3GPP TSG-RAN WG2 Meeting #116-e R2-21xxxxx

E-Meeting, 1st – 12th November, 2021

**Agenda item: 8.3.2**

**Source: vivo**

**Title: Summary of agenda 8.3.2: Paging Collision Avoidance (MUSIM)**

**WID/SID: LTE\_NR\_MUSIM-Core**

**Document for: Discussion and Decision**

# 1 Introduction

This document summarizes the contributions on paging collision avoidance under AI 8.3.2 in RAN2#116e-meeting. This document is organized with sub-sections for the following issues:

* Alternative IMSI calculation in EPS;
* Paging collision solution in 5GS;
* RAN2 specification impact:
  + AS-NAS interaction;
  + Other UE behaviour.

# 2 Discussion

## 2.1 Alternative IMSI calculation in EPS

To solve paging collision issue in EPS, an IMSI offset has been introduced by SA2. Based on IMSI and the configured IMSI offset, the UE can calculate an alternative IMSI which will be used to determine its PF/PO. However, regarding where the alternative IMSI should be calculated, it seems RAN2 agreement is aligned with CT1 specification, but not aligned with SA2 specification.

***SA2:*** *the alternative IMSI is calculated in NAS layer based on the MCC, MNC, MSIN value, MSIN address space, and the IMSI offset. RRC layer only receives the alternative IMSI value from the NAS layer.*

***RAN2:*** *RRC layer knows the IMSI offset and includes it in the UE\_ID formula defined in TS 36.304. In other words, the alternative IMSI is calculated in RRC layer.*

***CT1:*** *the NAS layer forwards the IMSI offset value to RRC layer or indicates the lower layers to erase any IMSI offset value, if available.*

For this issue, the related company proposals at this meeting are summarized in the following table.

|  |  |  |
| --- | --- | --- |
| **Company** | **Tdoc** | **Proposal** |
| ZTE | R2-2109690 | Proposal 2: From Ran2 aspect, the option 1 (The UE upper layer calculates the alternative IMSI value and indicates it to the AS layer) is preferred.  Proposal 3: Send an LS to CT1 and SA2 to indicate Ran2’S understanding and preference. |
| Huawei, HiSilicon | R2-2109766 | Proposal 3: For LTE, NAS forwards Accepted IMSI offset to AS.  Proposal 4: For LTE, AS calculates Alternative IMSI value based on the Accepted IMSI offset received from NAS and uses it for UE\_ID calculation.  Proposal 5: If Proposals 3 and 4 are agreed, send an LS to SA2/CT1 informing of the agreements to align the use of the IMSI offset. |
| Samsung | R2-2109802 | Proposal 6: RAN2 to agree that Alternative IMSI is calculated as defined in TS 23.401 and indicated by upper layer. UE\_ID is calculated as Alternative IMSI mode 1024 when P-RNTI is monitored on PDCCH and Alternative IMSI is indicated by upper layer. |
| China Telecommunications | R2-2110294 | Proposal 1: RAN2 conclude that alternative IMSI is calculated in AS layer and send a LS to inform SA2 of this conclusion. |
| vivo | R2-2110392 | Proposal 1: Alternative IMSI should be calculated in UE RRC layer.  Proposal 8: send an LS to SA2 about RAN2’s preference on paging collision issue for both EPS and 5GS, as in Section 5 Appendix. |

According to the above proposals, we observe that there is no clear majority view on this issue:

* 3/5 companies think the alternative IMSI should be calculated in RRC layer;
* 2/5 companies think the alternative IMSI should be calculated in NAS layer.

Given that RAN2 agreement is aligned with CT1 but not SA2, no matter RAN2 agrees that the alternative IMSI should be calculated in RRC layer or not, RAN2 needs to send an LS to SA2 and CT1 to indicate to them our preference. Thus, the rapporteur makes the following proposal:

**Proposal 1: for EPS, RAN2 to decide in which layer the alternative IMSI should be calculated, i.e., RRC or upper layer. Send an LS to SA2 and CT1 to indicate RAN2’s preference.**

## 2.2 Paging collision solution in 5GS

To solve paging collision issue in 5GS, SA2 has specified in TS 23.502 that a MUSIM UE, upon detection of PO collision, simply triggers the MRU procedure to get a new 5G-GUTI assigned. With this in mind, some companies (3/5) think there is no need for the RAN2 to study any supplementary solution for paging collision avoidance for NR with 5GC. However, some companies (2/5) think that 5G-GUTI reallocation cannot work in all cases, thus support some other solutions (option 2b or RAN-based solution) to supplement.

The related company proposals at this meeting are summarized in the following table.

|  |  |  |
| --- | --- | --- |
| **Company** | **Tdoc** | **Proposal** |
| Huawei, HiSilicon | R2-2109766 | Proposal 1: For the paging collision avoidance in NR+NR, RAN2 will follow the conclusion from SA2 [4] and confirm that there is no impact to any AS specifications. There is no need to discuss any further optimizations. |
| Samsung | R2-2109802 | Proposal 1: Option 1 for *UE-requested 5G-GUTI reassignment* is adopted as paging collision avoidance solution for 5GS.  Proposal 2: Option 2b and Option 3 are not adopted as independent solutions or as complementary solutions to Option 1 for 5GS. |
| Qualcomm | R2-2110190 | Proposal 1: For NAS based solutions, introduce a new ID offset parameter which is added to 5G-S-TMSI in PO calculation. The AMF allocates this along with GUTI.  Proposal 4: For NAS/AS based solution, RAN2 to consider introducing different PF/PO offset(s) which are used by UE(s) that report paging collision problem to the NW. |
| vivo | R2-2110392 | RAN2 to adopt 5G-GUTI reallocation (option 1) to solve paging collision issue in 5GS for RRC\_INACTIVE. |
| LG | R2-2111020 | Proposal 1. RAN2 uses Option 2b to solve the paging collision issue in 5GS. |

There is no clear majority view on this issue. RAN-based solutions have been discussed for several meetings but we still have no related conclusions, while option 2b has been adopted in EPS which can be easily applied to 5GS. For progressing this objective, the rapporteur suggests to only discuss the necessity of option 2b and makes the following:

**Proposal 2: RAN2 to discuss whether to support Option 2b (UE ID offset) as a complementary solution to the Option 1 (5G-GUTI reassignment via MRU) agreed by SA2 for 5GS.**

Besides, one contribution mentioned that in the agreed 23.502 CR for GUTI re-allocation, the AMF will not be aware whether the Mobility Registration Update from a MUSIM UE is due to actual mobility or paging collision. Thus, the contribution proposes the following:

|  |  |  |
| --- | --- | --- |
| **Company** | **Tdoc** | **Proposal** |
| Qualcomm | R2-2110190 | Proposal 2: RAN2 should act upon the RAN2#113bis-e agreement and request SA2/CT1 to introduce an explicit signaling for paging collision in the NAS Registration Request. |

In rapporteur’s understanding, RAN2 has sent an LS in which the above aspect has been indicated to SA2, and the decision can be up to SA2. So, the rapporteur understands a new LS may not be needed unless option 2b is agreed by RAN2 to handle paging collision issue in NR with 5GC. Therefore, the rapporteur makes the following proposal:

**Proposal 3: If Option 2b is adopted to handle the paging collision issue in 5GS, request SA2/CT1 to introduce an explicit signaling for paging collision in the NAS Registration Request.**

In addition, one contribution suggests RAN2 to confirm E-UTRA with 5GC is in the scope of MUSIM WID, and the solution we agreed for NR with 5GC is the baseline solution for this scenario.

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| --- | --- | --- |
| **Company** | **Tdoc** | **Proposal** |
| OPPO | R2-2109407 | Proposal 3: RAN2 confirm that E-UTAN connected to 5GC scenario is also in the WID scope for paging collision avoidance.  Proposal 4: For paging collision avoidance in E-UTAN connected to 5GC scenario, NR solution can be the baseline. The details can be discussed further. |

If RAN2 agrees to support option 1 or option 1 with option 2b for NR, it seems a common understanding that the agreed solution can be applied to E-UTRA with 5GC. Thus, the rapporteur proposes the following:

**Proposal 4: RAN2 confirms that E-UTRA connected to 5GC scenario is also in the WID scope for paging collision avoidance. The solution agreed for NR is the baseline solution for this scenario.**

## 2.3 RAN2 specification impact

### 2.3.1 AS-NAS interaction

The potential AS-NAS interaction for paging collision issues are listed as below:

* **Paging collision indication in both NR/LTE:** upon paging collision is detected, the AS layer needs to inform the NAS layer about the paging collision issue.
* **UE assistance information in LTE:** 
  + Upon paging collision is detected, the UE AS layer may indicate to upper layer an IMSI Offset or may indicate upper layer to remove the existing IMSI Offset.
  + AS layer receives an IMSI Offset from upper layer, and stores it to calculate alternative IMSI.If the upper layers indicate AS layer to remove IMSI offset value, AS layer removes IMSI offset, if exist.
* **UE assistance information in NR:** a preferred offset value or related information helping the decision of offset should be transferred from UE AS to UE NAS.

The related company proposals at this meeting are summarized in the following table.

|  |  |  |
| --- | --- | --- |
| **Company** | **Tdoc** | **Proposal** |
| OPPO | R2-2109407 | Proposal 1: For paging collision avoidance, even if NAS assistant information is introduced by SA2, RAN2 will not specify any AS-NAS interaction to assist the generation of NAS assistant information.  Proposal 2: For paging collision avoidance, RAN2 will not specify any AS-NAS interaction to indicate UE NAS the detection of paging collision issue. |
| Samsung | R2-2109802 | Proposal 5: If NAS assistance information on 5GC is supported, Access Stratum in the MUSIM UE builds it, when needed, for paging collision avoidance and provides same to NAS to signal to the network. It is left to UE implementation and there is no specification impact. |
| China Telecommunications | R2-2110294 | Proposal 2: RAN2 specify the interaction between AS and NAS layers during paging collision avoidance procedure.  Proposal 3: When paging collision is detected, AS layer may indicate to upper layers an IMSI Offset with the aim of modifying the timing of the Paging Occasions to avoid paging collisions.  Proposal 4: AS layer may indicate upper layers to remove the existing IMSI Offset.  Proposal 5: If the upper layers indicate an IMSI Offset, AS layer stores the IMSI offset value and use it to calculate alternative IMSI.  Proposal 6: If the upper layers indicate AS layer to remove IMSI offset value, AS layer removes IMSI offset, if exist. |
| vivo | R2-2110392 | Proposal 2: In EPS, the accepted IMSI Offset should be sent from UE NAS to UE AS.  Proposal 4: In EPS, upon paging collision is detected, an indication, as well as requested IMSI Offset (if any), shall be sent from UE AS to UE NAS.  Proposal 7: In 5GS, upon paging collision is detected, an indication, as well as the assistant information (if agreed), shall be sent from UE AS to UE NAS. |
| LG | R2-2111020 | Proposal 3. For assistance information, a preferred offset value or related information helping the decision of offset should be transferred from UE AS to UE NAS. |

According to the above proposals, there is no clear majority view on this issue:

* One company thinks the paging collision issue needs to be indicated to the UE NAS layer by UE AS layer.
* 3/5 think RAN2 needs to specify the AS-NAS interaction for UE assistant information in EPS, while 2/5 companies think it can be left to UE implementation.

Thus, the rapporteur suggests the following:

**Proposal 5: RAN2 to discuss whether to specify that UE AS indicates to UE NAS that paging collision issue is identified.**

**Proposal 6: RAN2 to discuss whether to specify the AS-NAS interaction for UE assistant information for EPS.**

### 2.3.2 Other UE behaviour

In RAN2#113bis meeting, RAN2 made the below FFS:

**Agreements**

1 MUSIM UE determines potential paging collision on two networks and triggers actions on potential paging collision avoidance.

2 It is left to UE implementation as to how it selects one of the two RATs/networks for paging collision avoidance.

* FFS if we can make the UE behaviour predictable for paging collision avoidance

For this issue, the related company proposals at this meeting are summarized in the following table.

|  |  |  |
| --- | --- | --- |
| **Company** | **Tdoc** | **Proposal** |
| Huawei, HiSilicon | R2-2109766 | Proposal 2: No need to have predictable behaviour on how UE selects one of the two RATs/NWs to address the paging collision issue. |
| Samsung | R2-2109802 | Proposal 3: RAN2 does not specify how to make predictable UE behavior for RAT/Network selection to avoid paging collision i.e. it is up to UE implementation. Text proposals to 38.300 and 36.300 given in annexure are adopted.  Proposal 4: No UE behavior is specified w.r.t. triggering time for paging collision avoidance, during the paging collision resolution procedure, no response for paging collision indication from network. |
| vivo | R2-2110392 | Proposal 3: Paging collision detection is performed at UE AS, how to detect paging collision is left to UE implementation.  Proposal 7: RAN2 will not specify how the UE in RRC\_CONNECTED to solve the potential paging collision that happens after RRC connection release. |
| Lenovo | R2-2109721 | Proposal 1: RAN2 specify rules (e.g. after how many anticipated collisions) for a UE to declare paging collision and seek network’s assistance.  Proposal 2: Paging collision is defined as inability to receive paging in two (or more) systems irrespective of if a direct overlap of the paging occasions exists, assuming finite retuning time between the two Systems.  Proposal 3: UE sends a RRC message seeking paging assistance from the network when it can’t solve the paging collision by itself.  Proposal 4: UE transmits the paging collision indication to network B if no response is received for a while (one timer) after transmitting the paging collision indication to network A. Therefore, the time duration should be specified for UE to reselect another network for paging collision indication.  Proposal 5: RAN2 agrees with the understanding of proposal 1 to proposal 4.  Proposal 6: To monitor SI change, if the UE’s own paging occasion collides with the PO of other USIM, UE shall monitor for SI change indication in any paging occasion at least once per modification period or in every DRX cycle. Similarly, for ETWS or CMAS capable UEs in RRC\_IDLE or in RRC\_INACTIVE state. |

According to the above proposals, there seems a clear majority view on that there is no need to define any other detailed UE behavior, for example, predictable UE behavior, how to declare paging collision, and how to select the network or the triggering timing for reporting paging collision issue. Thus, the rapporteur would like to give the below proposal:

**Proposal 7: RAN2 to discuss whether to specify any other detailed UE behavior, including how to make predictable UE behavior for RAT/Network selection to avoid paging collision, rules for declaring paging collision issue, and RAT/Network selection for reporting paging collision issue.**

# 3 Conclusion

**Proposal 1: for EPS, RAN2 to decide in which layer the alternative IMSI should be calculated, i.e., RRC or upper layer. Send an LS to SA2 and CT1 to indicate RAN2’s preference.**

**Proposal 2: RAN2 to discuss whether to support Option 2b (UE ID offset) as a complementary solution to the Option 1 (5G-GUTI reassignment via MRU) agreed by SA2 for 5GS.**

**Proposal 3: If Option 2b is adopted to handle the paging collision issue in in 5GS, request SA2/CT1 to introduce an explicit signaling for paging collision in the NAS Registration Request.**

**Proposal 4: RAN2 confirms that E-UTRA connected to 5GC scenario is also in the WID scope for paging collision avoidance. The solution agreed for NR is the baseline solution for this scenario.**

**Proposal 5: RAN2 to discuss whether to specify that UE AS indicates to UE NAS that paging collision issue is identified.**

**Proposal 6: RAN2 to discuss whether to specify the AS-NAS interaction for UE assistant information for EPS.**

**Proposal 7: RAN2 to discuss whether to specify any other detailed UE behavior, including how to make predictable UE behavior for RAT/Network selection to avoid paging collision, rules for declaring paging collision issue, and RAT/Network selection for reporting paging collision issue.**

# 4 References

1. R2-2109407 Leftover Issues for Paging Collision Avoidance OPPO discussion LTE\_NR\_MUSIM-Core
2. R2-2109690 Remaining Issues on the Paging Collision ZTE Corporation, Sanechips discussion Rel-17 LTE\_NR\_MUSIM-Core
3. R2-2109714 Draft LS on the alternative IMSI ZTE Corporation, Sanechips LS out Rel-17 LTE\_NR\_MUSIM-Core To:CT1,SA2
4. R2-2109721 Definition and solution for paging collision, SI change Lenovo, Motorola Mobility discussion LTE\_NR\_MUSIM-Core
5. R2-2109766 Paging Collision Avoidance Open Issues Huawei, HiSilicon discussion Rel-17
6. R2-2109802 Considerations on Paging Collision Avoidance Samsung discussion
7. R2-2110190 Way forward on paging collision Qualcomm Incorporated discussion
8. R2-2110294 Discussion on misalignment on EPS paging collision avoidance among SA2, CT1 and RAN2 China Telecommunications discussion
9. R2-2110392 Paging collision avoidance vivo discussion Rel-17 LTE\_NR\_MUSIM-Core
10. R2-2111020 Considerations on Paging Collision LG Electronics discussion Rel-17 LTE\_NR\_MUSIM-Core R2-2108724