3GPP RAN WG2 Meeting #131 R2-250xxxx

, 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:

* [POST130][027][AIoT] MAC Running CR (Huawei)

Intended outcome: Review CR and open issues

Deadline: Long

Companies are invited to provide feedback on open issue list by: **Aug 1st, 10:00 UTC.**

# Remaining open issues for specification 38.391

## List of the open issues and type of issue

The issue descriptions have been updated according to the RAN2#130 progress with revision marks.

* Some issues have been addressed in RAN2 #130 meeting. The classification of those issues will be marked as “Addressed/closed”.
* For some straightforward/very detailed/not technically complex issues, the Rapp will propose resolution, and invite companies to provide comments in the questionnaire. The summary will be submitted to the next meeting.
* For the specification implementation issues, the Rapp suggests to check/review the MAC running CR directly.
* For the issue newly identified or technically controversial, the classification will be marked as “To be discussed by company contributions”. Further discussion in next meeting would be based on companies’ contribution.

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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.   * *Rel-19 devices are not expected to receive parallel service request for overlapping reader scenario based on network implementation. Capture this in stage 2 specification.* * *The Rel-19 device always responds to the new service indicated by the received paging message applicable for that device. Capture this in stage 3 specification.* * *Send LS to RAN3 to notify them of agreements 1 and 2* * *Parallel service request for overlapping reader scenario can be addressed in Rel-20* * *Status in running CR: captured in 5.2.* | Addressed/closed |
| **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.* | Companies are invited to input views for Q#2 |
| **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, taking into account of CT4 and SA2 reply LS in C4-252466 and S2-2505793.   * *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. CT4 replied with LS and CR in* *C4-252466 (LS on paging ID)*. SA2 reply LS is in S2-2505793*.* * *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.* | Companies are invited to input views for Q#3 |
| 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:* * *Issue (1-4) For number of access occasions introduce exponential way, 4 bits, value range FFS* * *Status in running CR: the field name and format is captured in 6.2.1.1 with proposed value range to be reviewed by companies.* | Format is addressed, value range FFS is moved to issue 4-4 |
| Issue 1-5:  Paging content for CFRA | As baseline, the transaction ID is absent in Paging message for CFRA. FFS on the need for the transaction ID for command case.   * *For CFRA, as a baseline the fields related to the transaction ID, indication of paging ID present/absent and number of access occasions are absent. FFS on the need for the transaction ID for command case.* * *Status in running CR: the CR is implemented assuming no transaction ID for CFRA, and no issue is identified.* | Companies are invited to input views for Q#4 |
| **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 chairlady, 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.* * *For Msg1 resource selection procedure capture as guidance the countdown behaviour in the MAC specification (use TP in R2-2503952). Capture a NOTE that other implementation are allowed. X, Y will be signalled by paging message.* * *Status in running CR: captured in 5.3.3.1.* | Addressed/closed |
| 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 start of the first set of MSG1 resources is indicated by Paging message directly instead of the new R2D trigger messages. R2D trigger message is not sent in CFRA procedure. Come back if RAN1/4 sees any issues. Send LS to RAN1/RAN4.* * *Status in running CR: captured.* | Addressed/closed |
| 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.* * *FFS R2D byte alignment dependent on TBS size discussion* * *Status in running CR: not captured yet.* | To be discussed by company contributions |
| **Subgroup: CBRA procedure related** | |  |
| Issue 2-4: CBRA failure detection | Further down selection between option B and C for msg2 monitor window in CBRA.   * *1 Exclude the option of MSG2 transmission and any retransmission of MSG2 happens within a predefined time window (based on timer)* * *2 A device expecting MSG2 assumes CBRA failure if its MSG2 is not received before a boundary, where the boundary can be further downselected between option B and C below. A device receiving MSG2 within this boundary transmits MSG3. The device does not process MSG2 (re)transmission received after the boundary.* * *Option B – the boundary is the reception of either the next R2D trigger message or the subsequent paging message* * *Option C – the boundary is the reception of either the kth R2D trigger message or the subsequent paging message (K is FFS)* * *Option A (the boundary being the subsequent paging only) is excluded.* * *For option C, further discuss in terms of complexity at the device vs reader flexibility.* * *3 Including frequency index along with RN16 in MSG2 to reduce collisions of MSG1 between different devices is feasible. FFS Discuss further whether to include it.* * *Status in running CR: the common part of option B and C is captured, while the difference part is in [] and highligted.* | To be discussed by company contributions |
| **Subgroup: Msg2 content** | |  |
| Issue 2-5:  random ID differentiation in Msg2 | Whether to include frequency index along with RN16 in MSG2 to reduce collisions of MSG1 between different devices.   * *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.* * *RAN2#130 agreement: Including frequency index along with RN16 in MSG2 to reduce collisions of MSG1 between different devices is feasible. FFS Discuss further whether to include it.* * *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 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.* * *Status in running CR: the CR is implemented assuming no explicit number indication, and no issue is identified.* | Companies are invited to input views for Q#5 |
| Issue 2-7: present/absent indication of assigned AS ID in Msg2 | How to indicate the AS ID presence in Msg2.   * *One bit indication is needed for each echoed random ID in Msg2 to indicate whether AS ID is present (i.e., assigned by reader) for this random ID..* * *Status in running CR: captured.* | Addressed/closed |
| **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.* * *For CFRA, the device always responds to paging regardless of transaction ID (if we put a transaction ID) (i.e. as long as it is addressed to the corresponding device).* * *Status in running CR: captured in 5.2.* | Addressed/closed |
| Issue 2-9: AS ID assignment in multi-device CFRA | Whether to consider multiple device scenario as to the AS ID in CFRA.   * *The rapp understands there is no such scenario after we agreed that the device always response to new paging. 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.* * *For CFRA, the device always responds to paging regardless of transaction ID (if we put a transaction ID) (i.e. as long as it is addressed to the corresponding device* * *Status in running CR: not captured.* | Addressed/closed |
| **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* * *After MSG3 transmission, upon receiving NACK with its AS ID before subsequent paging or command addressed to this device from the reader, device determines it will perform re-access. FFS how to specify.* * *Status in running CR: captured in 5.5.* | Addressed.  “*FFS how to specify*” is moved to issue 4-4 |
| Issue 2-11: explicit message for NACK | Whether to use a new/explicit R2D message for NACK feedback.   * *Relevant agreements:* * *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.* * *NACK feedback is defined as an explicit message (i.e. new message type). AS ID(s) is/are included to indicate the failure for given device(s). Multiplexing of NACK feedback is supported in one message* * *Status in running CR: captured.* | Addressed/closed |
| 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.* * *Multiplexing of NACK feedback is supported in one message* * *Status in running CR: not captured yet.* | Addressed/closed |
| **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.* * *R2D message scheduling non-first segment (re)transmission does not include upper layer command.* * *Status in running CR: captured in 5.4.2.* | Addressed/closed |
| 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.* * *For the first segment and unsegmented packet (re)transmission, the “offset” indicator in R2D is not present.* * *Status in running CR: captured in 5.4.3.* | Addressed/closed |
| **Subgroup: AS ID** | | |
| Issue 3-3: AS ID release | Whether a release message is needed for AS ID release   * *Relevant agreements:* * *FFS other cases for release ASID to avoid keeping it indefinitely.* * *- For CBRA, to avoid AS ID being occupied for unnecessary time and to keep alignment between reader and device on AS ID release, device can release AS ID upon receiving paging message with different transaction ID, no matter the paging message is for it or not. FFS for CFRA* * *- FFS for need for release message* * *Status in running CR: captured as Editor’s Note in 5.2.* | Companies are invited to input views for Q#6 |
| **Subgroup: D2R message content for data transmission** | | |
| Issue 3-4: D2R padding indication | How to indicate padding and the Length field for SDU (segmentation or non-segmentation) 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.* * *A mandatory length field directly indicates the length of D2R data MAC SDU to support varying lengths of D2R data. The size of length field is 7-bit in bytes.* * *The offset indication for transmission/retransmission of the segments after the first segment of a D2R message is 7-bit length in bytes. Segmented SDUs are also byte aligned.* * *Status in running CR: captured in 6.2.2.2.* | Addressed/closed |
| 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* * *FFS D2R message type. Current running CR will capture no message type, but we can revisit this next meeting and also consider if any other bits are needed for the MAC header* * *Status in running CR: captured as Editor’s Note in 6.1.1.* | Companies are invited to input views for Q#7 |
| Issue 3-6: Write operation response | Whether the write command type may cause a case of ‘no upper layer data is available for a D2R scheduling’ due to long writing time.   * *Relevant agreements:* * *The device is expected to send a MAC response to the reader in the D2R occasion. The MAC response contains the NAS message if available at the D2R occasion. If there is no NAS message available to transmit at the D2R occasion then the response contains MAC with 0 SDU and padding as needed.* * *Send LS to CT1 to inform the agreement 1 to CT1 and explain that we have an issue with delayed NAS write success response. RAN2 would prefer that this is handled by CT1 (and give the example of sending NAS response upon successful reception of write command). Ask if this can be handled by CT1* * *Status in running CR: captured in 5.4.1.* | Addressed/closed |
| (New)Issue 3-7: more data indication handling | How to set “more data indication” value in case of no NAS response available (i.e., zero SDU)   * *During CR implementation, the rapp identified there is no clear conclusion how to set the “more data indication” in case of no data available, i.e., zero SDU.* * *Status in running CR: captured as value FFS.* | To be discussed by company contributions |
| **Subgroup: R2D message content for data transmission** | | |
| (New) Issue 3-8: R2D TBS | How to handle the R2D TBS, which may impact R2D padding, byte-alignment design.   * *Relevant agreements:* * *RAN1 LS in R1-2504915* * *The length field inside MAC for SDU is not needed for R2D messages, assuming R2D MAC padding is not needed. FFS can come back if padding is needed depending on granularity of TBS (only if needed)* * *Status in running CR: not captured yet.* | To be discussed by company contributions |
| **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.   * *Based on RAN1 LS in R1-2504915, the Rapp created a subclause 6.2.1.7 in the MAC running CR to capture all the RAN1 agreement parameter, companies are encouraged to check the details and make comment if any.* * *Status in running CR: a field named as D2R Scheduling Info is included in Paging message, Msg2 and R2D command message as a placeholder, and the details are captured in subclause 6.2.1.6 based on RAN1 inputs.* | To be checked/discussed directly in CR review [POST130][027][AIoT] MAC Running CR |
| **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.   * *Relevant agreements:* * *Assume two transport channels are introduced between A-IoT MAC and PHY. One is for R2D, and the other is for D2R. Neither logical channel concept nor SAP is defined for the interface between A-IoT MAC and upper layers.* * *Status in running CR: captured as Editor’s Note in 4.2.* | Addressed/closed |
| Issue 4-3 | Terminology, message names, field names, definitions used in MAC running CR   * *Relevant agreements:*   Use as baseline the following message names, field names and definitions are to be used in A-IoT MAC:  − Message name: A-IoT Paging message, Access Trigger message, Random ID message, Random ID Response message, R2D Upper Layer Data Transfer message, D2R Upper Layer Data Transfer message.  − Field name: R2D Message Type, RA Type, Indication of Paging ID Presence, Length of Paging ID, Paging ID, Transaction ID, Number of Access Occasions, D2R Scheduling Info, Random ID, Echoed Random ID, AS ID, Assigned AS ID, More Data Indication, SDU Length, MAC Padding, Received Data Size.  − Definitions:  o Access occasion: A time-frequency resource for device(s) to transmit Msg1 (i.e., the Random ID message) during a CBRA procedure.  o AS ID: The AS layer identifier to address the specific device for R2D reception and D2R scheduling | Addressed/Further update can be conducted during CR review |
| **Subgroup: MAC spec implementation to be checked in CR review** | | |
| Issue 4-4: MAC spec implementation | For some easy FFS (e.g., how to implement agreement in spec), the Rapp took the liberty to propose some implementation resolution, and invite companies to check and review in the running CR.   * *AS ID release: FFS for CFRA* * *Msg2 retransmission: How to capture device behavior is FFS* * *Segmentation: This implies that the R2D message will either have command or offset (but not both).FFS whether we define two message types or one message type with optional fields.* * *NACK: FFS how to specify.* * *Paging message format: FFS if more than one R bit is required.* * *Access occasion number: value range FFS.* | To be checked/discussed directly in CR review [POST130][027][AIoT] MAC Running CR |

**Q#1: Companies are invited to provide feedback regarding the above open issue description and classification.**

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| **Company** | **Issue No.** | **Comments** |
| CATT |  | OK with the rapporteur update |
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## Collection of company inputs to the open issues

### Issue 1-2: transaction ID

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| 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.* | Companies are invited to input views for Q#2 |

According to previous discussion, the main motivation to consider long transaction ID/specify the generation of transaction ID seems for multi-reader scenario. However, in last meeting, it has been agreed that it should be network implementation to avoid devices receiving parallel service requests. In this case, network implementation can also avoid transaction ID collision, if needed. Therefore, there is no need to further discuss how to specify the transaction ID generation. Then for the length of transaction ID, proposals from companies seem to focus between 2 and 6. So the rapp would like to ask for company’s inputs on the suggested transaction ID length, based on that we can follow majority view.

**Q#2: Companies are invited to provide feedback regarding:**

* **Q2.1: do you agree how to generate transaction ID is also left to implementation?**
* **Q2.2: how many bits between 2 and 6 of transaction ID do you prefer?**

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| **Company** | **Q2.1: Agree or not** | **Q2.2: how many bits** | **Comments if any** |
| CATT | agree | 2 bits |  |
| OPPO | agree | No strong view |  |
| vivo | agree | 4bit | For Q2.1, a Note can be captured to reflect that: at least the NW implementation should guarantee that the transaction ID and correlation ID has a one-to-one mapping relationship. |
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### Issue 1-3: Paging ID length field

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| Issue 1-3:  Paging ID length field | The field to indicate the paging ID length, e.g. value range, how many bits, format design, taking into account of CT4 and SA2 reply LS in C4-252466 and S2-2505793.   * *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. CT4 replied with LS and CR in C4-252466 (LS on paging ID)*. SA2 reply LS is in S2-2505793*.* * *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.* | Companies are invited to input views for Q#3 |

In previous discussion, companies are thinking of paging ID length reduction by indicating the type instead of bit number. However, by reading CT4 and SA2 reply LS in C4-252466 and S2-2505793, it looks like the format of device ID and filter info (in the unit of bit) is very flexible, and there exist uncountable types. The following figures are copied from CT4 agreed CR C4-252464.



Figure aa.3.1: Structure of Filtering Information



Figure aa.3.2: Structure of Identification Information Filter

In this case, 8 bits are needed to indicate 256 bits because filtering Information defined by CT4 is with a maximum length of 256 bits. Companies can check the CT4 and SA2 LS, and feedback whether 8-bit length is acceptable or if there is any better solution.

**Q#3: Do companies agree to use 8 bits to indicate the paging ID length in unit of bit?**

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| **Company** | **Agree or not** | **Comments if any** |
| CATT | agree |  |
| OPPO | agree |  |
| vivo | See comments | I think the issue should be considered as follows:   * Whether there is a need for length indicator? For example, the device can know the whole size of R2D message by R2D TBS, and it can therefore obtain the paging ID length by a simple subtraction operation together with TBS and fields with fixed size. * However, as we noticed that the current design for D2R TBS is in unit of byte, suggesting R2D TBS may be designed the same as that. Therefore, if paging ID is of viable size which is not byte-aligned, a subtraction operation may not get the absolute length of paging ID because of designing issue. And there is still need for the length indicator of paging ID. In such case, we can consider 8-bit is feasible. |
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### Issue 1-5: Paging content for CFRA

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| Issue 1-5:  Paging content for CFRA | As baseline, the transaction ID is absent in Paging message for CFRA. FFS on the need for the transaction ID for command case.   * *For CFRA, as a baseline the fields related to the transaction ID, indication of paging ID present/absent and number of access occasions are absent. FFS on the need for the transaction ID for command case.* * *Status in running CR: the CR is implemented assuming no transaction ID for CFRA, and no issue is identified.* | Companies are invited to input views for Q#4 |

In last meeting online discussion, some companies raised that transaction ID is needed for command case, but there was no time to elaborate the use case, then an FFS was left. Companies are invited to input views for the following question.

**Q#4: Do companies see a need to include transaction ID in the CFRA paging message for command case?**

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| **Company** | **Yes or no** | **Reason** |
| CATT | No |  |
| OPPO | No strong view | We are open to discuss whether there is any issue for command case. |
| vivo | no | The transaction ID is introduced to let device know the current paging is for the same service or different service from the last received one, when there might be an access failure case due to the contention. However, for the case of CFA, since the device should response to every CFA paging message, the transaction ID is not necessary for the device to determine whether to respond the paging message. Moreover, the case is not relevant to whether the paging is triggered by command or inventory, since the device anyway should firstly perform access according to the received paging message. |
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### 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 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.* * *Status in running CR: the CR is implemented assuming no explicit number indication, and no issue is identified.* | Companies are invited to input views for Q#5 |

As the running CR implemented, msg2 may include multiple entries, and each entry includes random ID, AS ID indication and AS ID if assigned. So the question is whether the device need to know the number of the entry when decoding msg2. The CR is implemented without an explicit number indication assuming the device just decodes the entry one by one till the end of the message. The same logic can also apply to NACK Feedback message.

**Q#5: Do companies agree that there is no need to indicate the number of random ID entry, the device just decodes the entry one by one till the end of the message?**

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| **Company** | **Agree or not** | **Comments** |
| CATT | Partially agree with comments | For the NACK msg, we share the same view with the rapporteur. The device can know the end of the NACK based on the R2D TBS indication or postamble (either way is OK from RAN1 perspective). So the device can detect the 16-bit AS ID one by one to detect whether it is addressed. No other fields (except for msg type) exist in the NACK msg.  For the msg2, we prefer to put the echoed RN16 at the top of the msg2 format, for example,    By this way, after the device decoding the whole msg2, the device firstly checks the echoed RN16 to determine whether it finishes the contention resolution. If not, the device does not need to understand the remaining fields. This helps to the device complexity. |
| OPPO | Yes | All bits of TB are verified via CRC checking. It is unclear to us why decoding the whole msg2 increases the device complexity. |
| vivo | Yes | The length of each entry in Msg2, i.e., random ID, AS ID indication and AS ID if assigned, is accurately determined. The number of random ID entry is useless for fast decoding and only increases the overhead. Anyway, device should decode the entry one-by-one till the end of the message or its own entry. Hence, there is no need to indicate the number of random ID entry.  Furthermore, we think Msg1 location indication in Msg2 is useful for RN16 collision case. We propose RAN2 to agree to include the Msg1 location indication in Msg2. |
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### Issue 3-3: AS ID release

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| Issue 3-3: AS ID release | Whether a release message is needed for AS ID release   * *Relevant agreements:* * *FFS other cases for release ASID to avoid keeping it indefinitely.* * *- For CBRA, to avoid AS ID being occupied for unnecessary time and to keep alignment between reader and device on AS ID release, device can release AS ID upon receiving paging message with different transaction ID, no matter the paging message is for it or not. FFS for CFRA* * *- FFS for need for release message* * *Status in running CR: captured as Editor’s Note in 5.2.* | Companies are invited to input views for Q#6 |

According to the current agreements/running CR, devices should release AS ID upon a CFRA paging message or upon a CBRA paging message with new transaction ID/resulting re-access which already address the issue “*avoid keeping it indefinitely*”. In this sense, whether to have a release message to enable early AS ID release is not a critical issue. But the rapp would like to check if there is a majority view on the need of the release message and the detailed solution.

**Q#6: Do companies agree that release message is needed for AS ID release? If so, which option is preferred?**

**Opt1. Unicast message (only one AS ID)**

**Opt2. Multiplexing with a list of AS ID (NACK message-like)**

**Opt3. Broadcast message (without device AS ID)?**

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| **Company** | **Needed or not** | **Preferred option** |
| CATT | Option 3 | We share the similar view with the rapporteur there is no critical issue on the AS ID based on the current agreement. If we do some optimization for this early indication, we prefer Option 3, for example, the paging introduces one-bit to indicate this is the end of the current session, and all the devices end the current procedure with AS ID release. |
| OPPO | Not | The proponent should probably elaborate more on the use cases of the release message. |
| vivo | Yes | We think release message is useful in some cases, e.g., the interval between two paging messages is relatively long or transaction ID coordination between two readers is not easy. The release message is used to avoid useless AS context keeping and unexpected device's behaviors. And the overhead of the release message may be very small, e.g., via multiplexing and broadcast method. Of cause, unicast message is also necessary when single device is paged/released. Broadcast is also useful to reduce signaling overhead. Details can be left to reader implementation. |
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### Issue 3-5: D2R message type

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| 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* * *FFS D2R message type. Current running CR will capture no message type, but we can revisit this next meeting and also consider if any other bits are needed for the MAC header* * *Status in running CR: captured as Editor’s Note in 6.1.1.* | Companies are invited to input views for Q#7 |

According to the previous discussion, some companies propose to have D2R message type for further proof. But it’s not crystal clear what’s the future scenario they are thinking of. Considering the R20 scope/objectives are relatively stable now, companies are invited to double check if the D2R message type is necessary and provide detailed reason and use cases if any.

**Q#7: Whether D2R message type is necessary and what’s the use case if any?**

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| **Company** | **Necessary or not** | **Use cases** |
| CATT | Not |  |
| OPPO | Not |  |
| vivo | See comments | It seems not critical to introduce D2R message type. But we are open to understand the motivation. |
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# Other identified open issues

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

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| **Company** | **Other identified open issues? (please describe)** |
| CATT | In the current MAC running CR, it captured that upon receiving the paging msg (CBRA), the device will store the transaction ID no matter whether it is addressed or not. From our view, we should re-structure this part and follow the similar principle in NR paging, i.e., the device firstly check whether it is paged or not, and then do the corresponding behavior. |
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# Conclusions

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

[Proposals for easy agreement]

# Appendix (Optional)

Agreements in RAN2#129 meeting and RAN2#129bis meeting:

 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.

Agreements in RAN2#130 meeting

1 Use as baseline the following message names, field names and definitions are to be used in A-IoT MAC:

− Message name: A-IoT Paging message, Access Trigger message, Random ID message, Random ID Response message, R2D Upper Layer Data Transfer message, D2R Upper Layer Data Transfer message.

− Field name: R2D Message Type, RA Type, Indication of Paging ID Presence, Length of Paging ID, Paging ID, Transaction ID, Number of Access Occasions, D2R Scheduling Info, Random ID, Echoed Random ID, AS ID, Assigned AS ID, More Data Indication, SDU Length, MAC Padding, Received Data Size.

− Definitions:

o Access occasion: A time-frequency resource for device(s) to transmit Msg1 (i.e., the Random ID message) during a CBRA procedure.

o AS ID: The AS layer identifier to address the specific device for R2D reception and D2R scheduling

2 One bit indication is needed for each echoed random ID in Msg2 to indicate whether AS ID is present (i.e., assigned by reader) for this random ID.

3 NACK feedback is defined as an explicit message (i.e. new message type). AS ID(s) is/are included to indicate the failure for given device(s). Multiplexing of NACK feedback is supported in one message

4 Assume two transport channels are introduced between A-IoT MAC and PHY. One is for R2D, and the other is for D2R. Neither logical channel concept nor SAP is defined for the interface between A-IoT MAC and upper layers.

**Agreements on parallel service request**

1. Rel-19 devices are not expected to receive parallel service request for overlapping reader scenario based on network implementation. Capture this in stage 2 specification.
2. The Rel-19 device always responds to the new service indicated by the received paging message applicable for that device. Capture this in stage 3 specification.
3. Send LS to RAN3 to notify them of agreements 1 and 2
4. Parallel service request for overlapping reader scenario can be addressed in Rel-20

**Agreements on paging**

1. For CFRA, as a baseline the fields related to the transaction ID, indication of paging ID present/absent and number of access occasions are absent. FFS on the need for the transaction ID for command case.
2. For CFRA, the device always responds to paging regardless of transaction ID (if we put a transaction ID) (i.e. as long as it is addressed to the corresponding device).
3. To ensure forward compatibility for paging with multiple identifiers, introduce at least one R field. FFS if more than one R bit is required.
4. Rel-19 devices would ignore the content of future release instead of ignoring the whole paging message.
5. Issue (1-4) For number of access occasions introduce exponential way, 4 bits, value range FFS

**Agreements**

1. For Msg1 resource selection procedure capture as guidance the countdown behaviour in the MAC specification (use TP in [R2-2503952](file:///C:\Users\panidx\OneDrive%20-%20InterDigital%20Communications,%20Inc\Documents\3GPP%20RAN\TSGR2_130\Docs\R2-2503952.zip)). Capture a NOTE that other implementation are allowed. X, Y will be signalled by paging message
2. The start of the first set of MSG1 resources is indicated by Paging message directly instead of the new R2D trigger messages. R2D trigger message is not sent in CFRA procedure. Come back if RAN1/4 sees any issues. Send LS to RAN1/RAN4
3. FFS R2D byte alignment dependent on TBS size discussion

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| Agreements on RA  1 Exclude the option of MSG2 transmission and any retransmission of MSG2 happens within a predefined time window (based on timer)  2 A device expecting MSG2 assumes CBRA failure if its MSG2 is not received before a boundary, where the boundary can be further downselected between option B and C below. A device receiving MSG2 within this boundary transmits MSG3. The device does not process MSG2 (re)transmission received after the boundary.   * Option B – the boundary is the reception of either the next R2D trigger message or the subsequent paging message * Option C – the boundary is the reception of either the kth R2D trigger message or the subsequent paging message (K is FFS) * Option A (the boundary being the subsequent paging only) is excluded.   For option C, further discuss in terms of complexity at the device vs reader flexibility.  3 Including frequency index along with RN16 in MSG2 to reduce collisions of MSG1 between different devices is feasible. FFS Discuss further whether to include it.  **Agreements on NACK reception:**   1. After MSG3 transmission, upon receiving NACK with its AS ID before subsequent paging or command addressed to this device from the reader, device determines it will perform re-access. FFS how to specify.   **Agreements on RN16/AS ID maintainance:**   1. Confirm a device is not expected to maintain both AS ID and RN16. After msg2 reception, RN16 becomes AS ID, if new AS ID was not assigned by reader.   This implies that the reader cannot change AS ID and RN16 pair across message 2 retransmission. How to capture device behavior is FFS |

**Agreements**

1. R2D message scheduling non-first segment (re)transmission does not include upper layer command.
2. For the first segment and unsegmented packet (re)transmission, the “offset” indicator in R2D is not present.
3. This implies that the R2D message will either have command or offset (but not both). FFS whether we define two message types or one message type with optional fields.

**Agreements**

1. The device is expected to send a MAC response to the reader in the D2R occasion. The MAC response contains the NAS message if available at the D2R occasion. If there is no NAS message available to transmit at the D2R occasion then the response contains MAC with 0 SDU and padding as needed.
2. Send LS to CT1 to inform the agreement 1 to CT1 and explain that we have an issue with delayed NAS write success response. RAN2 would prefer that this is handled by CT1 (and give the example of sending NAS response upon successful reception of write command). Ask if this can be handled by CT1

**Agreement on MAC PDU format**

1. A mandatory length field directly indicates the length of D2R data MAC SDU to support varying lengths of D2R data. The size of length field is 7-bit in bytes.
2. The offset indication for transmission/retransmission of the segments after the first segment of a D2R message is 7-bit length in bytes. Segmented SDUs are also byte aligned.
3. FFS D2R message type. Current running CR will capture no message type, but we can revisit this next meeting and also consider if any other bits are needed for the MAC header
4. The length field inside MAC for SDU is not needed for R2D messages, assuming R2D MAC padding is not needed. FFS can come back if padding is needed depending on granularity of TBS (only if needed)

**Agreements**

- For CBRA, to avoid AS ID being occupied for unnecessary time and to keep alignment between reader and device on AS ID release, device can release AS ID upon receiving paging message with different transaction ID, no matter the paging message is for it or not. FFS for CFRA

- FFS for need for release message