3GPP RAN WG2 Meeting #130 R2-25xxxxx

St.Julians, Malta, May 19th – 23rd, 2025

Agenda Item: 8.2.1

Source: Huawei, HiSilicon

Title: Remaining A-IoT MAC open issues

Document for: Discussion, Decision

# Introduction

The following document includes a list of open issues according to the following email discussion:

* [POST129bis][017][AIoT] 38.391 Running CR (Huawei)

 Intended outcome:

 1 Update and review running CR

 2 Create list of remaining open issues

 Deadline: long

Companies are invited to provide feedback on open issue list by: **2 May 2025**

# Remaining open issues for specification 38.391

## List of the open issues and type of issue

According to the guidance from chair lady, the issues are classified to the following types:

* For some straightforward/easy issues, the Rapp will mark them as ‘**Straightforward**’ in the below table, and will provide proposals or questions (to collect company preference if there are multiple options) in section 2.2, companies are invited to provide comments to the proposal/questions.
* For complex/controversial technical issues, the Rapp will mark them as ‘**To be discussed by company contributions**’, and the proposal would be that companies provide contributions to the following meeting to resolve the issue.
* For the issue for optimization or without clear spec/RAN2 impact, the Rapp will mark them as ‘**Not critical**’.

Based on company comments, the Rapp will finalize the open issue list and proposed resolutions.

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| Issue number, brief title | Issue description | Issue classification |
| **Group 1: Paging** |
| **Subgroup: Multi-reader scenario** |
| Issue 1-1: multi-reader paging | If a device gets a new service request while one procedure is still ongoing, whether/how to specify device behaviour or leave it to implementation, and the end of procedure if needed.* *Relevant agreements:*
* *RAN2 acknowledges that multi-reader scenario may exist but we will not specify something specific for this purpose. We can rely on transaction ID and implementation to handle it.*
* *FFS which solution if any for device behavior if it gets a new service request while one procedure is still ongoing or leave it to implementation.*
* *For CBRA, as a baseline, NACK based mechanism is applied only to the Msg3. May come back for D2R data, if the NACK feedback indication is needed for the purpose to stop/terminate the “on-going procedure” and release the AS ID accordingly (depending on other later discussion).*
* *FFS on end of procedure*
* *Status in running CR: captured as Editor’s Note in 5.2.*
 | To be discussed by company contributions |
| **Subgroup: Transaction ID** |
| Issue 1-2: transaction ID  | Whether/how to specify how the reader generate Transaction ID, and the size* *Relevant agreements:*
* *The “transaction ID” can be generated by reader based on CN corelation ID. FFS how reader will generate “transaction ID”. FFS the size of transaction ID*
* *1 bit solution is excluded. FFS the size. Aim to have a reasonable size*
* *Status in running CR: captured as Editor’s Note in 6.2.1.1.*
 | To be discussed by company contributions |
| **Subgroup: Paging message content** |
| Issue 1-3:Paging ID length field | The field to indicate the paging ID length, e.g. value range, how many bits, format design* *Relevant agreements:*
* *A field indicating Paging ID length information is always included together with the paging ID field in the A-IoT paging message, except the case where no ID is included in the A-IoT paging message.*
* *The number of bits required for paging ID length field should be as small as possible. This would require the number of different Paging ID lengths to be small.*
* *RAN2 sent LS to CT4 and SA2 in R2-2503197 asking for their feedback on the above agreement, for RAN2 to determine the field for paging ID length.*
* *Note: SA2 already agreed the filtering information and captured it in clause 5.8 in 23.369, this may enable some extent of RAN2 discussion before their feedback.*
* *Status in running CR: the field name is captured in 6.2.1.1 without the detailed format.*
 | To be discussed by company contributions |
| Issue 1-4: AO number field | How to indicate the number of access occasions, e.g. the maximum number, the length of field, format design.* *Relevant agreements:*
* *the A-IoT paging message can include a number of msg1 resources*
* *Status in running CR: the field name is captured in 6.2.1.1 without the detailed format.*
 | To be discussed by company contributions |
| Issue 1-5:Paging content for CFRA | Whether paging in CFRA can omit the CBRA related fields, such as transaction ID, Indication of Paging ID present/absence, Number of access occasions in Paging message.* *In last meeting, there was a discussion whether transaction ID is needed for CFRA in Paging message. Then during the CR drafting, the Rapp identifies other fields like no paging ID indication, number of access occasions are not useful for CFRA. Since RAN2 also agreed to introduce an explicit indication to indicate CFRA and CBRA, it should be feasible to have different fields in the paging message for CFRA and CBRA. Thus, this can be discussed further.*
* *Status in running CR: captured as Editor’s Note in 6.2.1.1.*
 | To be discussed by company contributions |
| **Subgroup: Others** |
| Issue 1-6:Paging ID visibility | Whether Paging ID is invisible or visible to MAC.* *Relevant agreements:*
* *The current assumption is that the paging identifier is transparent to the A-IoT MAC Layer and carried by upper layer. FFS if there is really a need for visibility in the MAC layer.*
* *From the previous discussion, there are some motivations to make paging ID visible to MAC:*
	+ *1. Reader can operate on the paging ID for further sub-grouping. The Rapp understands this can be considered as an enhancement from reader side for better system efficiency. From device side, since there is an explicit indication for CBRA and CFRA, the device (even in multi-device CFRA) can determine how to perform random access instead of paging ID/group ID. In this case, such visibility is not an essential function. And according to guidance from chair lady, such enhancement can be considered with lower priority.*
	+ *2. Reader can associate the paging ID/device ID and AS ID for a given device within a service request. The Rapp understands according to RAN3 LS* *R3-252481, reader will allocate NGAP device ID for each device and maintain the per-session per-device context, via which the reader can associate the command receiving from the NG interface with the AS ID assigned for a device, i.e. such device management/association does not rely on the paging ID/device ID.*
	+ *3. The Temp ID may have impact on this visibility discussion. The Rapp understands SA3 has not concluded on the solution of Temp ID. But majority seems think this Temp ID is maintained/managed between CN and device, since they already concluded there is no AS security in A-IoT. Therefore, no RAN2 discussion is needed before SA3 further inputs.*
 | Not critical |
| **Group 2: Random access** |
| **Subgroup: R2D trigger message and Msg1 related** |
| Issue 2-1:Msg1 resource selection | Whether/how to specify the device detailed behaviour of randomly selecting the Msg1 resource based on the R2D trigger message.* *Relevant agreements:*
* *A new R2D message other than the paging message is introduced for A-IoT device determining MSG1 resources unless RAN1 concludes to use L1 signaling. The R2D message indicates the start of a set of MSG1 resources that were configured in paging message.*
* *Assumption: The R2D message does not include slot number/count down number.*
* *Status in running CR: captured as Editor’s Note in 5.3.3.1.*
 | To be discussed by company contributions |
| Issue 2-2:Paging&first R2D trigger message | Whether the R2D trigger message is needed in CFRA, and whether the first R2D trigger message will be merged into paging message in CBRA.* *The Rapp understands the discussion of the R2D trigger message focused on CBRA, and it’s not crystal clear whether the R2D trigger message is also needed in CFRA, and whether it can be merged to paging message if it’s the first R2D trigger message in CBRA.*
* *Status in running CR: not captured yet.*
 | To be discussed by company contributions |
| Issue 2-3: R2D trigger message byte alignment | The R2D trigger message should be byte aligned or not.* *Relevant agreements:*
* *The MAC PDU should be byte-aligned, assuming the allocated TBS value is in the unit of byte. The actual TBS value depends on RAN1. FFS for R2D trigger message.*
* *Status in running CR: not captured yet.*
 | To be discussed by company contributions |
| **Subgroup: CBRA procedure related** |  |
| Issue 2-4: CBRA failure detection | How to determine CBRA failure/contention resolution failure.* *In SI, RAN2 agreed to support re-access in case of contention resolution failure as capture in TR 38.796. In WI phase, RAN2 has agreed to re-use the subsequent paging message to trigger re-access, but has not discussed how to determine CBRA failure/* *contention resolution failure.*
* *Status in running CR: captured as Editor’s Note in 5.5.*
 | To be discussed by company contributions |
| **Subgroup: Msg2 content** |  |
| Issue 2-5:random ID differentiation in Msg2 | Whether/how to address random ID collision in Msg2, i.e. multiples devices generate same random ID using different Msg1 resources.* *In previous meetings, RAN2 discussed whether Msg2 need to include more information on top of the random ID to avoid random ID collision, but there was no consensus.*
* *Status in running CR: not captured yet.*
 | To be discussed by company contributions |
| Issue 2-6:number indication of echoed random IDs in Msg2 | Whether/how to indicate the number of echoed random IDs included in Msg2.* *RAN2 agreed that A-IoT Msg2 contains one or multiple echoed random ID(s) from A-IoT Msg1 of different A-IoT devices, but there is no discussion on whether/how to indicate the number of echoed random IDs. The Rapp understands this can be considered as signaling design/stage3 issue which should be quite straightforward. Companies can check the proposal in 2.2.*
* *Status in running CR: not captured yet.*
 | Straightforward |
| Issue 2-7: present/absent indication of assigned AS ID in Msg2 | How to indicate the AS ID presence in Msg2.* *Based on the following agreement, the Rapp understands the assigned AS ID is an optional field in Msg2, but how to indicate the presence/absence has not been discussed yet. This can be considered as signaling design/stage3 issue which should be quite straightforward. Companies can check the proposal in 2.2.*
* *For CBRA, it is up to Reader to decide whether to reuse the random ID as the AS ID or to assign a new AS ID. FFS how this is signalled, which message is used and size of AS ID.*
* *For CBRA, Msg 2 is used for AS ID assignment .*
* *Status in running CR: captured as Editor’s Note in 6.2.1.3.*
 | Straightforward |
| **Subgroup: CFRA procedure specific** |
| Issue 2-8: no re-access for CFRA | How to achieve “no re-access” for CFRA* *Relevant agreements:*
* *For CFRA, NACK feedback and re-access is not supported. FFS how to achieve.*
* *Status in running CR: captured as Editor’s Note in 5.2.*
 | To be discussed by company contributions |
| Issue 2-9: AS ID assignment in multi-device CFRA | Whether to consider multiple device scenario as to the AS ID in CFRA.* *Relevant agreements:*
* *ID is the only ID needed for addressing the device in R2D command message assuming for CFRA no multiple devices are performing the procedures with the given reader. FFS if we can assume or need to support multiple device scenario.*
* *Status in running CR: not captured.*
 | To be discussed by company contributions |
| **Subgroup: NACK feedback** |
| Issue 2-10: NACK before paging or R2D trigger message | For the re-access due to reception of NACK indication before subsequent R2D message, whether the subsequent R2D message is the R2D trigger message or paging message.* *Relevant agreements:*
* *For msg3, we rely on whether the device receives NACK indication before subsequent R2D message to determine re-access. No need for a timer. FFS whether subsequent R2D message is trigger message or paging*
* *Status in running CR: captured as Editor’s Note in 5.5.*
 | To be discussed by company contributions |
| Issue 2-11: explicit message for NACK | Whether to use a new/explicit R2D message for NACK feedback.* *There is an FFS in the following agreement, but according to the online discussion in last meeting, the Rapp feels companies already consider this NACK message is a separate message, thus marks this as straightforward issue, and companies can check the proposal in 2.2.*
* *NACK based mechanism is supported for D2R messages to determine re-access for at least msg3. FFS details including whether we need a timer or explicit message and when reader sends feedback.*
* *Status in running CR: captured as Editor’s Note in 5.5.*
 | Straightforward |
| Issue 2-12: multiplexing for NACK indication | Whether to support multiplexing of information for multiple devices in NACK feedback.* *Relevant agreements:*
* *Support multiplexing of information for multiple devices in R2D message for msg2. FFS others for multicast messages.*
* *Status in running CR: not captured yet.*
 | To be discussed by company contributions |
| **Group 3: Data transmission** |
| **Subgroup: Segmentation** |
| Issue 3-1: command for non-first segment | Whether upper layer command is included in the R2D message scheduling for non-first segment.* *Relevant agreements:*
* *FFS whether the reader always includes the command for retransmission of segments.*
* *Status in running CR: captured as Editor’s Note in 5.4.2.*
 | To be discussed by company contributions |
| Issue 3-2: offset for first segment | Whether offset is included in the R2D message scheduling for the first segment and unsegmented message* *Relevant agreements:*
* *For the retransmission of the first segment/unsegmented D2R message, the reader sends the R2D message by including the upper layer command again. FFS whether offset zero is always included.*
* *Status in running CR: captured as Editor’s Note in 5.4.3.*
 | To be discussed by company contributions |
| **Subgroup: AS ID** |
| Issue 3-3: AS ID release | Whether to specify any additional AS ID release method* *Relevant agreements:*
* *FFS other cases for release ASID to avoid keeping it indefinitely.*
* *Status in running CR: captured as Editor’s Note in 5.2.*
 | To be discussed by company contributions |
| **Subgroup: D2R message content for data transmission** |
| Issue 3-4: D2R padding indication | How to indicate padding and the Length filed for SDU or padding and its size* *Relevant agreements:*
* *In case where MAC PDU includes both MAC SDU and padding, for D2R a field to indicate how many SDU bits are present is required. FFS how this is provided (i.e. SDU length field or padding length field). The size of length field is FFS.*
* *Status in running CR: captured as Editor’s Note in 6.2.2.2.*
 | To be discussed by company contributions |
| Issue 3-5: D2R message type | Whether to support D2R message type* *Relevant agreements:*
* *FFS whether we introduce D2R message type. Discuss after looking at the overall MAC header design and space before deciding whether we introduce message type or reserved bits*
* *Status in running CR: captured as Editor’s Note in 6.1.1.*
 | To be discussed by company contributions |
| Issue 3-6: Write operation response | Whether the write command response means ‘successfully completing the write operation’, and whether this may cause a case of ‘no upper layer data is available for a D2R scheduling’ due to long writing time.* *During the running CR review, companies identified that in SA2 LS S2-2501241, the service data response for write command is “operation result indication response for 'Write'”. But, it’s not clear whether the operation result means successfully completing the write command or successfully receiving the command message or both. And if the command response means successfully completing the writing operation, there may be an uncertain writing time in different device implementation. Then we need to accommodate this in the data transmission procedure.*
 | To be discussed by company contributions |
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| **Group 4: Others** |
| **Subgroup: RAN1 parameters** |
| Issue 4-1:RAN1 parameters | How to handle RAN1 parameters if any, e.g. scheduling info in paging, Msg2, R2D command messages.* *According to the below agreements, the Rapp understand there are some RAN1 parameters to be carried in MAC, and RAN1 is expected to send the concluded parameters to RAN2 after May meeting, and RAN2 can capture the parameters in MAC via a post email discussion after May meeting. For now, RAN2 can just wait for RAN1 inputs.*
* *RAN2 agreed that the MSG1 resources are configured in Paging message, and RAN1 agreed that for scheduling D2R transmission, any scheduling information related to resource allocation that needs to be signaled is indicated by higher-layer signaling.*
* *Status in running CR: a field named as Scheduling Info is included in Paging message, Msg2 and R2D command message as a placeholder, and the details are pending to RAN1 inputs.*
 | Wait for RAN1  |
| **Subgroup: MAC modelling issue** |
| Issue 4-2: transport channel | Whether transport channel concept is used for A-IoT MAC, i.e., between MAC and PHY, and whether logical channel concept or “SAP” is used on the interface between MAC and upper layer.* *There is no discussion on whether transport channel concept is needed for A-IoT. The Rapp understands this is not a technical issue but just a modelling issue, which should be straightforward. Companies are welcome to provide preference in the discussion in 2.2.*
* *Status in running CR: captured as Editor’s Note in 4.2.*
 | Straightforward |
| Issue 4-3 | Terminology, message names, field names, definitions used in MAC running CR* *As discussed in running CR, companies are welcome to provide comments to the names used in the running CR, and the Rapp will make a summary and proposal according to the comments in running CR discussion. So, no need to duplicate the discussion here.*
 | Straightforward |

**Companies are invited to provide feedback regarding the above open issue description and classification.**

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| **Company** | **Issue No.** | **Comments** |
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## Collection of company comments to the straightforward issues

**Issue 2-6: number indication of echoed random IDs**

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| Issue 2-6:number indication of echoed random IDs in Msg2 | Whether/how to indicate the number of echoed random IDs included in Msg2.* *RAN2 agreed that A-IoT Msg2 contains one or multiple echoed random ID(s) from A-IoT Msg1 of different A-IoT devices, but there is no discussion on whether/how to indicate the number of echoed random IDs. The Rapp understands this can be considered as signaling design/stage3 issue which should be quite straightforward. Companies can check the proposal in 2.2.*
* *Status in running CR: not captured yet.*
 | Straightforward |

Upon a Msg2 is received by the device, the device needs to understand how many random IDs are included in that Msg2. According to the previous discussion on D2R padding, there is no need to have explicit indication of the size if all other parts have the fixed length. Therefore, assuming all the other parts in Msg2 (i.e. message type, scheduling info if any) have fixed length and are put in the beginning of the MAC PDU, the device can consider the left part is random ID/random ID list, and then decode random ID one by one. A example is shown as below:

**Proposal for Issue 2-6: There is no need to indicate the number of random ID(s) assuming all the other parts in Msg2 (i.e. message type, scheduling info if any) have fixed length and are put in the beginning of the MAC PDU, and the device can decode the random ID one by one.**

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| **Company** | **Agree or not** | **Comments** |
| LGE | Disagree | We think that only multiple RNs are contained in Msg2, it makes a problem as explained below.AT T1: the device#1 transmits the RN=10 in frequency#1 and the device#2 transmits the RN=10 in frequency#2.AT T2: the reader receives the RN=10 on the frequency#1 but the does not receive the RN=10 on the frequency#2.AT T3: the device#1 and device#2 receive the Msg2 containing RN=10. In this case, both devices consider the contention resolution successfully completed. AT T4: the reader schedules the uplink grant for Msg3 only for the device#1.In the above case, the reader cannot schedule uplink schedule for the device#2. Thus, we think that additional information, e.g., frequency information, should be contained in the Msg2.Rapp: For clarification, this issue is only for echoed random IDs, and the additional information like frequency information you mentioned is covered by issue 2-5. |
| Lenovo | Agree | For LG’s comments, although we have sympathy, it’s relates to *Issue 2-5:**random ID differentiation in Msg2*. And here we think for whether there needs to indicate the number of random ID(s), we tend to agree with Rapp here. |
| vivo | Disagree | We think that the mapping between echoed random IDs (&potential AS ID) and Msg1 resources are more important and should be explicitly indicated in Msg2. There is an example of typical RN16 collision case:In 1st RO, no device sends Msg1;In 2nd RO, device#1 sends its Msg1 with RN16 value n;In 3rd RO, device#2 sends its Msg1 with RN16 value n; (RN16 collision)In 4th RO, no device sends Msg1;When reader sends Msg2 without any Msg1 resource index or mapping, e.g., the first RN16 value n and assigned AS ID value x to device#1, the second RN16 value n and assigned AS ID value y to device#2, it is difficult for both device#1 and device#2 to understand this Msg2 correctly. |
| CMCC | Agree | We agree that the indicator of the number of random IDs is not needed. The details of the Msg2 format are not restricted; all other parts are placed at the beginning of the MAC PDU. We prefer that each echoed random ID be placed together with its D2R scheduling information. This way, the device can avoid decoding all the information before it starts to search the random ID list.For LGE’s comments, we share same understanding as Rapp. |
| Qualcomm | Disagree | There are several issues that need further discussion.1. How to know the end of A-IoT Msg2 without indication for number of random ID 2. Whether/how the scheduling info is fixed length field3. In the example figure above, it is unclear how to assign AS ID. The number of assigned AS ID and random ID may be different.3. Since the question is related to issue 2-5 and may have impacts on A-IoT Msg2 format. These issues have to be jointly considered. |
| CATT | Disagree | Not only RN16 is multiplexed in MSG2, but also the AS ID and scheduling resources for MSG3 can be multiplexed in MSG2. So the number of multiplexing devices are required (fixed size, e.g. 5bits). Here is the example of Number of Multiplexing of devices.

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| Number of Multiplexing of devices | Multiplexing of RN16 |  | Multiplexing of AS ID assignment | Multiplexing of AS ID | Multiplexing of UL grants |
| 00100(Up to 32) | 16bits for device#1 | 16bits for device#2 | 16bits for device#3 | 16bits for device#4 |  | 00110 | 8bits for device#2 | 8bits for device#3 | Device#1 | Device#2 | Device#3 | Device#4 |

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| Ofinno | Disagree | In general, we share the concerns raised by other companies. The association or mapping between an access occasion for A-IoT Msg1 and the corresponding A-IoT Msg2 needs to be clearly defined. For this, our suggestion is to discuss if A-IoT Msg2 includes option (1) bitmap indication, or option (2) an indication (or index) time-frequency resource of an access occasion for the A-IoT Msg1 (for further details, please refer to our RAN2#129bis TDoc, R2-2501987). |
| Ericsson | Disagree | We also agree with companies conveying concerns on the issue assumptions. In doing that, we agree the discussion in 2-5 and this issue needs to be considered together. Points made by e.g. QC and LG are a good starting point. |
| Apple | Disagree | For inventory only case * The number of “RN16-only” are to be included (This is for inventory only case).

For inventory + command case:* The number of “RN16+ASID” are to be included, plus a separate # of “RN16” prompted as AS ID are to be included.

Logically, all those formats has to be supported, so we need indication of three different group of echo RN16 together with each associated with a numerical counter.. |

**Issue 2-7: present/absent indication of assigned AS ID**

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| Issue 2-7: present/absent indication of assigned AS ID in Msg2 | How to indicate the AS ID presence in Msg2.* *Based on the following agreement, the Rapp understands the assigned AS ID is an optional field in Msg2, but how to indicate the presence/absence has not been discussed yet. This can be considered as signaling design/stage3 issue which should be quite straightforward. Companies can check the proposal in 2.2.*
* *For CBRA, it is up to Reader to decide whether to reuse the random ID as the AS ID or to assign a new AS ID. FFS how this is signalled, which message is used and size of AS ID.*
* *For CBRA, Msg 2 is used for AS ID assignment .*
* *Status in running CR: captured as Editor’s Note in 6.2.1.3.*
 | Straightforward |

The Rapp understands the most straightforward method is to have a bit to indicate whether AS ID is assigned for each entry of the random ID list.

**Proposal for** **Issue 2-7: To have a bit to indicate AS ID presence/absence for each entry of the random ID included in Msg2.**

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| **Company** | **Agree or not** | **Comments** |
| LGE | Agree | Considering that the RN can be used for AS ID, the AS ID presence/absence indication is needed.  |
| Lenovo | Agree | This bit should be always presence for each entry of the random ID list |
| vivo | Agree | AS ID is optional and 1-bit indicator is needed for its presence/absence for each entry of the echoed random ID included in Msg2. |
| CMCC | Agree | We agree with Rapp’s proposal. One bit indicator for the present of AS ID assignment in Msg2.We also recommend considering bit manipulation when designing Msg2 format. Because the different assignment solution and length of response for Msg1 in Msg2. |
| Qualcomm | Agree  | It should be one bit indication for each entry of the random ID. |
| CATT | Agree | 1 bit for each device in the list of Multiplexing of devices |
| Ofinno | Agree | In addition, RAN2 needs to also discuss what absence means.  |
| Ericsson | Agree |  |
| Apple | See comment | There are two cases: 1) RN16 has been prompted to AS ID, in this case, we only need 1-bit to indicate the promotion, when compared with inventory-only case whether the RN16 is not prompted; 2) Reader assigned AS ID different from RN16, in this case, we need “16+16” bit. We do not understand how the proposed 1-bit is going to solve the problem. |

**Issue 2-11: explicit message for NACK**

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| Issue 2-11: explicit message for NACK | Whether to use a new/explicit R2D message* *There is an FFS in the following agreement, but according to the online discussion in last meeting, the Rapp feels companies already consider this NACK message as a separate message, thus marks this as straightforward issue, and companies can check the proposal in 2.2.*
* *NACK based mechanism is supported for D2R messages to determine re-access for at least msg3. FFS details including whether we need a timer or explicit message and when reader sends feedback.*
* *Status in running CR: captured as Editor’s Note in 5.5.*
 | Straightforward |

**Proposal for Issue 2-11: To define an explicit R2D NACK feedback message, where the AS ID is included to indicate the failure for a given device.**

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| **Company** | **Agree or not** | **Comments** |
| LGE | Disagree | As agreed before, the NACK feedback is used only for Msg3. It means that the reader should indicate the NACK feedback to the device before transmitting the next access occasion trigger message. This is because the reader does not know whether the Msg2 is successfully transmitted to the device or not. If the device does not receive the Msg2, the device cannot know the AS ID. In this case, from the device perspective, the NACK feedback containing the AS ID is useless. Thus, we do not think that the AS ID is needed. Instead of AS ID, we think that the RN or frequency information used in Msg1 transmission is needed in the NACK feedback. However, considering that the signaling overhead, we think that the frequency information used in Msg1 transmission is sufficient. |
| Lenovo | See comments | The reader is possible to send NACK to the device when Msg3 is not correctly received and not retransmit Msg2, since this is up to the reader implementation. In this case, either AS ID or random ID is used for NACK, in case Msg2 is not received by the device. |
| vivo | Agree | AS ID in NACK indication is enough. If Msg2 is received successfully by the device, AS ID is stored in device, e.g., confirmation via RN16 or AS ID re-assignment. Then device can detect NACK indication with correct AS ID and perform re-access as expected.Else if Msg2 is not received successfully by device, the device will ignore any NACK indication since it has not any valid AS ID. Msg2 failure or contention resolution failure will be declared till the next R2D trigger, which will also trigger to re-access. |
| CMCC | Agree | We support defining an explicit R2D NACK feedback message and including the AS ID in that message. And considering the multiple devices’ MSG3 can be transmitted in FDM, the NACK feedback should also support multiplexing and containing multiple AS IDs. |
| Qualcomm | Agree | AS ID included in the explicit R2D NACK feedback message is sufficient. The concern raised by LGE is a corner case as vivo explained. |
| CATT | Agree | The AS ID included in the R2D NACK feedback message is enough. * The device receives MSG2 (with AS ID) successfully and sends the MSG3, but reader failed to receive MSG3. The NACK message with AS ID will indicate the target device to re-access.
* The device fails to receive MSG2 successfully (no AS ID associated with the target device), the device will take as contention failure and respond subsequent paging message again.
 |
| Ofinno | Agree with comment | We are ok with the proposal for this issue 2-11. One thing to note is that the retransmitted Msg2 may also be considered as the R2D NACK feedback message. |
| Ericsson | Agree, comment | Separate feedback message can work and is simple, but we think also a Msg2 with new resources for triggering retransmission (implicit NACK) as an alternative should be discussed as this could in some cases be the natural next step in the procedure. The Msg2 is anyway up to reader implementation. We think the details put by Vivo is not really agreed as a common assumption (ignore NACK vs. AS Id (optional)), i.e we think RAN2 still need to consider the comment from LG etc. |
| Apple | Disagree | Given that this NACK does not really trigger any device action, and the device receiving this NACK can only re-access after being paged again. There is no need to design this as a separate MAC message. Instead, this NACK should be combined as part of subsequent paging message. So, we propose to add “NACK of AS IDs” as an optional list in paging message itself. This also matches the agreement to release of (old) AS ID based on the paging message reception. |
| Futurewei | AS ID alone is insufficient. | When RAN2 agreed on using Msg2 to assign AS ID for CBRA case, we had cautioned the group that the implication of the agreement was that both the RN16 and the assigned AS ID of the device need to be included not only in a retransmitted Msg2 sent for triggering a retransmission of Msg3 from the device, but also in a NACK feedback Indication intended for the device, because the reader does not know for sure which one of the RN16 and the assigned AS ID that the device is currently holding now. |

**Issue 4-2: transport channel**

|  |  |  |
| --- | --- | --- |
| Issue 4-2: transport channel | Whether transport channel concept is used for A-IoT* *There is no discussion on whether transport channel concept is needed for A-IoT. The Rapp understands this is not a technical issue but just a modelling issue, which should be straightforward. Companies are welcome to provide preference in the discussion in 2.2.*
* *Status in running CR: captured as Editor’s Note in 4.2.*
 | Straightforward |

**Question.A for Issue 4-2: Do companies think the concept of transport channel is needed for A-IoT to define the interface between MAC layer and Physical layer, and to describe the R2D/D2R block?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes or No** | **Comments** |
| LGE | Yes | We think that the transport channel concept is needed. A MAC PDU or a data block which is to be interpreted as a MAC PDU is delivered via transport channel between MAC and PHY. Unlike NR, there is no need to decode TB to obtain a MAC PDU in A-IoT because A-IoT doesn’t have HARQ. The data which is identical to a MAC PDU may be delivered via the transport channel. |
| Lenovo | No strong view |  |
| vivo | Comments. | In NR, transport channel is used between MAC and PHY so that the MAC/PHY can differentiate signal processing and resource mapping for MAC PDUs of different transport channels. As there is only PRDCH in R2D direction and only PDRCH in D2R direction, there is no differentiation handing/resource mapping for different MAC PDUs in PHY. It is not required to introduce transport channel for AIoT. However, it can be considered if using transport channel modeling is proven to be beneficial. |
| CMCC | Yes | No strong view, as long as the complexity and cost of device is not impacted. |
| Qualcomm | Yes with comments | The concept of transport channel is fine. But for R2D/D2R block, it is better to use R2D/D2R transport block (TB) in all specifications including RAN2 and RAN1. |
| Ofinno | Yes | We share the view that the concept of transport/logical channels is needed as explained and also for forward compatibility.  |
| Ericsson | Yes | As Ofinno mentions, this modeling also allows for future extensibility. This model has also no real down side for the current specification. |
| Apple | No strong view |  |
| Futurewei | No | For A-IoT, delivery of SDUs/PDUs between MAC and PHY does not have to go through transport channel(s), e.g., through SAP may be sufficient. How to model the delivery of SDUs/PDUs between MAC and PHY should be up to implementation.As there is no multiplexing in A-IoT, there is no other function that requires the introduction of transport channel.  |

**Question.B for Issue 4-2: Do companies think the concept of logical channel is used on the interface between MAC and upper layer, or we can use a more general concept of ‘‘SAP’’ between MAC and upper layer as current running MAC CR?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Logical channel or SAP** | **Comments** |
| Qualcomm |  | We do not see a need to capture anything about “SAP” in the figure in MAC Spec. Whether the Logical channel needed or not can be further discussed |
| Futurewei | No need for logical channel. For SAP, see comments. | According to Wikipedia, “The SAP is a conceptual location at which one OSI layer can request the services of another OSI layer.” So, SAP seems to be very generic and suitable here. On the other hand, we also agree with Qualcomm that we do not need to explicitly have the words “A-IoT MAC-SAP” in Figure 4.2-1: A-IoT MAC structure overview, since we do not have the word “SAP” in Figure 4.2.2-1: MAC structure overview in TS 38.321 today. Just have the ovals to represent the SAPs in the figure is sufficient. |
|  |  |  |
|  |  |  |
|  |  |  |
|  |  |  |

**[Placeholder] Summary of the discussion in running CR for Issue 4-3.**

# Other identified open issues

**Companies are invited to describe any other identified open issues not currently included within this document**

|  |  |
| --- | --- |
| **Company** | **Other identified open issues? (please describe)** |
| LGE | According to the current running CR, it is ambiguous when the device determines the contention resolution failure, i.e., CBRA procedure failure. This ambiguity arises because there are no defined conditions for determining contention resolution failure in the running CR. Therefore, we need to discuss the failure conditions. In our view, the following conditions warrant further discussion:* If the device does not receive the same random number transmitted in Msg1, it should consider this a contention resolution failure.
* If the device receives the access occasion trigger message before receiving the same random number transmitted in Msg1, this should also be considered a contention resolution failure.

Rapp: this is covered by issue 2-4. |
| Lenovo | **Paging**1. Parallel service request from multi-reader with same service request
2. store/release/maintenance of transaction ID from device side

Rapp: the intention of issue 1-1 is to cover all above discussion points for multi-reader scenario.**Random access**1. Whether interleaved R2D trigger message transmission is supported
2. The content of R2D trigger message
3. Whether to support different Msg2 response types, e.g. separate Msg2, partial Msg2, common Msg2 etc.

Rapp: (1) is also covered in issue 1-1. (2) do you mean transaction ID? I think it’s also depending the discussion of issue 1-1. (3) I do not see the need to have separate message type, but companies can discuss this together with issue 2-5 if needed.**AS ID Assignment**1. Revisit Msg0 Assign AS ID for CFRA, consider both single device and multi-devices case.

Rapp: this is covered by issue 2-9.**MAC PDU format**1. Whether control part of MAC PDU is bye-aligned or not.
2. Whether padding is needed for R2D message or not.

Rapp: (1) is already clear assuming by control part you mean the AS info part (other than data SDU), as we agreed that the PDU is byte-aligned and SDU also byte-aligned.(2) For my clarification, the R2D padding is because the scheduling from reader may be larger than the required size of D2R transmission. Then what’s the motivation of R2D padding (if there are spare bits, we can define them as reserved bits)? |
| Qualcomm | So that everyone is on the same page, we want RAN2 to explicitly confirm that* “re-access” means the device re-starts the whole procedure from MSG1.
* “re-transmit” means the device transmit the last-transmitted-message again.
 |
| Ofinno | We suggest discussing further the success and failure scenarios one by one with their corresponding handling for any D2R message sent after Msg3 until the A-IoT procedure is concluded.  |
| Apple | We need to confirm re-access only happens with subsequent paging message. A device re-access by the new R2D trigger message should not be allowed because this will increase contention and create unfairness issue (e.g, the device choose an earlier slot in Aloha gets much higher chance to re-access again and again). |
| Futurewei | On MAC PDU format, we have the same question as Lenovo as to whether the control part of MAC PDU has to be bye-aligned or not. Given the potential variety of control information fields we may have for Rel-19 and we may add in future releases, best efforts should be made to make each of these control information fields as short as possible. When all the control information fields (including Message Type field) are not byte-aligned after being summed up, MAC padding bits can be used to keep the entire MAC PDU byte-aligned. Another question, which we have raised in another e-mail thread, is whether segmentation must be done byte-aligned (note that the earlier discussion on segmentation retransmission used the words “offset bit”, not “offset byte”). If the control part is not guaranteed to be byte-aligned, it appears more efficient to segment in bits, not in bytes, to avoid using MAC padding bits for all non-last segments. However, the price to pay is that, on the R2D direction, three more bits are needed to indicate the offset due to the finer granularity.  |

# Conclusions

*<To be filled after companies have provided feedback to the proposed resolutions for simple issues only. Please include the number of supporting companies (e.g., 18/20]) in brackets within the proposal>*

The following proposals have been provided based on feedback to the above document:

[Proposals for easy agreement]

*<List all proposals with consensus and/or may be easily agreed based on Rapporteur’s opinion>*

[Proposals for discussion]

*<List all proposals which will likely require further online/offline discussion to resolve>*

# References

1. XX

# Appendix (Optional)

*<Can include past meeting agreements etc.>*

Agreements:

 RAN2 understands that the service type of A-IoT (e.g. inventory, command) and whether the service is targeted for a single or multiple devices can always be provided. The approximate number of target devices can be provided if available.

8.2.2 A-IoT Paging

 Parallel service requests by the same reader is not supported.

 The device is expected to only perform one procedure at a time. FFS device behaviour if multiple requests are received in parallel (if needed).

 The “transaction ID” can be generated by reader based on CN corelation ID. FFS how reader will generate “transaction ID”. FFS the size of transaction ID

 1 bit solution is excluded. FFS the size. Aim to have a reasonable size.

 RAN2 acknowledges that multi-reader scenario may exist but we will not specify something specific for this purpose. We can rely on transaction ID and implementation to handle it.

 The “one identifier” in the paging message includes both the case of “one single device identifier” and “one group identifier”/”filtering criteria”, while the exact format of latter is supposed to be designed by SA2.

 The current assumption is that the paging identifier is transparent to the A-IoT MAC Layer and carried by upper layer. FFS if there is really a need for visibility in the MAC layer

 the A-IoT paging message can include a number of msg1 resources

 From RAN2 perspective, after initial paging message, the R2D transmission which determines the Msg1 resource(s), can be achieved by one of the below two ways, unless RAN1 concludes to use L1 signaling later:

 Way-1: introducing new R2D message other than the paging message, e.g., QueryRep-like; or

 Way-2: reusing the same paging message, using field(s) to indicate it is only to determine the Msg1 resource(s) and omitting the paging identifier (device ID/group ID) field

 The service type of A-IoT (e.g., inventory only, inventory + command) is not included in paging message.

 FFS which solution if any for device behavior if it gets a new service request while one procedure is still ongoing or leave it to implementation.

 RAN2 aims to design Rel-19 AIoT R2D messages extensible to accommodate devices and features of future release.

 Introduce an explicit 1 bit indication to indicate whether it is CFRA or CBRA per paging message

 A field indicating Paging ID length information is always included together with the paging ID field in the A-IoT paging message, except the case where no ID is included in the A-IoT paging message.

 The number of bits required for paging ID length field should be as small as possible. This would require the number of different Paging ID lengths to be small.

 Send an LS to SA2 to tak this into account for their design.

8.2.3 A-IoT Random Access

 For Rel-19, only 3-step CBRA is supported for A-IoT

 We will specify both CBRA and CFRA.

 Re-use the subsequent paging message to trigger re-access. There is no need to differentiate msg1 resource for initial access vs re-access.

 NACK based mechanism is supported for D2R messages to determine re-access for at least msg3. FFS details including whether we need a timer or explicit message and when reader sends feedback

 RAN2 assumes that device randomly selects among FDMA occasions as the baseline.

 In case of CBRA, only 16 bits random ID is included in Msg1. FFS can be revisited if message type will be needed for other D2R messages purposes

 RN16 is not included in the first D2R message in the CFRA procedure. AS ID is the only ID needed for addressing the device in R2D command message assuming for CFRA no multiple devices are performing the procedures with the given reader. FFS if we can assume or need to support multiple device scenario.

 A new R2D message other than the paging message is introduced for A-IoT device determining MSG1 resources unless RAN1 concludes to use L1 signaling. The R2D message indicates the start of a set of MSG1 resources that were configured in paging message.

 Assumption: The R2D message does not include slot number/count down number.

 A-IoT Msg2 contains one or multiple echoed random ID(s) from A-IoT Msg1 of different A-IoT devices.

 Same Msg2 format is used for initial transmission and retransmission of Msg2.

 For CBRA, as a baseline, NACK based mechanism is applied only to the Msg3. May come back for D2R data, if the NACK feedback indication is needed for the purpose to stop/terminate the “on-going procedure” and release the AS ID accordingly (depending on other later discussion).

 For msg3, we rely on whether the device receives NACK indication before subsequent R2D message to determine re-access. No need for a timer. FFS whether subsequent R2D message is trigger message or paging

 For CFRA, NACK feedback and re-access is not supported. FFS how to achieve

 FFS on end of procedure

8.2.4 A-IoT Data Transmission and Other general aspects

 For CBRA, it is up to Reader to decide whether to reuse the random ID as the AS ID or to assign a new AS ID. FFS how this is signalled, which message is used and size of AS ID.

 From device perspective, it is only required to use one AS ID.

 CFRA is not supported for group ID

 RAN2 assumes, AS ID is needed for CFRA at least for inventory + command procedure

 For CFRA, if a valid AS ID is not already assigned, continue the discussion on AS-ID assignment based on the following options:

 Option 2: the device includes a random ID in “Msg 1”. And same as CBRA, it is up to Reader to decide whether to reuse the random ID as the AS ID or to assign a new AS ID.

 Option 3: New “Msg 2” for AS ID assignment, complementary option or independent from option 2

Option 4: “Msg 2” (including the “Command”) for AS ID assignment, complementary option or independent from option 2

 To support segmentation, a 1 bit indication is introduced to indicate whether there is more data or not, if SA2 indicates that CN can provide an estimated expected D2R message size. If not possible, FFS if the 1 bit is sufficient.

 Segment retransmission is supported.

 For segment retransmission, reader explicitly indicates an offset in the MAC layer– e.g. number of bits successfully received so far (from the start). FFS This implies that unsegmented packet can also be retransmitted. FFS if this applies to msg3

 R2D segmentation is not supported for R19 A-IoT.

 From RAN2 perspective only the following types of procedures will be considered in the normative phase: “Inventory only” and “Inventory and command”.

 AS ID is applied for Inventory + command case;

 AS ID is not included in D2R message except Msg 1 (RN16 in Msg 1 has been agreed.

 For both CFRA and CBRA, the AS ID size is same as RN 16, i.e. 16 bits.

 Do not specify the reader behaviour on how exactly the ASID is generated.

 The device releases the AS ID upon power off (no stage 3 specification impact);

 The device only keeps one AS ID at a time.

 For CFRA, command message is used for AS ID assignment

 For CBRA, Msg 2 is used for AS ID assignment

 The device releases the AS ID at least:

 - upon receiving Paging with new transaction id for that device, i.e. different session/service

 - when it triggers new msg1 transmission as a result of receiving Paging message (i.e. it has to generate a random ID for CBRA)

 - FFS other cases for release ASID to avoid keeping it indefinitely.

 For the retransmission of the first segment/unsegmented D2R message, the reader sends the R2D message by including the upper layer command again. FFS whether offset zero is always included.

 FFS whether the reader always includes the command for retransmission of segments.

 1-bit indication is sufficient to indicate whether more D2R data will be sent

 For inventory response, RAN2 assumes that segmentation is not applied. RAN2 assumes that the reader can avoid segmentation by reader being aware of inventory response size. Notify SA2 about this assumption.

Agreements on MAC PDU format design

 Aim to design simple MAC PDU format design

 Support multiplexing of information for multiple devices in R2D message for msg2. FFS others for multicast messages

 At least the following field are required for at least for R2D in the MAC header– message type, length for SDU and variable part(s).

 FFS whether for D2R we need message type field, any length and need for padding

 Specify message types and contents. As starting point consider the following MAC message types.

 R2D MAC PDU (Paging/R2D trigger (depending on agreement on WF))

 D2R MAC PDU (MSG1) (FFS if this requires a MAC header or not)

 R2D MAC PDU (MSG2)

 D2R MAC PDU (MSG3 and data)

 R2D MAC PDU (R2D data)

 Other message types are FFS. The message types may evolve based on functionality agreements.

 The MAC PDU should be byte-aligned, assuming the allocated TBS value is in the unit of byte. The actual TBS value depends on RAN1. FFS for R2D trigger message

 RAN2 assumes that the upper layer data SDU is byte-aligned, and an LS can be sent to CT1.

 The D2R MAC PDU size will correspond to the TBS size indicated in the R2D message

 The MAC padding is supported at least for D2R from RAN2 perspective. The device includes padding bits if there is no more data and there is still space available in the TBS.

 In case where MAC PDU includes both MAC SDU and padding, for D2R a field to indicate how many SDU bits are present is required. FFS how this is provided (i.e. SDU length field or padding length field). The size of length field is FFS.