**3GPP T****SG-RAN WG2 Meeting #112-e R2-2010737**

**Electronic Meeting, November 2nd – 12th, 2020**

**Agenda item:** 8.3.1

**Source:** Intel Corporation

**Title:** [AT112-e][240][Multi-SIM] Reply LS to SA2 (Intel)

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

**Document for:** Discussion and Decision

# Introduction

This is to progress the following email discussion:

* [AT112-e][240][Multi-SIM] Reply LS to SA2 (Intel)

Scope:

* + - Draft LS reply to SA2 based on online agreements (can also include some analysis from email discussion)

Intended outcome:

* + - Discussion summary in [R2-2010737](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_112-e/Docs/R2-2010737.zip) (by email rapporteur) and draft reply LS in [R2-2010738](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_112-e/Docs/R2-2010738.zip).

Deadlines:

* + - Deadline for email discussion report: 2nd week Thu, UTC 1000

Companies are encouraged to provide comments or suggestions until **Nov 11th (Wed) 1400 UTC**

# Discussion

## Paging cause

SA2 has asked the following questions [1]:

**Q1)** *Please confirm the feasibility and overhead of sending a Paging Cause in [Uu] Paging message for EPS and for 5GS. [RAN2, RAN3]*

**Q2)** *Please indicate whether adding the paging cause (e.g. 3-4bits) per UE in the paging message would reduce the number of paging records that could be included in a single paging message, and if so by what magnitude. (For NR and E-UTRA) [RAN2]*

**Q3)** *Please indicate how the paging cause is expected to be supported in RAN nodes (e.g. per PLMN, per TA, per RAN node, per cell) (For NR and E-UTRA) [RAN2, RAN3]*

During online discussions, the following agreements were made:

* Provide SA2 with information on paging cause costs based on the email discussion + contributions. Indicate that this may change if assumptions change.
* From RAN2 perspective, we haven't decided on paging cause feasibility yet.
* RAN2 will evaluate short/long time switching in this WI

From the current progress, the rapporteur would like to suggest reply as in the following four paragraphs:

1. RAN2 couldn’t decide on paging cause feasibility, including how it should be supported in RAN nodes at this meeting. RAN2 will further inform SA2 once decided.
2. For Q2, the overhead of paging cause is expected additional (1 + log2 [number of paging cause]) bits per UE in NR and LTE, if a parallel list (a solution adopted in R16 LTE paging message) is applied for introducing paging causes.
3. This means that, assuming 3 bits paging cause, additional 17 bytes (9 bytes) are expected when keeping the maximum number of paging records in NR (LTE) paging message (which is roughly ~8% for NR and ~6% for LTE increase in size), translating into two or less paging records when fixing the paging message size.
4. The above overhead analysis may be changed based on SA3 feedback.

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### **Question 1A: Any comments or suggestion to the above paragraphs?**

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| **Company** | **Paragraph #** | **Comments / Suggestions** |
| ZTE | 2/3/4 | For the 2) 3), in our paper [R2-2009624](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_112-e/Docs/R2-2009624.zip), we find that  **“**Even with the same Asn.1 coding, the signaling overhead may be different for the different parameters setting methods.” In the paper, we give 2 different parameter setting methods based on the ASN.1 example provided in the [Post111-e][917][Multi-SIM]. Based on the methods 2 (in [R2-2009624](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_112-e/Docs/R2-2009624.zip)), for the 3 bits paging cause, if there are 32 paging records, the size increases only 3.9% (63/1608).  However, we think in the current state, we don’t have enough time to discuss the details. To be safe, we can add the wording of “at most” to the 2) as below:   1. For Q2, the overhead of paging cause is expected additional (1 + log2 [number of paging cause]) bits per UE at most in NR and LTE, if a parallel list (a solution adopted in R16 LTE paging message) is applied for introducing paging causes.   And for the 3), if we adopt the method 2 in the R2-2009624, for the 3bits NR, there would be additional 9 bytes for the NR and 7 bytes for the LTE, thus it can be modified as below, add if companies have concerns, the content newly added in the bracket can be deleted.   1. This means that, assuming 3 bits paging cause, additional 17 bytes (9 bytes) at most (it can be further optimized to 9 bytes for the NR and 7 bytes for the LTE) are expected when keeping the maximum number of paging records in NR (LTE) paging message , which is roughly ~8% for NR and ~6% for LTE increase in size at most (it can be further optimized to ~4% for NR and ~5% for LTE ), translating into two or less paging records when fixing the paging message size.   For the 3) another comment is about the last sentence that “ translating into two or less paging records when fixing the paging message size”, though it’s a right description, but we have some concern that the SA2 may misunderstand that the paging cause will reduce the number of paging records, thus we think it’s better to delete this sentence, or add a further clarification e.g. “whether 3/4 bits paging cause will impact the real deployment about paging volume and coverage is still under RAN2’s discussion”  For the 1), we are OK, but maybe we can use the wording of “ haven't decided ” instead of “ couldn’t decide”. (No strong view on it)  For the 4), our understanding is that the SA3’s feedback will determine whether the paging cause can be indicated in the paging message or not, the analysis on the overhead will not be changed if there is no security issue to include the cause in the paging message. So can we say “Whether indicate the paging cause in the paging message depends on the SA3 feedback”. |
| Vodafone | 1/2/3/4 | From the above analysis it seems clear that RAN 2 believe it is feasible. I think that it is pretty obvious to SA2 that an X bit paging cause will require “log2 [number of paging cause]” bits and at least some form of ‘flag’ to say that the cause value exists.  So it will be perfectly logical that adding 4 bits (flag plus 3 bits of cause value) reduces paging capacity for 40 bit 4G S-TMSIs by about 10%.  My understanding of the “feasibility” question relates to:   1. Does the paging message have mechanisms to carry a paging cause? (and it seems that this is “yes”) 2. Does adding a paging cause require a disproportionate overhead e.g. a one byte “tag” followed by a one byte length field? (and it seems that the answer to this is no.) |
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### **Summary (TBD)**

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### **Question 1B: Any other information to be included in the reply for Paging Cause?**

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| **Company** | **Comments / Suggestions** |
| ZTE | AS the comments to the 3) above, to avoid misunderstanding, its better to clarify that “whether 3/4 bits paging cause will impact the real deployment about paging volume and coverage is still under RAN2’s discussion” |
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### **Summary (TBD)**

## Busy Indication

SA2 has asked the following questions [1]:

**Q4)** *Please indicate an order of magnitude (tens of ms? Hundreds of ms?) of the expected time required to send a (NAS) Busy Indication for USIM A and whether a scheduling gap would be needed for USIM B to do so [RAN2]*

**Q5)** *Please provide feedback if it is feasible (and secure) that the Busy Indication is sent as RRC message instead (no NAS message to the CN) i.e. as a RRC response to paging without requiring an RRC connection [RAN2, RAN3, SA3]*

During online discussions, the following agreements were made:

* Indicate to SA2 that the table 1 is a baseline on the discussion the expected time (in ms) required for UE to send a (NAS) busy indication to Network B.
* From RAN2 point of view, it is feasible that the busy indication is sent as an RRC message with security for RRC\_INACTIVE. FFS how this works.

From the current progress, the rapporteur would like to suggest reply as in the following four paragraphs:

1. RAN2 has discussed based on the following analysis table:



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| Step | Description | Latency in NR [ms] | Latency in LTE [ms] |
| 1 | Monitoring PO and decoding the paging message | 4 | 4 |
| 2 | Delay due to RACH scheduling period | Depend on the PRACH configuration [6.3.3, TS 38211] | 2.5 on average |
| 3 | Transmission of RACH Preamble | Length of the preamble according to the PRACH format [6, 38211] | 1 |
| 4 | Preamble detection and processing in RAN | Tproc,2 (assuming d2,1=0) | 2 |
| 5 | Transmission of RA response | the length of 1 slot | 1 |
| 6 | UE Processing Delay (decoding of scheduling grant, timing alignment, and C-RNTI assignment + L1 encoding of RRC Connection Setup Request) | *N*T,1*+N*T,2*+*0.5ms [8.3, TS 38213] | 4 |
| 7 | Transmission of RRC Connection Setup Request | the length of 1 slot | 1 |
| 8 | Processing delay in RAN (L2 and RRC) | 3 | 3 |
| 9 | Transmission of RRC Connection Setup | the length of 1 slot | 1 |
| 10 | Processing delay in UE of RRC Connection Setup including grant reception | 10 | 15 |
| 11 | Transmission of RRC Connection Setup complete (including NAS Service Request) | the length of 1 slot | 1 |
| 12 | Processing delay in RAN (Uu –> S1-C/NG-C) | 4 | 4 |
| 13 | S1-C/NG-C Transfer delay | T | T |
| 14 | MME/AMF Processing Delay | 15 | 15 |
| 15 | S1-C/NG-C Transfer delay | T | T |
| 16 | Processing delay in RAN (S1-C/NG-C –> Uu) | 4 | 4 |
| 17 | Transmission of RRC Connection Release | the length of 1 slot | 1 |
| NOTE:   1. in step 4, Tproc,2 is used only for evaluation. RAN processing delay may vary depending on the implementation. 2. in step 8, the delays due to inside-gNB/eNB or inter-gNB/eNB communication are not included. Such delays may exist depending on deployment. | | | |

1. From the analysis, RAN2 confirms that at least a few tens of milliseconds are expected from paging reception until delivery of NAS message by RRC (Connection) Setup Complete over Uu.
2. RAN2 also confirms that, from RAN2 point of view, it is feasible to send busy indication as an RRC message with security for RRC\_INACTIVE. RAN2 haven’t discussed for RRC\_IDLE yet.
3. RAN2 haven’t decided on scheduling gap yet. RAN2 will further inform SA2 once decided.

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### **Question 2A: Any comments or suggestion to the above paragraphs?**

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| **Company** | **Paragraph #** | **Comments / Suggestions** |
| ZTE | 1 | Just a s small comments, we just notice that the step 1 of the flowchart, it said:  “1. UE A enter a periodic absence time allowing UE B to Monitor paging”  We know that it’s not a key issue but it conflicts with above paragraph “4).RAN2 haven’t decided on scheduling gap yet.”  Thus to avoid confusion, can we simply say “1, UE B to Monitor paging”?  For this issue, we don’t have strong view, for that the flow chart is just an example, we can follow the majority’s views on whether modify it or not. |
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### **Summary (TBD)**

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### **Question 2B: Any other information to be included in the reply for Busy Indication?**

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| **Company** | **Comments / Suggestions** |
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### **Summary (TBD)**

## Coordinated leaving

SA2 has asked the following questions [1]:

**Q6)** *Please indicate whether it is feasible to define an RRC-based leaving and returning procedure in 5GS/NR. [RAN2, RAN3]*

**Q7)** *Please let us know whether changes to 5GS/E-UTRA (Option 5) to support RRC-based leaving is part of RAN Work Item. [RAN2, RAN3]*

During online discussions, the following agreement was made:

* RAN2 will continue to discuss RRC-based switching/leaving and returning procedure in 5GS/NR when UE is in RRC\_CONNECTED. There may be different mechanisms (short/long, leaving/returning, etc.).

From the current progress, the rapporteur would like to suggest reply as in the following two paragraphs:

1. RAN2 haven’t decided on the feasibility of RRC-based leaving and returning procedure in 5GS/NR when the UE is in RRC\_CONNECTED. RAN2 will further inform SA2 once decided.
2. For now, changes to 5GS/E-UTRA (Option 5) to support RRC-based switching is not part of RAN Work Item. But this may be changed at RAN plenary discussion.

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### **Question 3A: Any comments or suggestion to the above paragraphs?**

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| **Company** | **Paragraph #** | **Comments / Suggestions** |
| ZTE | No Further Comments | We are fine with the current description |
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### **Summary (TBD)**

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### **Question 3B: Any other information to be included in the reply for Coordinated Leaving?**

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| **Company** | **Comments / Suggestions** |
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### **Summary (TBD)**

## Paging Collision Avoidance

SA2 has asked the following questions [1]:

*SA2 would also like to point out that TR 23.761 also contains several solutions for paging reception when paging collisions are detected. These solutions require RAN’s feedback. The solution principles in these solutions can be categorized as follows:*

*-* **Sol 1)** *UE-requested 5G-GUTI reassignment for one USIM using the Mobility Registration Update). However, it should be noted the 5G-GUTI is systematically reassigned by the network during the Mobility Registration Update procedure (as of Rel-15) requires. Proposed for 5GS only.*

*-* **Sol 2)** *Changes related to the UE\_ID (UE Identity Index) that is used for calculation of PF/PO only:*

*-* **A)** *Calculation of PF/PO by using an Alternative UE\_ID I. The UE ID sent in the paging message is not impacted by this Alternative ID that is only used for PO/PF calculations Proposed for both EPS and 5GS.*

*-* **B)** *Calculation of PF/PO by using a UE\_ID which is derived from IMSI+offset value. The offset value is negotiated between UE and MME. Proposed for EPS only.*

*-* **C)** *Calculation of PF/PO based on MUSIM Assistance Information which can carry either a paging policy selector in RAN or an Alternative ID (like in solution above) or a pattern of availability (e.g. specific SFN Slots/ DRX cycles).*

*-* **Sol 3)** *Repeating paging in the RAN on consecutive POs. for MUSIM devices.*

*-* **Sol 4)** *UE Implementation-based solution to address overlapping POs (like today)*

*-* **Sol 5)** *Access Stratum-based solution with scheduling gap.*

**Q8)** *SA2 would like to ask RAN2 whether these approaches are all feasible and effective for paging reception when paging collisions are detected in 5GS and in EPS respectively.*

**Q9)** *SA2 would like to ask RAN2 and RAN3 to take these solutions into consideration and provide feedback including proposals from RAN that SA2 may have not yet considered.*

**Q10)** *Some companies in SA2 believe that the RAN plenary decision on “No E-UTRA impact” restriction is only related to layers RRC and below. Other companies in SA2 believe that the restriction also includes no impact to S1\_AP and NG\_AP. It would be helpful for SA2 to get the correct definition of the WI restriction from RAN WGs.*

During online discussions, the following agreements were made:

* From RAN2 point of view, Option 1 , 2a, 2b, and 3 are feasible to solve the paging collision issue in 5GS. Each have different effectiveness (as per analysis during the email discussion). When indicating reply to SA2, indicate both feasibility as well as effectiveness.
* Indicate to SA2 that RAN2 continues to further evaluate the pros and cons of options 1, 2a, 2b, 3.
* Option 4 is still allowed (but RAN2 will not specify UE implementation).
* Clarifying "No E-UTRA impact" can be done in RANP.
* Option 2c can be evaluated later as it doesn't work alone.

From the current progress, the rapporteur would like to suggest reply as in the following three paragraphs:

1. From RAN2 point of view, Solution 1, 2a, 2b, and 3 are feasible to solve paging collision issue in 5GS. RAN2 will continue to evaluate their pros and cons baselined on the following effectiveness analysis:

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| **Solution** | **Advantage** | **Disadvantage** | **RAN spec impact** |
| Solution 1 | Less signalling overhead over Uu | Without UE assistant info, a new assigned 5G-GUTI/alternative UE\_ID/offset may still result in PO collisions  Paging collision may occur after cell reselection in which UE needs to request new 5G-GUTI/alternative UE\_ID/offset again. | No impact. |
| Solution 2a | Change the legacy way to calculate PF/PO. |
| Solution 2b | Change the legacy way to calculate PF/PO. |
| Solution 3 | Paging collision can be totally solved. | Could result in significant Uu signaling overhead | UE is required to at least monitor one PO in a single DRX among consecutive DRX cycles. |

1. From RAN2 point of view, Solution 4 is still allowed but won’t be specified. From RAN2’s understanding, Solution 2c cannot work alone so it may be evaluated later.
2. RAN2 also decided to clarify "No E-UTRA impact" at RAN plenary discussion. RAN2 will further inform SA2 once decided.

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### **Question 4A: Any comments or suggestion to the above paragraphs?**

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| **Company** | **Paragraph #** | **Comments / Suggestions** |
| ZTE | No Further Comments | We are fine with the current description |
| Vodafone | Paragraph 7, Solution 3 | Even when paging occasion collisions are NOT occurring, Solution 3 has a battery life impact on all other UEs in the UE’s TAI list as it causes them to have to read (and then discard) many more paging messages. (I’m not very knowledgeable on LTE-M paging but this may be particularly damaging for any LTE-M devices implementing WUS.) |
| Vodafone | Paragraph 8 | UE implementation solutions are likely to lead to paging retransmissions (either RAN or CN based) that cause a battery life impact on other UEs – but this is only when PO collisions are occurring. |

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### **Summary (TBD)**

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### **Question 4B: Any other information to be included in the reply for Paging Collision Avoidance?**

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| **Company** | **Comments / Suggestions** |
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### **Summary (TBD)**

# Conclusion

# Reference

[1] R2-2008754/S2-2006037, “LS on System support for Multi-USIM devices”, To RAN2, RAN3, SA3.

[2] R2-2009325, “Summary of [Post111-e][917][Multi-SIM] Multi-Sim”, Vivo