apply this feature to RedCap UE shouldn’t be discussed here, and currently a specified threshold offset has been introduced for RedCap UE for cell (re)selection). |
| Apple | See comments | Though we are open to discuss if RedCap is in the scope, for now, seems only LTE is mentioned in SA1 CR. |
| Lenovo |  | Not a RAN2 decision – our specification do not prohibit eitherways. |
| OPPO | Yes |  |
| Samsung | Maybe | It may depend on operators’ intention. |
| China Telecom | - | Not a RAN2 discussion. |
| CMCC | Yes |  |
| CATT | No | Accord to SA1’s information, we think SENSE is just for stationary devices. Just wonder whether we can classified redcap UE into stationary devices? |
| LGE | - | Not sure if we have to discuss this |
| Deutsche Telekom | See comments | According to SA1 CR, SENSE feature is applicable “*For UEs supporting any, or a combination, of NB-IoT, GERAN EC-GSM-IoT and Category M1 or M2 of E-UTRA*”. |
| Qualcomm | Not applicable | This is not within RAN2 scope. |

# 4 Conclusion

*To be filled*