3GPP TSG-RAN WG2 Meeting #113bis Electronic R2-2104332

Elbonia, April 12 – April 19 2021

**Agenda item: 8.3.3**

**Source: Nokia (RAN2 VC)**

**Title: Summary of [AT113bis-e][231][MUSIM] Impacts of NAS-based busy indication (RAN2 VC)**

**WID/SID: LTE\_NR\_MUSIM-Core - Release 17**

**Document for: Discussion**

# 1 Introduction

This document is the report of the following email discussion:

* [AT113bis-e][231][MUSIM] Impacts of NAS-based busy indication (RAN2 VC)

Scope:

* + - Discuss whether the agreement to only support NAS-based busy indication creates issues with SA2/CT1 and determine whether LS needs to be sent to SA2/CT1.
    - If needed, provide draft LS to SA2/CT1 asking them for feedback

Intended outcome:

* + - Discussion summary in [R2-2104332](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2104331.zip) (by email rapporteur) and (if needed) draft LS in [R2-2104333](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2104331.zip)

Deadline for providing comments and for rapporteur inputs:

* + - Initial deadline (for companies' feedback): 2nd week Mon, UTC 1200
    - Initial deadline (for rapporteur's summary): 2nd week Mon, UTC 1600

Note that this email discussion was declared the day after online session as per following session notes made by the session chair (RAN2 VC, rapporteur of this discussion):

* [200] It was raised that this decision may have unforeseen impacts to SA2/CT1 so session chair declared email discussion [231] to attempt to clarify those.
* [200] discuss over email [231] what are the consequences of this decision, and if there are issues to ask from SA2/CT1, provide a draft reply LS.

# 2 Background

The following was decided in RAN2#113bis-e BO1 online session on Tuesday April 13th:

Agreements

1 Only support NAS-based busy indication (for IDLE and INACTIVE)

The agreement was made after a long debate on whether RAN2 would like to define RAN-based indication for INACTIVE (in contrast to NAS-based indication for IDLE). The discussion had also other alternatives such as 1) using RAN-based paging, 2) using RAN-based paging but allowing UE not to send busy indication in case it cannot do so (e.g. in case of emergency calls), and 3) not specifying busy indication for INACTIVE. Finally the discussion converged to a view that reusing NAS-based signalling could be sufficient as it 1) aligns behaviour in IDLE and INACTIVE (and thus both states support the procedure) and 2) there is only one procedure to consider for busy indication (which minimizes RAN2/SA2/CT1 effort).

**Observation 1:** The intent of the agreement was to minimize RAN2/SA2/CT1 work while support busy indication in INACTIVE.

After the session, some discussion ensued over reflector on whether this would impact SA2/CT1 since the busy indication would be delivered via Service Request, which may not currently support INACTIVE mode. Therefore, either that cannot be used or the same procedure as used for IDLE mode (which uses Service Request) cannot be used, which is contrary to the original intent of aligning procedures for IDLE and INACTIVE to save specification effort.

**Observation 2:** If the SA2/CT1 busy indication behaviour for IDLE cannot be reused for INACTIVE, the intent of the agreement may not be fulfilled.

Therefore, it should be understood whether the agreement makes sense or not. As RAN2 cannot say how much impact there would be to SA2/CT1, and LS would be necessary almost no matter which way the discussion goes.

**Observation 3:** Regardless of the actual procedure for busy indication in INACTIVE, RAN2 should send LS to SA2/CT1 to inform them of the decision and ask whether it poses any issues to them.

The following section then discusses the way forward in RAN2 with the agreement for using NAS-based busy indication for INACTIVE.

# 3 Discussion

There are at least the following three aspects to consider in this discussion:

1. Is it clear that the current agreement will pose issues to SA2 and CT1 (at least in its current form)?
2. Are there any ways to mitigate the technical concerns raised by some companies?
3. If LS is sent to SA2/CT1, what should be indicated and/or asked?

First, RAN2 should be clear on what the most important issues related to the agreement are: So far the issue raised was that Service Request cannot be sent in INACTIVE or CONNECTED, so using that for busy indication (as in IDLE) would require some changes in CT1 for Service Request. Companies should detail these expected issues in the table below and indicate if they disagree with some of the issues, and if new issues are found, those should be added.

**Question 1**: What are the potential issues the decision to use NAS-based busy indication in INACTIVE causes to SA2/CT1?

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| --- | --- | --- |
| Answers to Question 1 | | |
| Description of potential SA2/CT1 issue | Agree [company] | Disagree: Why? [Company]: [Reason] |
| Service Request cannot be sent in INACTIVE or CONNECTED, so using that for busy indication (as in IDLE) would require some changes in CT1 for Service Request | Qualcomm/OPPO. Just to clarify that SR can be sent in 5GMM Connected mode but only for establishing UP resources for PDU sessions or for emergency services fallback. It can’t be sent in response to a paging otherwise. Also note that for CN, both RRC Inactive and RRC Connected are 5GMM Connected.  Apple : Same view as Qualcomm/OPPO. Additionally SA2/CT1 has left the issue of handling BUSY Indication in RRC INACTIVE state to RAN2 decision as per NOTE 3 in 23.761v1.3.0 (conclusion part)  **vivo:**  As per TS 24.501, 5.6.1.1, Service Request procedure can be used in 5GMM Connected mode for some purpose, such as the establishment of user-plane resources for PDU sessions.  So, using service request for busy indication in INACTIVE would require some changes in CT1 for Service Request Trigger.  Spreadtrum: same view with Apple. SA2/CT1 may has no motivation to handle BUSY Indication in RRC INACTIVE state.  Sony. Same view as QC/OPPO. Currently the busy indication is specified in SA2 for Idle state.  LGE: Agree with Qualcomm, OPPO, and Apple. In our understanding, the UE in 5GMM Connected mode may transfer to RRC Connected mode from RRC Inactive mode to send SR for this new feature (busy indication) according to the current spec. |  |
| **Reason1**: SR can be sent in 5GMM Connected mode but only for establishing UP resources for PDU sessions or for emergency services fallback. It can’t be sent in response to a paging otherwise. Also note that for CN, both RRC Inactive and RRC Connected are 5GMM Connected (PS: Copy from QC comments).  **Reason2:** NAS should get the notification from AS every time receiving RAN paging, but in current spec, NAS is only informed of the RRC connection resumption upon receiving *RRCResume* message.  **3.13.4 Reception of the *RRCResume* by the UE**  The UE shall:  *Omit something here:*  1> enter RRC\_CONNECTED;  1> indicate to upper layers that the suspended RRC connection has been resumed; | OPPO  If reason2 is identified also, both CT1/SA2/RAN2 impact is foreseen. AS should indicate to NAS that RAN paging is receiving every time UE AS receiving RAN paging.  Apple  Addressing Reason 2 for the INACTIVE RAN Paging would involve additional specification impact, to indicate every RAN paging from AS to NAS.  Nokia: If Service Request is reused for sending BUSY indication already, extending it for RRC-INACTIVE will have the issues indicated in the Reasons. Responding to RAN paging via NAS message requires inter-layer interaction as indicated in Reason 2.  In addition there could be additional inter-node impacts which will also involve RAN3  Spreadtrum |  |
| **Impact 1:** Add new trigger to the CT1 spec, e.g. 24.301  **Impact 2:** CT1 need to process this busy indication together with assistance information for the paging filtering, the CN need to suspend the data for the corresponding PDU based on the assistance information  **Impact 3:** Once the UE can process the RAN paging normally, the UE may need to send a revoke indication to the CN, which also have impact to the CT1 spec.  **Impact 4:** UE side, once Ran paging received but the need to send busy indication, the UE AS need to inform NAS. However, the CN would suspend the data once busy indication was received, thus the UE AS would not receive RAN paging frequently thus the UE AS would not inform NAS frequently.  About these 4 impacts, we think the impact 1/3 are similar to the idle state, which wouldn’t introduce much additional work for the SA2/CT1, the impact 4 is also small as analyzed above.  The impact 2 is the most important one, and it can help to suspend the data at the CN, which means the related data would not be sent to RAN again, thus it can help to prevent the RAN paging from the source.  Furthermore, for the idle state the CN also need to process the assistance information for the paging filtering, we are not sure whether the CN can take the similar way to process it in the CM\_Connected mode.  Thus we need to confirm with SA2/CT1 whether the impact 2 would introduce unacceptable specification work. | ZTE  Spreadtrum  Sony: we see impact on both SA2, CT1 and RAN2 if the busy indication is sent to 5GC, and then the 5GC must inform RAN about the busy indication, which impacts RAN3 as well. This creates a much larger gap in the other connection than a RAN based busy indication and the standard/specification impact is much larger. |  |
| **The issue mentioned above is pasted below for quick reference:**  Service Request cannot be sent in INACTIVE or CONNECTED, so using that for busy indication (as in IDLE) would require some changes in CT1 for Service Request | CATT:  Same view as Huawei,  CT1 need to introduce a new trigger for service request to indicate busy indication in 5GMM-CONNECTED state  Spreadtrum | Huawei, HiSilicon:  **Disagree** with “Service Request cannot be sent in INACTIVE or CONNECTED” as clarified by QC.  **Agree** that this requires some changes in CT1.  Input from our SA2/CT1 colleagues is that Service Request can also be triggered in 5GMM-CONNECTED. When UE NAS is in 5GMM-CONNECTED with inactive indication state, Service Request is used to establish the user plane if it’s not already established.  Since the state handling is already there, it’s possible to extend Service Request procedure in inactive state for busy indication, for example with a new trigger for Service Request. |
| Currently, SR cannot be triggered in 5GMM-CONNECTED state for just sending NAS busy indication. |  | **[Intel]** EPS Leaving procedure that was approved by SA2 and implemented in TS 23.401 v17.0.0 already relies on the SR procedure in CN-CONNECTED state to allow the UE just to send the leaving indication. We believe the point that a procedure cannot be supported currently should not be a show stopper. |
| Add new trigger for SR in CT1/SA2 specification based on the indication from AS for busy indication procedure in 5GMM-CONNECTED state. | Samsung  Spreadtrum  DENSO |  |
| Service Request cannot be sent in INACTIVE or CONNECTED, so using that for busy indication (as in IDLE) would require some changes in CT1 for Service Request |  | **[Futurewei]**  Agree with Huawei and Intel. It seems feasible to extend the SR request procedure in 5GMM\_CONNECTED to allow for busy indication as was done in 23.401 for CN-CONNECTED state. It is not within the scope of RAN2 to decide that this is not possible, nor speculate on what the implications might be. We can leave this discussion to relevant WG (SA2/CT1) to discuss and decide. |
| While in RRC\_CONNECTED in network A and in RRC\_INACTIVE in network B, upon sending the busy indication to network B, would the UE be required to be in RRC\_CONNECTED in network A? | Ericsson  If yes, this may pose an issue (e.g. during the busy indication procedure via NAS, the connection to the UE is up and running and data in gNB will be sent to the UE for NW B.). But we think that this discussion and the other issues raised above are actually part of what SA2 and CT1 have to discuss. We do not think this discussion needs to be pursued in RAN2. RAN2 can inform its decision to SA2/CT1, which will anyway trigger such discussion – RAN2 can further discuss this based on SA2/CT1 reply. |  |
| Does it really work to have NAS response to a RAN paging? RAN paging is initialized by RAN and the CN is still in 5GMM-CONNECTED mode during INACTIVE state. | MediaTek | Sony: if the busy indication is sent to 5G C, and then the 5GC must inform RAN about the busy indication, which impacts RAN3 as well. |
| For RAN paging, based on paging cause provided by RRC, can NAS decide whether to send busy indication? | vivo:  In our understand, UE may be unable to send busy indication upon the reception of ran paging e.g. due to UE implementation constraints. In this case，  If CT1 arbitrates whether to send busy indication in INACTVE, NAS should get the paging cause or indication from RRC every time upon receiving RAN paging before initiating RRC Connection Resume procedure. If NAS decides not to send busy indication, RRC does not initiate RRC Connection Resume procedure. |  |
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| EXAMPLE ISSUE: CAN'T USE SERVICE REQUEST IN CONNECTED | COMPANY1, COMPANY2 | COMPANY3: NOT RELEVANT FOR THIS WI  COMPANY4: ISSUE DESCRIPTION IS WRONG |

**Summary 1**: The following potential issues were identified:

* TBA1
* TBA2
* TBA3

**Proposal 1**: TBA

Next, it should be considered whether there are ways to mitigate any of these potential issues.

**Question 2**: Are there any ways to mitigate the issues that RAN2, SA2 and CT1 might face with the decision to use NAS-based busy indication for INACTIVE?

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| Answers to Question 2 | |
| Company | Proposed way to mitigate RAN2, SA2 or CT1 issues with NAS-based busy indication |
| Qualcomm | The only way seems to be to add a new trigger in CT1 specs for sending the Service Request in CN Connected mode. |
| OPPO | If NAS based busy indication is agreed, both CT1 and RAN2 should change the spec, no easy way to go. For CT1, new trigger is needed in CT1 specs for sending the Service Request in CN Connected mode. For RAN2, upon receiving RAN paging, a RAN paging indication should be sent to NAS. |
| ZTE | We think anyway the CT1 need to introduce spec change for the Idle sate, for the inactive state the CT1 can follow the similar way as much as possible. We think the impact 1/3 are similar to the idle state, whether the impact 2 would introduce additional spec work or can also follow the idle state way is FFS. |
| Huawei, HiSilicon | Though we tend to agree with QC, we should wait for SA2/CT1 on technical details. |
| Intel | As commented above, we believe the point that a procedure cannot be supported currently should not be a show stopper. |
| Apple | Not restricting the Service Request in CN 5GMM CONNECTED mode and additional RAN2 impact to indicate every INACTIVE RAN paging from AS to NAS. |
| Samsung | We believe that informing our understanding on potential SA2/CT1 issues with NAS-based busy indication and whether it is acceptable seems the only way. |
| CATT | Agree with other companies that new trigger in CT1 specs for sending the Service Request in CN Connected mode seems feasible and not complicated. |
| Futurewei | Similar to ZTE we think that CT1 will anyway introduce spec changes to address the Idle State.  If SA2/CT1 find technical difficulties regarding UEs in RRC Inactive, they will no doubt inform us about this. However, there should still not be any show-stopper from a RAN2 perspective, because if the UE does nothing in response to RAN paging (which can serve as an implicit Busy indication), the network can always revert to CN paging. |
| Ericsson | We are not sure whether RAN2 needs further discuss on how to address such details. |
| MediaTek | Similar comment as OPPO.  However, whether this is feasible should be decided by CT1/SA2. |
| Nokia | It is possible to mitigate this issue with modification to the CT1 specs for messages and NAS behaviour. There would be need for AS spec change to provide the indication to NAS layer. For complete solution there could be some impacts on RAN3 interfaces (NG) to indicate the reception of BUSY indication to RAN. In our view the efforts to mitigate the NAS based indication for RRC-INACTIVE against RAN level BUSY indication to be compared prior to the conclusion. |
| vivo | 1. New trigger is needed in CT1 specs for sending the Service Request in CN Connected mode; 2. RRC informs NAS about RAN paging indication, or Busy Indication request. |
| Sharp | We agree with QC that define a new trigger in CT1 specs for sending the SR in CN connected mode. |
| Spreadtrum | We can ask SA2/CT1 firstly. If negative RSP received, we can discuss AS based procedure, considering the security issue. |
| DENSO | Agree with Apple. |
| Sony | The best way to mitigate the issues and minimize the standard impact as well as creating much shorter gap on the other connection is to use RAN based busy indication |
| LGE | CT1 specs seems to be anyway updated to send a NAS based busy indication regardless of RRC\_IDLE or RRC\_INACTIVE. |
| Xiaomi | An LS should be sent to SA2/CT1 to ask for their technical opinion about adding a new trigger. |

**Summary 2**: The following ways to mitigate the identified potential issues are raised:

* TBA1
* TBA2
* TBA3

**Proposal 2:** TBA

Finally, it should be understood that if we send an LS to SA2/CT1, which should be included in it? I.e. what are the most important questions to ask, and what will need further time in RAN2 to be resolved.

**Question 3**: What are the questions that an LS to SA2/CT1 should ask?

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| Answers to Question 3 | | |
| Question to ask from SA2/CT1 | Agree [company] | Disagree: Why? [Company]: [Reason] |
| Service Request cannot be sent in INACTIVE or CONNECTED, so using that for busy indication (as in IDLE) would require some changes in CT1 for Service Request | Qualcomm (with the explanation in Q1)  OPPO (Agree QC)  Apple (Agree QC and OPPO)  Nokia (Agree)  Sharp(Agree)  Xiaomi(Agree) | **[Intel]** We unfortunately disagree for the reasons mentioned under Q1. SR is already used in Connected state.  **[Futurewei]** agree with Intel  [**vivo]**: just better wording  Service Request for busy indication cannot be sent in 5GMM CONNECTED, so using that for busy indication in INACTIVE (as in IDLE) would require some changes in CT1 for Service Request |
| Can a new trigger be introduced for sending SR in 5GMM Connected mode in response to RAN paging for busy indication? This is assuming that AS will deliver the necessary trigger reason to NAS upon reception of RAN paging. | Qualcomm  OPPO(Agree QC)  Apple (Agree QC and OPPO)  Samsung  CATT  Nokia(Agree)  Sharp(Agree)  DENSO  Xiaomi(Agree) | **[Intel]** We see no reason why RAN paging could not be delivered to NAS as a trigger for NAS busy indication..  **[Futurewei]** RAN2 can discuss whether there is a need for AS to trigger NAS after SA2/CT1 have discussed the implications of our agreement (if any), and defined an appropriate solution.  In any case, if seems trivial to provide such a trigger if required. |
| Are there any other impacts to NAS procedures other than the new trigger for this purpose? For example, can the new busy indication for CN paging in Idle mode be also used for RAN paging? | Qualcomm  Samsung  CATT  Nokia | **[Intel]** We think that the same NAS procedure for busy indication from Idle state can be used from Inactive state. We expect that upon reception of NAS busy indication, 5GC will trigger NG-C release to put the UE in Idle state.  **[Futurewei]** We don’t see a need for RAN2 to speculate on how NAS procedures might work, or not work. Let the relevant WGs discuss their procedures, and if there is any impacts to RAN2 from new/modified procedures we can address these going forward. |
| Once NAS makes the decision to not send the busy indication, should NAS inform the decision to AS to stop the AS RAN paging response? | OPPO |  |
| Whether the CN can process assistance information for the paging filtering at CM connected state, e.g. suspend the data for the corresponding PDU based on the assistance information? | ZTE |  |
| RAN2 can inform SA2 about the busy indication agreement in RRC\_INACTIVE and convey RAN2’s concern about SA2/CT1 impact. Leave the technical details to SA2/CT1. | Huawei, HiSilicon  Ericsson  LGE |  |
| Is SA2/CT1 inclined to address the BUSY Indication in RRC INACTIVE as a NAS solution given the NOTE 3 in 23.761v1.3.0  “NOTE 3:  Whether Busy indication is supported for RRC\_Inactive case is up to RAN decision. “ | Apple  Samsung | Nokia  No. In our view the Note is meant for RAN to support solution for RRC-INACTIVE. This note does not indicate the possibility to support this indication in BUSY indication. |
| Nothing  RAN2 should not speculate on impacts to SA2/CT1 procedures. | Futurewei | There is no need to send any LS to SA2 or CT1. Delegates of interested companies should be aware of RAN2’s agreement and can bring contributions to the appropriate WGs to discuss the implications, if needed. There is no question that RAN2 requires a response to at this point in order to progress. |
| Open question on whether busy indication **via NAS message** could be supported in INACTIVE mode. | MediaTek |  |
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| EXAMPLE QUESTION: HOW DIFFICULT WOULD IT BE TO MODIFY SERVCE REQUEST SO THAT IT CAN BE SENT IN RRC\_INACTIVE? | COMPANY1, COMPANY2 | COMPANY3: NOT RELEVANT QUESTION  COMPANY4: SEE BETTER WORDING FOR QUESTION BELOW |

**Summary 3**: The following ways to mitigate the identified potential issues are raised:

* TBA1
* TBA2
* TBA3

**Proposal 3:** TBA

Finally, in case there are proposals on how to better resolve the matter of busy indication for INACTIVE, those can still be indicated here. However, note that the bar is high on reverting the decision so any proposals should be based on technical analysis. Therefore, the responses to this question should build on top of the responses provided to the previous question(s).

**Question 4**: Are there better ways to resolve the busy indication for INACTIVE?

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| Answers to Question 4 | |
| Company | Alternative ways to resolve the busy indication + why they are better |
| Qualcomm | The other alternative, as discussed, is to use the Resume procedure or not to have any busy indication for RAN paging. We can discuss these options if SA2/CT1 respond negatively on RAN2 request for a new trigger. |
| OPPO | The same view with Qualcomm. |
| ZTE | We agree with Qualcomm we can ask SA2/CT1 whether the NAS\_Based procedure can be acceptable first. If negative RSP received, we can discuss AS based procedure. |
| Huawei, HiSilicon | We agree with the alternatives mentioned by QC if SA2/CT1 respond negatively.  We would also like to mention that RAN2 needs to wait for SA3 input on security aspects of sending RRC busy indication. SA3 will study this as part of their study item (SP-201018) |
| Apple | If SA2/CT1 does not intend to address this issue with NAS solution, RAN2 can retrigger the discussion on possible AS centric options (e.g. RESUME procedure) |
| Samsung | Same view with others. |
| CATT | If SA2/CT1 is negative on support NAS solution for inactive, we need to discuss the RRC based solution.  But before that, RAN2 may need to reconsider whether it is worth to support busy indication in inactive. We are wondering why UE is kept in RRC INACTIVE state on network B while UE is in RRC CONNECTED state on network A? So it seems a very corner case that UE receives a paging in in RRC INACTIVE state on network B. |
| Futurewei | Not necessarily a better approach, but an alternative approach is to take the absence of a response to RAN paging as an implicit Inactive Busy indication.  As far as RAN2 is concerned, is suffices for the UE to simply ignore the RAN paging in the case the UE can not respond to it. Then by existing procedures, the RRC state at the network side can be released to Idle, if needed. We could subsequently expect the UE to receive CN paging, and it could then respond appropriately using a NAS procedure, if warranted. |
| Ericsson | Agree with Qualcomm. |
| MediaTek | Busy indication via RRC message during the resume procedure is better if no security concern. |
| vivo | Agree with Apple |
| Sharp | We share QC’s view. |
| DENSO | Agree with Qualcomm. We should ask SA2/CT1 if new trigger for Service Request is acceptable. Then, if negative response is received, we can discuss the 2 options (AS based solution or not to have busy indication for RAN paging). |
| Sony | To use RAN based busy indication, using the Resume procedure which creates a quick and secure indication and a much smaller gap and impact on the other RAT. Most applications can handle a gap of about 10 ms, less than handovers. |
| Xiaomi | Agree with QC. |

**Summary 4**: The following ways to mitigate the identified potential issues are raised:

* TBA1
* TBA2
* TBA3

**Proposal 4:** TBA

# 4 Conclusion

A total of **N** companies provided responses to the discussions. The proposed conclusions are:

**Proposal 1:** TBA

**Proposal 2:** TBA

**Proposal 3:** TBA

**Proposal 4:** TBA

# Annex – Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Name | Email Address |
| RAN2 VC (Rapporteur) | Tero Henttonen | tero.henttonen@nokia.com |
| OPPO | Jiangsheng Fan | fanjiangsheng@oppo.com |
| Huawei, HiSilicon | Rama Kumar Mopidevi | rama.kumar@huawei.com |
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