**3GPP T****SG-RAN WG2 Meeting #123bis R2-230xxxx**

Xiamen, China, 9- 13October, 2023

Agenda Item: 7.13.7

Source: CATT

Title: [Post123][559][R18 SONMDT] Open issues of SONMDT for NPN (CATT)

Document for: Discussion and Decision

# Introduction

This document is the report of the following email discussion,

* **[Post123][559][R18 SON/MDT] SON/MDT for NPN (CATT)**

Discussion the following FFS issues from FFS1-FFS3

Output: Report

Deadline: long

Please provide your comments before Sep. 26th, 00:00 UTC

# Contact Information

Participants are encouraged to leave their contact information in the following table.

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# Discussion

In RAN2#123 meeting, agreements on SON/MDT for NPN achieved by companies are concluded as follows:

Agreements:

1 Include SNPN ID (list) in the logged MDT area configuration following RAN3 agreement to align with the future NPN evolution.

2 No new UE variables will be introduced for PNI-NPNs.

3 UE performs SNPN ID checking before transmitting the information for corresponding SON and MDT reports, upon the network requests for it.

4 Assuming ESNPN is supported, include a list of SNPN IDs in the logged MDT report.

In this email discussion, some FFS on SON/MDT for NPN are listed, and companies can discuss these issues in more detail:

FFS1: Include UE CAG subscription information in the RLF/HOF report:

- CAG subscription statues indication;

- CAG-only indication.

FFS2: RAN2 to discuss whether and how to address the loss issue of logged MDT report when UE switches between SNPN and PN and then send RAN2 decision to RAN3.

- Option 1: Introducing new variables for SNPNs;

- Option 2: Storing only the collected MDT measurements report (UE deletes the MDT configuration as legacy);

- Option 3: No enhancement is needed;

FFS3: RAN2 to discuss:

- Whether and how to introduce information reporting for OOC analysis involving NPN network;

- Whether and which to introduce other SON/MDT enhancements for NPN in this Release.

## UE CAG subscription information in the RLF/HOF report

Three options are summarized in [1] for UE to report for the UE CAG subscription information in the RLF/HOF report. Since “Allowed CAG list” has been excluded during the meeting, the rest options could be further discussed here:

* Option 1: CAG subscription statues indication (if the UE has subscription with any of the CAG IDs broadcast by the cell, and whether the UE only allowed to access CAG cells);
* Option 2: CAG-only indication;
* Option 3: Other information, if any.

**Question 1: Companies are invited to provide the views on whether and which option should be reported by UE for the UE CAG subscription information in the RLF/HOF report.**

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| **Company** | **Option** | **Comments** |
| Ericsson | Nothing needed | After further checking, we think nothing is needed. A cell can act either as PLMN cell or CAG cell, so the CGI of the cell in the RLF report already describes whether/what CAGs a cell is supporting.  For the sake of mobility robustness optimization, we don’t see any gain by including CAG the subscription information in the RLF report.  We appreciate if companies discuss the use case of these information in the RLF report before deciding which information to log. |
| Vivo | Option 2 | Upon receiving the RLF report, the source cell may optimize the HO-related parameters for some candidate target cells. With the CAG-only indication, the cells that do not support PNI-NPN can be excluded as candida cell. On the other hand, the NW can analyze whether there is a resource allocation issue with the indication if the resources of the public network and private network are separate.  Besides, the indication is beneficial for operators to analyze the performance of PNI-NPN. |
| Nokia | Option 1 | The CAG memberships of the UE influence the UE and network behavior (e.g., during cell reselection, or the target cell selection at HO) and this may impact the service quality (e.g., delays and failures experienced during Hos). Therefore it is reasonable to send this indications to the NW in the report. |
| Huawei, HiSilicon | Nothing needed | We share similar views as Ericsson.  For option 2, CAG-only inndication has been defined in sectio 9.3.3.45 in TS 38.413, and thus last serving gNB can associate the information and UE RLF report to analyze issue. Thus, we see no strong need for UE to report CAG-only indication to network. |
| CATT | Option2 | A cell can act either as PLMN cell or CAG cell, but one CGI could be assoiated to multiple CAGs with the same PLMN ID and the same cell identity. So whether the UE was worked in a CAG-only manner when the RLF/HOF occurred can be a useful information to assist the performance analysis. |
| Qualcomm | Nothing needed | For option 2, similar view as Huawei. This is already known at the last serving gNB.  Option 1 is not clear either. Whether UE has subscription or not to a CAG cell is internal to the UE or informed to the UE by the AMF via NAS signaling right? We never expose such subscription information to gNB and should continue to not expose. |
| Samsung | Nothing needed | We think that network already has this information. |
| Apple | Nothing needed | Shared the view with E/// and QCOM |
| ZTE | Option 2 | Agree with vivo and CATT. Whether UE is working on CAG only mode is beneficial since UE may not be able to reconnect or set-up new connection to a cell due to lack of CAG cells deployed near by. And if the situation happens repeatedly can imply a mismatch between NPN network deployment and UE requirements. |
| Xiaomi | Option2 | We share the same view with vivo and CATT that reporting CAG-only mode is beneficial for development analysis.  Regarding to the Huawei's comments, we wonder if the last serving gNB can always maintain such information until the RLF report is retrieved. We think that UE-based logging and reporting seem more straightforward. |
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**Summary of UE CAG subscription information in the RLF/HOF report**

5 companies (5/10) do not want to introduce anything, i.e. do not support any UE CAG subscription information in the RLF/HOF report;

4 companies (4/10) support Option 2, i.e. introduce CAG-only indication into RLF/HOF report;

1 company (1/10) supports Option 1, i.e. introduce CAG subscription statues indication into RLF/HOF report.

There is no clear majority based on the feedback received. Therefore this could be further discussed during the meeting, to discuss whether to introduce CAG-only indication (when the RLF/HOF occurred) into RLF/HOF report.

**Proposal 1 RAN2 to discuss whether to introduce CAG-only indication (when the RLF/HOF occurred) into RLF/HOF report.**

## Loss issue of logged MDT report when UE switches between SNPN and PN

In RAN3 LS [2], RAN3 would like to check with RAN2 if there are any solutions to avoid the loss of stored logged MDT reports upon moving from a network of one type to another type, even upon deregistration. Based on the summary of discussion provided to the meeting RAN2#123, two solutions have been discussed by RAN2 so far:

- Option 1: Introducing new variables for SNPNs;

- Option 2: Storing only the collected public network MDT measurements report, so upon returning back to the PN, the PN can fetch the MDT report (UE deletes the MDT configuration as legacy);

So first of all, we have to decide whether and how to address the loss issue of logged MDT report when UE switches between SNPN and PN in RAN2.

**Question 2: Companies are invited to provide the views on whether and how to address the loss issue of logged MDT report when UE switches between SNPN and PN in RAN2:**

- Option 1: Introducing new variables for SNPNs;

- Option 2: Storing only the collected public network MDT measurements report, so upon returning back to the PN, the PN can fetch the MDT report (UE deletes the MDT configuration as legacy);

- Option 3: No enhancement is needed;

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| **Company** | **Option(1/2/3)** | **Comments** |
| Ericsson | Option 2 | First we would like to highlight that the mobility between public network (PN) and SNPN is much more frequent than mobility between PNs (moving between countries). Therefore, enhancement is needed to avoid unexpected deleting of at least MDT measurements for the public network  We think Option 2 can be a compromise i.e., upon moving from PN to SNPN, the UE stores only the MDT report, (deletes the MDT configuration), and upon returning to the public network, the network can fetch the collected MDT measurements. |
| vivo | Option 3 | For mobility between PLMNs, such a problem may also occur when the UE moves from one network to another as long as the two networks are not equivalent. However, there is no enhancement mechanism for this problem in legacy.  Besides, the coverage issue can still be identified by the MDT report from other UEs that do not switch between SNPN and PN. |
| Nokia | Option 1 | There is a clear requirement from RAN3 to solve this issue. As SNPN coverage can be sporadic or limited, moving between SNPN and PLMN can happen frequently.  The problem of option 2 is that it means no logged MDT for SNPN, which is a deviation from the objective of the work item. |
| Huawei, HiSilicon | Option 3 | Regarding the loss issue of logged MDT report between SNPN and PN, we understand that RAN3 indicated the issue in their LS. However, we wonder whether it is a corner case or not.  As specified in TS 38.300, when the UE is set to operate in SNPN access mode, the UE only selects and registers with SNPNs. It is our understanding that SNPN Ues only camp on SNPN, and they seldom acccess PN. And smart phone users seldom access SNPN. In summary, the mobility between SNPN and PN for SNPN/PN Ues does not happen frequently, and then we do not think enhancements are needed.  Perhaps operators can clarify the scenario and requirements. |
| CATT | Option 3 | We believe that a smart network can retrieve the required measurement result before being overwritten or cleared. The complexity introduced by this can be avoided in RAN2. |
| Qualcomm | Option 3 | Similar view as HW, CATT and Vivo.  Seems to be a very corner scenario. There might be loss of logged MDT reports only if a UE set to operate in SNPN access mode and configured with logged MDT configuration went to RRC\_IDLE in SNPN, never came back to RRC\_CONNECTED in SNPN and moved to a PLMN.  If the UE came back to RRC\_CONNECTED in SNPN, the network can retrieve the reports and avoid the loss.  The same applies to PLMN 🡪 SNPN mobility as well. |
| Samsung | Option 3 | In our understanding this is not a critical issue and is a corner case. SON works in statistical way and some loss can be tolerated. Moreover, UE doesn’t keep any information with respect to the previously camped network after deregistration and there is no need to keep the logged MDT reports after deregistration. |
| Apple | Option 3 | Agree that mobility between SNPN and PLMN should not happen requently so it is a corner case at best. |
| ZTE | Option 3 | Option 1 can perfectly address the problem with the cost of additional complexity and additional UE costs. If new variable is introduced with additional UE buffer requirement it will increase the UE costs. If the new variable is introduced with shared UE buffer between PN and NPN logged MDT, the overall MDT performance maybe compromised due to decreased UE buffer. We still don’t know how much the gain will be compared to the overall cost, especially considering there are companies consider reselect between NPN and PN may not happen frequently  As explained by vivo, the coverage problem may still be identified by other UEs that still within the network in some extends, which is still acceptable for first release supporting NPN MDT.  To sum-up, we prefer not to do further enhancements in R18. |
| Xiaomi | Optionv3 | Share the same view with above companies that the mobility between PLMN and SNPN is a corner case.  Even if it is not a corner case, we think that data loss can be avoided through network implementation and no enhancement is needed. This is because the NG-RAN is aware of the UE's currently registered network and knows that the UE will perform the deregistration procedure based on the UE context release cause "Deregister." As a result, the NG-RAN can retrieve the report first if it thinks the report is very important. |
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If the answer of Q2 is ‘Option1’, a new SNPN specific variable for logged MDT needs to be introduced. Companies are invited to continue to discuss other detailed about this solution:

a) Whether to introduce storage limitation/ additional memory [3][4][5];

b) Considerations on logged MDT types (signalling/management based) [4].

**Question 3: Companies are invited to provide the views on which issue(s) listed above should be considered for the detailed specification impact involve the new SNPN specific variable for logged MDT.**

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| **Company** | **a/b** | **Comments** |
| Nokia | a) | We think that a new SNPN specific variable is a simple solution to avoid removing logged MDT reports when there is a switch between SNPN and PLMN. Introducing storage limitations is acceptable to avoid UE implementation issues. |
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**Summary of Loss issue of logged MDT report when UE switches between SNPN and PN**

8 companies (8/10) do not want to introduce the enhancement and think it is a corner case and there is no enhancement mechanism for the similar problem in legacy between PLMNs;

1 company (1/10) supports Option 1 to introduce new variables for SNPNs, and 1 company (1/10) supports Option 2 to store only the collected public network MDT measurements report.

As there is clear majority’s support, rapporteur suggests the following:

**Proposal 2 Not introducing any enhancements to address the loss issue of logged MDT report when UE switches between SNPN and PN. RAN2 to send the decision to RAN3 in the reply LS.**

## Others

For out-of-coverage scenario, some companies propose to consider information reporting in RLF/HOF report and logged MDT report for out-of-coverage analysis:

1. UE access mode;
2. OOC cause (e.g., whether due to weak coverage or due to cell being barred);
3. SNPN OOC indication (e.g. in RA report, or CEF report, or new report).

**Question 5: Companies are invited to provide the views on whether and which information listed above can be introduced for OOC analysis involving NPN network:**

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| **Company** | **(None/a/b/c)** | **Comments** |
| Ericsson | c | Out of coverage indication can be added to the RA report or CEF report. Details can be FFS. |
| vivo | None | For RLF report, if CAG-only indication is included in the RLF report, the network can analyze the reason for out-of-coverage based on this indication and noSuitableCellFound indication.  For logged MDT report, UE includes anyCellSelectionDetected in the report if there is no suitable or no acceptable cell found. This indication is sufficient for out-of-coverage analyses since the network will consider there is a coverage hole only if all the UEs (including NPN-capable UE and non-NPN-capable UE) report anyCellSelectionDetected indication. |
| Nokia | None |  |
| Huawei, HiSilicon | None | Share similar views as vivo. |
| CATT | None |  |
| Qualcomm | None |  |
| Samsung | None |  |
| Apple | c | We think this is an important use case which can be addressed relatively easily |
| ZTE | b | Similar to public network, UE operates in NPN might also experience out of coverage situation due to entering the AnyCellSelection state. For NPN UE will goes to any cell selection state due to being barred on all frequencies when the strongest/highest Ranked cells of all of the frequencies doesn’t belong to allowed NPN network, which could imply improper NPN deployment.  Therefore to allow further differentiation the root cause why UE goes to any cell selection state in NPN network additional information(e.g., OOC is due to weak signal strength or due to cell being barred), can be provided in logged MDT report in case OOC is detected. Wherein the cell being barred means the UE was barred and enter into OOC service due to the strongest/highest Ranked cells of all of the frequencies are not the suitable for the unmatched network ID, and the Weak Signal means the UE is out of coverage. |
| Xiaomi | a | In NPN, a UE operating in SNPN access mode or with CAG-only indication may experience an out-of-coverage situation due to the access mode. In order to identify the root cause of the UE entering any cell selection state, the UE access mode can be reported along with the existing OOC indication, which is beneficial for the network analysis. |
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**Summary of OOC**

6 companies (6/10) do not want to introduce any enhancements for OOC analysis involving NPN network;

1 company (1/10) supports to introduce a) UE access mode, 1 company (1/10) supports to introduce b) OOC cause, and 2 companies (2/10) support to introduce c) SNPN OOC indication.

As there is clear majority’s support, rapporteur suggests the following:

**Proposal 3 Not introducing any enhancements for OOC analysis involving NPN network.**

Some companies propose to consider other SON/MDT enhancement use cases for NPN networks. These use cases can potentially be considered quickly, based on the agreed principles made for RLF/HOF report and logged MDT:

1. **For CEF**: Include the SNPN ID into the VarConnEstFailReport and perform checking before sending CEF availability indication;
2. **For L2 measurement**: Report the NPN related information to the TCE together with the L2 measurement (e.g. throughput or data volume measurement);
3. **For RACH report**: UE logs NID in the RA report and checks if NID of the current SNPN matches the SNPN of the previously logged RA reports before logging a new RA report and before transmitting a RA report to the network;
4. **For MHI**: UE logs time spent in the SNPN network in an entry in the existing PN MHI report, and performs PLMN check before transmitting MHI report to network.

**Question 6: Companies are invited to provide the views on whether and which SON/MDT use case(s) listed above should also be considered for NPN enhancement in this Release.**

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| **Company** | **(None/a/b/c/d)** | **Comments** |
| Ericsson | A and C and D | These are functionalities that should be supported in Rel-18 otherwise, it might lead to some privacy/security issues. |
| vivo | a, c, d | Enhancements on RLF and logged MDT can be reused for use cases a, c, d.  Use case b) seems up to RAN3/SA5. |
| Nokia | A, C, D |  |
| Huawei, HiSilicon | A, C, D |  |
| CATT | B, D | Fo B, we think it is simple and necessary to include the NPN information to OAM, since the NPN capable UE may have high priority than other normal UEs for access control or for flow control.  For D, we can simply introduce the NPN related information based on the discussed use cases.  But for A and C, we should first decide whether the ESNPN should be applied for these SONMDT use cases. Then we should discuss whether the NPN ID should be included in the report. Especially for RACH report, since the RACH resource will not be allocated per SNPN, we do not think the NPN ID should be inside the RACH report. The relevant discussions for these cases are not simple, so we suggest that we only discuss simple cases such as B and D in this Release. |
| Qualcomm | A, C, D | **To CATT:** on A & C, even if E-SNPNs are not supported, UE should perform check before sending the RA Report and CEF Report collected in a different SNPN right? Also even for RLF Report, we have added NID in CGI. Makes sense to add NID in other reports as well  Motivation for B is not clear and perhaps not needed. |
| Samsung | See Comments | B and D are not needed. Can discuss on A and C |
| Apple | A and C |  |
| ZTE | A, C | For D we are wondering if current MHI can already log cell of NPN since plmn identity and cell identity will be there. Considering the MHI is used to estimate UE’s mobility states, current information may be sufficient. |
| Xiaomi | A, C |  |
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**Summary of OOC**

9 companies (9/10) support to consider CEF enhancement for NPN networks;

9 companies (9/10) support to consider RA report enhancement for NPN networks;

6 companies (6/10) support to consider MHI enhancement for NPN networks;

1 company (1/10) supports to consider L2 measurement enhancement for NPN networks.

To follow majority’s support, rapporteur suggests considering CEF and RA report for NPN networks in this release. Since we have already discussed the RLF/HOF and logged MDT use cases for NPN networks, similar conclusions could be reached rapidly and repetitive discussions should be avoided.

**Proposal 4 Consider CEF and RA report enhancements for NPN networks in Rel-18. Similar conclusions should be reached rapidly and repetitive discussions should be avoided.**

Since Functional freeze for Rel-18 SONMDT WI will take place by the end of the year, in order to save time, rapporteur lists the potential issues which can be discussed for these two use cases:

* Whether and how to perform NPN ID (e.g.SNPN ID) checking before sending the available indicator and before sending the report;
* Whether and which information (e.g. NID, CAG-ID) should be included in the report;
* Whether E-SNPN should be supported for the case.

**Proposal 5 RAN2 to discuss the issues of NPN ID checking, NPN ID reporting, support of E-SNPN for CEF and RA report enhancements for NPN networks, if proposal 5 is agreed:**

* + - * **Whether and how to perform NPN ID (e.g.SNPN ID) checking before sending the available indicator and before sending the report (if any);**
      * **Whether and which information (e.g. NID, CAG-ID) should be included in the report;**
      * **Whether E-SNPN should be supported for the case.**

**Question 7: Companies are invited to provide other issues may need to be discussed, if any.**

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| **Company** | **Comments** |
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# Conclusion

Based on discussion of above, following proposals are made:

**For easy agreement**

**Proposal 2 Not introducing any enhancements to address the loss issue of logged MDT report when UE switches between SNPN and PN. RAN2 to send the decision to RAN3 in the reply LS.**

**Proposal 3 Not introducing any enhancements for OOC analysis involving NPN network.**

**Proposal 4 Consider CEF and RA report enhancements for NPN networks in Rel-18. Similar conclusions should be reached rapidly and repetitive discussions should be avoided.**

**For online discussion**

**Proposal 1 RAN2 to discuss whether to introduce CAG-only indication (when the RLF/HOF occurred) into RLF/HOF report.**

**Proposal 5 RAN2 to discuss the issues of NPN ID checking, NPN ID reporting, support of E-SNPN for CEF and RA report enhancements for NPN networks, if proposal 5 is agreed:**

* + - * **Whether and how to perform NPN ID (e.g.SNPN ID) checking before sending the available indicator and before sending the report (if any);**
      * **Whether and which information (e.g. NID, CAG-ID) should be included in the report;**
      * **Whether E-SNPN should be supported for the case.**

# Reference

1. R2-2309023, Summary of 7.13.7 SONMDT enhancements for NPN, CATT
2. R3-232118, LS on potential override of logged MDT reports upon moving from SNPN to PLMN, RAN3
3. R2-2307286 Discussion on open NPN issues in SON/MDT Nokia, Nokia Shanghai Bell
4. R2-2307798 Discussion on SON-MDT support for NPN ZTE Corporation, Sanechips
5. R2-2308426 SON Support for NPN Ericsson