**3GPP TSG RAN WG2 Meeting #129bis R2-250xxxx**

Wuhan, China, April 7th– 11th, 2025

Agenda Item: 8.2.4

Source: Xiaomi

Title: Report of [POST129][036][AIoT] AS ID (Xiaomi)

Document for: Discussion and Decision

# Introduction

This report provides a summary for the following post-meeting email discussion:

* [POST129][036][AIoT] AS ID (Xiaomi)

Intended outcome: Discuss the pros/cons of the related CFRA and CBRA options and validity of AS ID

Deadline: long

Rapporteurs would suggest to have two phases discussion:

**Phase 1**: Companies are invited to provide comments/inputs on the pros/cons of each option for CFRA/CBRA and validity of AS ID.

Deadline for providing comments for phase 1 is March 14th, 2025, 10:00UTC.

**Phase 2**: Rapporteur will provide summary based on the inputs from companies in Phase 1. Companies are invited to provide comment on the summary and new questions from Rapporteur.

Deadline for providing comments for phase 2 is March 20th, 2025, 10:00UTC.

Companies providing input to this email discussion are requested to leave contact information below.

|  |  |  |
| --- | --- | --- |
| **Company** | **Name** | **Email Address** |
| ZTE | Eswar Vutukuri | eswar.vutukuri@zte.com.cn |
| OPPO | Liu Yang | liuyangbj@oppo.com |
| Lenovo | Jing HAN/Hyung-Nam Choi | hanjing8@lenovo.com  hchoi5@lenovo.com |
| NEC | Zonghui Xie/ Satoaki Hayashi | [xie\_zonghui@nec.cn](mailto:xie_zonghui@nec.cn)  satoaki-hayashi@nec.com |
| vivo | Boubacar Kimba | kimba@vivo.com |
| CATT | Jianxiang Li | lijianxiang@catt.cn |
| MediaTek | Nathan Tenny | nathan.tenny@mediatek.com |
| CMCC | Chenningyu | Chenningyu@Chinamobile.com |
| Huawei, HiSilicon | Rui Wang | wangrui46@huawei.com |
| Apple | Zhibin Wu | Zhibin\_wu@apple.com |
| Spreadtrum, UNISOC | Huifang Fan | [Huifang.fan@unisoc.com](mailto:Huifang.fan@unisoc.com) |
| InterDigital | Martino Freda | martino.freda@interdigital.com |
| ETRI | Seungkwon Baek | skback@etri.re.kr |
| Panasonic | Quan Kuang | [Quan.kuang@eu.panasonic.com](mailto:Quan.kuang@eu.panasonic.com) |
| Qualcomm | Ruiming Zheng | [rzheng@qti.qualcomm.com](mailto:rzheng@qti.qualcomm.com) |
| Nokia | Jakob Buthler | Jakob.buthler@nokia.com |
| HONOR | Xiaoxuan Tang | tangxiaoxuan@honor.com |
| LGE | Seong Kim | sj117.kim@lge.com |
| Fujitsu | Sue Yi | yisu@fujitsu.com |
| Samsung | Weiwei Wang | ww1016.wang@samsung.com |
| Ericsson | Henrik Enbuske | Henrik.enbuske@ericsson.com |
| Futurewei | Yunsong Yang | yyang1@futurewei.com |

# Phase 1 Discussion

## AS ID assignment for CFRA

Based on offline discussion “R2-2501510 [AT129][020][AIoT] AS ID (XiaomiHuawei)”, RAN2 discussed the need of AS ID for CFRA and candidate options for AS assignment for CFRA and concluded that:

|  |
| --- |
| 1. RAN2 assumes, AS ID is needed for CFRA at least for inventory + command procedure 2. 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 |

During offline discussion, 4 options were listed as below, but option 1 has been precluded during online discussion.

|  |
| --- |
| **Option 1**: the reader assigns AS ID via Msg0 Paging  **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 (command) for AS ID assignment, complementary option or independent from option 2  - Option 1: 4  - Option 2: 7  - Option 3: 8  - Option 4: 11 |

In addition, based on the offline discussion, there was clear consensus that AS ID is needed for data transmission, i.e., Command procedure after inventory procedure. Therefore we may focus on whether AS ID can be used for Command procedure when analyse Option2-4.

As RAN2 concluded that “1. NACK based mechanism is supported for D2R messages to determine re-access for at least msg3.”, the successful Inventory+Command procedure for CFRA could be:



##### Q1-0: Do companies agree with the above AS ID assignment procedure for CFRA which will be used for further analysis?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes | Option s may be combined as already hinted above and option 2+4 would be something that would be similar to CBRA for instance. |
| OPPO | Yes | But the usage of the AS ID for CFRA case may need to be discussed in the first place. At least for us, the reason why AS ID shall be needed for the CFRA is not clear |
| Lenovo | Yes | For option 4, in the bracket after command, it should be *read* instead of *reader?* |
| NEC | See Comments | We understand that “Msg.1” in the above figure (CF access) refers to “the first D2R data transmission” in the TR38.769 Figure 6.3.1-1.    Figure 6.3.1-1 Overall AS procedures between A-IoT device and reader  Considering “A-IoT Msg.1, A-IoT Msg.2” are only defined for CBRA case in TR38.769, to avoid unnecessary confusion, we suggest not using “Msg.1~Msg.5”, followings can possibly be used instead:  Msg 1→the first D2R data transmission of CFRA  Msg.2→the first R2D command transmission of CFRA  Msg.3→command response to the first R2D command transmission of CFRA  Msg.4→R2D command transmission of CFRA  Msg.5→command response  With the above, we have 1 question for clarification: Whether device ID is included in the first D2R data transmission of CFRA?  According to TR38.769 6.3.1 and 6.3.4 (copied below), seems the answer is Yes?  *(6.3.1) Step B: D2R data (device ID) transmission. Triggered A-IoT device(s) perform the device ID transmission via the A-IoT random access procedure or without using the A-IoT random access procedure. See clause 6.3.4 (and 6.3.5).*  *(6.3.4) If the random access is contention-free access:*  *- Selects the indicated D2R occasion/resource;*  *- Skips the contention resolution in Step 2 and performs the data transmission in accordance to clause 6.3.5.* |
| vivo | Yes, with comments | For all options, the Inventory Response in MSG1 includes the Upper layer Device ID. While RN16 needs to be included in MSG1 only for **Option 2**. Therefore, we suggest adding the one common step for MSG1 as “MSG1: Inventory Response (Device ID)” following the step for the paging message. |
| CATT | Yes with comment | We agree to the general procedure on the allocation of AS ID in CFRA for inventory + command procedure. AS ID here is not for CFRA, but for being scheduled for inventory + command procedure. During last meeting discussion, we had precluded the parallel services by the same reader. In this case, all the R2D messages are targeted for the single device during the service period. Even we consider the scenario where the device is located at the overlapping area by two readers, the readers should execute the service request from CN (paging associated with the same transaction ID) in TDM manner (reader 1 by [t1 t2], reader 2 by [t2 t3]) so that the device can successfully receive the R2D message (As per my RAN1 colleague, the device cannot filter FDMA signals due to low complexity). If we take the assumption that CFRA here means the following command(s) is always for the single target device, it seems AS ID is not required. |
| MediaTek | Yes | Option 2 as described doesn’t specify which message optionally assigns the AS ID, but we understand it is compatible with options 3 and 4. |
| CMCC | Yes, with comments | We think for inventory only case, the AS ID is not needed, because there is not subsequent scheduling and command.  Same question as vivo mentioned, we wonder whether the upper layer device id in paging message need to be included in the MSG1 for option 2/3/4? There is a trade-off between efficiency and forward compatible. The upper layer device id is ~hundred bits long id which impacts the efficiency. And for forward compatibility, CFRA paging message may include multiple device id in future release, without replying upper layer id, it is difficult to figure out which device is replying. |
| Huawei, HiSilicon | Yes, with comments | The solution description itself is clear to us. But we also would like to echo the comments mentioned above:  1. the need/usage of the AS ID:  The agreed usage is for the purpose of D2R scheduling and R2D reception, i.e. to let device tell which D2R scheduling/R2D message is for itself. Therefore, for one-device CFRA, considering all the resources in one paging round are for this certain device, there is no specific use of the AS ID.  Then during offline discussion, companies mentioned 3 potential usages, i.e. multi-reader scenario, forward compatibility for multi-device CFRA, unification of CBRA and CFRA.   * For multi-reader scenario, if assuming two D2R transmissions collide on the same resource, none of them can be decoded correctly, since the physical layer signal (e.g. OOK based) basically has no ability to resist interference. Therefore, adding AS ID does not help much. And if the network wants to deploy overlapping multiple readers, the only way is to assign them with separated radio resources. * For multi-device CFRA, we are not against this, but we should control the standard effort, since this is not a R19 feature. * For unification, the intention of reducing device process logic is always good when it’s possible, but unification is not a top requirement…   To sum up, in our view there is **no AS ID for inventory-only case** (same for CFRA and CBRA), while for command case in CFRA, we can consider to include AS ID, but with small standard effort.  2. the meaning of the term ‘msg1/2/3…’, as discussed for MAC format design, the msg1/2 in CBRA and CFRA would be different message types, so the names that Rapp put in brackets are clear enough. |
| Apple | Yes with comments | My understanding is that for inventory only procedure, there is only Paging(msg0) and Msg 1, so none of the options is needed. I hope this can be clarified in the discussion.  Then, for inventory + command case, Option 2 needs include RN16 in Msg 1. This needs to be clarified, too.  For Option 3, it is unclear how the device will know this AS ID is assigned to it or some other device? So, some device ID has to be included. This needs to be clarified in the signalling diagram. |
| Spreadtrum, UNISOC | Yes | Share view with MTK. For option 2, it is not specify which message allocates the AS ID. But it can combine with option 3 and 4. |
| InterDigital | Yes, with comments | For option 2, we don’t think the reader needs to provide the AS ID (using either option 3 or option 4) for CFRA case and this is mostly for CBRA case. However, if we want to have the same solution for CBRA and CFRA, we would then need to clarify which of option 3 or 4 we are using. |
| ETRI | Yes | Similar view with MedidaTek. |
| Panasonic | Yes with comments | We have some sympathy on NEC’s concern on naming of Msg1 and Msg2. According to our reading of TR38.769, Msg1 and Msg2 are used only for CBRA for contention resolution (i.e. Msg1 and Msg2 are skipped for CFRA). But according to Huawei’s comment above, Msg1 and Msg2 are still used for CFRA but with different meaning than CBRA. If this is the common understanding of the group, we are ok.  Another point, it needs to be clarified whether upper layer device ID should be included in the first D2R data transmission of CFRA (i.e. “Msg1” in Rapporteur’s formulation)  Regarding Huawei’s comment that AS ID is not needed in multi-reader scenario, we have a different view. The use case is for R2D instead of D2R. For example, without AS ID included in R2D message for addressing the target device, the device would be confused by another R2D message from other readers in a multi-reader overlapping area on whether the device is the intended target device or not. |
| Qualcomm | Comment | For contention-free A-IoT access, only the device ID or the identification for the target A-IoT device carried in A-IoT paging message should be included in the first D2R message (i.e. what is shown as “Inventory Response” in the figure actually contains the AIoT device ID). Therefore, the random ID is neither needed nor suitable in Msg1 for contention-free case.  Also suggest removing the terms like msg4/5 which we didn’t use in SI. Moreover, Msg4 may not be ‘command’ but a re-trigger with resource allocation for further D2R segment transmissions in case of D2R segmentation. |
| Nokia | Comment | Although we agree that the random ID may not be needed, we believe that at least paging, msg1, and msg2 is needed to establish the security context.  Especially CFRA has the opportunity for security considerations in case it is unicast or multicast.  In case of a single device using CFRA only, the AS ID is not needed since we would assume the command would be in sequence with the inventory, but in case of multicast, it could be beneficial to identify the target of a command. |
| HONOR | Yes | For the inventory + command use case, the device ID needs to be included in the “Msg 1” to response the paging including inventory request.  And for option 4, the Msg 2 (command) could assign the AS ID or confirm the AS ID corresponding to the RN16 in “Msg 1”. It is preferred to have the similar format with option3: 1) command (to assign AS ID); 2) command (confirmation of AS ID). |
| LGE | Yes |  |
| Fujitsu | Yes | As mentioned by some companies, option 2 is not exclusive with option 3 and 4, i.e., option 2 can be combined with option 3 or option 4 to make a unified solution with CBRA. |
| Samsung | Yes | On top of all those options, we may need have a common ground for the baseline:   * Msg1 includes the device ID (upper layer ID), and whether this is visible to the reader is FFS. So, our assumption is that the reader has no information of the device ID. * During CFRA procedure, the collision due to the multi-reader scenario is a rare case. If it happens, the reader cannot receive Msg. 1.   In addition, in our opinion, the inventory only case for CFRA does not need AS ID assignment. |
| Ericsson | Yes | Agree that for Inventory only, only an upper layer Id is needed. |
| Futurewei | See comments | First, we agree that for inventory service with CFRA, AS ID is not needed.  Secondly, for command service, if the command is already included in Msg0 (i.e., the paging message with CFRA), the device will start to respond to the command. Given that RAN2 has agreed that parallel services from the same reader are not supported, the reader should try to complete the service transaction with the device in a non-stop manner, in which case we also don’t see a need of AS ID.  We think assigning AS ID may be useful only if the assigned AS ID will remain valid for multiple rounds of service requests (such as periodical service requests).  In any case, if we are to consider AS ID assignment, besides the mechanisms described by the rapporteur above, we think there is a variant of option 2, which may be simpler and consumes less energy for the device, as follows:  There must be a unique ID of the device in Msg0 (the paging message) for the CFRA procedure, whether it is the device’s permanent ID (for deployment scenarios where security/privacy is not a concern) or a NAS-level temporary ID that SA3 has agreed to define for deployment scenarios where security/privacy is a concern. When the device finds that its ID matches with the ID in Msg0, the device can echo back a truncated version, e.g., the 16 LSBs, of its ID in its Msg1 (instead of using RNG to generate an RN16). Using RNG to generate a RN16 each time on the fly is more energy consuming than generating a truncated ID from the device’s ID. Given there is no contention here, echoing back a definite ID is also more robust than sending back a random number for error detection and handling purposes. After that, if the echoed ID is not unique at the reader, the reader can assign a more unique AS ID, as in options 4. BTW, we prefer not to create a need of a “new Msg2” just for the purpose of assigning AS ID. AS ID assignment should be piggy-back on subsequent R2D trigger, to reduce latency and minimize the number of messages that we need to define. |

During online discussion and offline discussion, companies already explained the Pros/Cons of each option. Rapporteur try to summarize them as below:

**Option 2**: the device includes a random ID in Msg 1 (Inventory Response). 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 (The assignment can be done via Option 3 or Option 4).

**Pros:**

* The random ID included in Msg1 (Inventory Response) can be used in “New Msg2” or “Msg 2 Command” to associate the resources and identify the device if the ID can be reused;
* If new ID is needed, the RN 16 indicated in Msg1 can be used to identify the device and associate with the resources.

**Cons**:

* Additional signalling overhead in Msg 1 (Inventory Response); But same content as Msg3 for CBRA if RAN2 agrees that AS ID is contained in D2R message if available. FFS on RN 16 collision case

##### Q1-1. Do companies agree the above analysis on Pros/Cons of option 2 (the device includes a random ID in Msg 1 (Inventory Response))?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes | The additional overhead I guess is there in MSG1, when compared to the case when there is no RN16 in MSG1 but UE directly includes UE ID. But, then the paging message needs to include ASID in the other option (i.e. option 1). It is worth clarifying hence what the additional signalling overhead is with respect to… |
| OPPO | Yes | There is no guarantee that, for CFRA procedure, subsequent D2R transmission is needed. If there is no subsequent D2R transmission, then transmission of the random ID in msg1 is totally waste of energy and signalling overhead. |
| Lenovo | Yes | And different as CBRA, RN16 in Msg1 of CFRA is not for contention resolution, but only for AS ID allocation. It’s unnecessary to let AIoT device generate random number only for AS ID allocation, which increase the device burden. Besides, whether there follows command may not known by the device, so there could be unnecessary to generate RN16 if there does not follows command messages. In this sense, we think the reader allocate AS ID for CFRA is more suitable. |
| NEC | Basically Yes | Two pros listed by the rapporteur are the same in our understanding.  Regarding Cons, if there is RN16 collision, then reader can assign a new ID like in CBRA case, maybe FFS part is not needed. |
| Vivo | Yes, with comments | Cons: RN16 is not needed for Inventory-only procedure; however, from a device perspective, it does not differentiate whether the CFRA is for Inventory-only or Inventory+Command procedure but always transmits RN16 in all cases, which means signaling overhead due to RN16 transmission would be quite worse in **Option 1**. |
| CATT | Yes | We tend to agree with the rapporteur understanding on the pro/cons of option 2. Further comments please see our Q1-0 response. |
| MediaTek | Yes | The preceding comments are correct that there are cases where the RN16 is useless, but the overhead has to be weighed against device complexity. If we see that there are some cases where it’s useful to have RN16, it should be included consistently rather than trying to optimize with a conditional behaviour at the device. |
| CMCC | With comments | We understand for both inventory only and inventory+ command case, the random ID is not necessary to be contained in Msg1. Device can send device ID for acknowledge the paging or for AS ID assignment purpure.  For the Cons, we wonder why it is same as Msg3 for CBRA. For Msg3 of CBRA, the content includes AS ID+device ID; for option2, the content of Msg 1 includes Random ID+device ID. We suggest to update the Cons as, same ~~content~~ **bits** as Msg3 for CBRA if RAN2 agrees that AS ID is contained in D2R message if available. |
| Huawei, HiSilicon | See comments | We fully agree with this cons part ‘Additional signalling overhead in Msg 1 (Inventory Response)’. As we replied to Q1-0, **we do not see the need to have AS ID in this release,** **especially for inventory case**, then including AS ID in inventory response message is not good to make a simple/efficient inventory procedure.  For the pros part ‘The random ID included in Msg1 (Inventory Response) can be used in “New Msg2”’, if anyway the new Msg2 (as in option3)/R2D command message (as in option4) is needed to support AS ID reallocation, then what’s the point to have AS ID included in device ID reporting in the first place. (This is not the same situation as in CBRA where the random ID is already there for contention resolution.)  For the cons part ’ But same content as Msg3 for CBRA if RAN2 agrees that AS ID is contained in D2R message if available’, we understand this is highly related to the next question Q1-1. (Although the intention of reducing the message types by unifying the device ID reporting message in CBRA and CFRA sounds good to us, we prefer to do it without AS ID included in all D2R messages scheduled by dedicated resource. :) |
| Apple | No | We agree with the Con part.  But we do not agree on the two Pros provided as we fail to understand why RN16 is even needed in CFRA case.  Let us assume the Option 2 is only used for “inventory +command” procedure. Frist, the resource for CFRA is uniquely provided in Msg 0 w/o RN16, so we do not see why Msg 2 or other follow-up message to a single device need to be associated with a RN16 to identify the CFRA resource. Second, when reader decides to assign a AS ID, it needs to be associated with some high-layer identity, so that the reader can map the follow-up CN service requests to the correct AS ID. “RN16 – AS ID” mapping relationship is useless. What the reader is needed is to establish a “device ID AS ID” mapping table |
| Spreadtrum, UNISOC | Yes | For CFRA, the RN16 in Ms1 is only for AS ID allocation. Whether there follows command is not known by the device. If the current service is for inventory only procedure. The AS ID is not necessary. And option 2 bring additional signalling overhead and increase the device complexity. |
| InterDigital | See comments | Additional pro for option 2 would be alignment of the procedure of CFRA and CBRA, as the device always includes the random ID in the first message following paging. |
| ETRI | Yes, with comments | One more pros is that the device behaves the same way for both CBRA and CFRA. |
| Panasonic | Yes | We agree with pros and cons from rapporteur.  Regarding Apple’s comment on why no AS ID is needed for paging but it is needed for Msg2 and follow-up command to single device in CFRA case, this is because paging can use group ID or upper layer ID for addressing. In Msg2 or follow-up command, it is true that reader can continue use the device upper layer ID but with price of larger overhead. Instead, short AS ID can be used. We agree with Apple’s second point that reader needs to establish a mapping relation between device upper layer ID and AS ID. |
| Qualcomm | No | Agree with signalling overhead issue in the Cons part. Similar to comments by Apple, for Pros part, it is not clear why random ID is needed for ‘new msg2’ or ‘msg2 command’. This is different from contention-based case that random ID is for contention resolution. For contention-free, it is up to reader to assign AS ID in ‘new msg2’ or ‘msg2 command’. |
| Nokia | Yes | The advantage would also be that the ID is anyway stored when generated, and since we cannot have a big group using CFRA, the risk of collision is small. Since we anyway need msg1, we don’t necessarily think the overhead is a big issue. |
| HONOR | Yes | Generally, we agree with the rapporteur. Since the AS ID is for scheduling, we see the benefits of early assignment. In addition, if we could reuse the Msg3 in CBRA, the device complexity would not be increased. |
| LGE | Yes |  |
| Fujitsu | See comments | Agree with InterDigital that option 2 has additional pro which is the unified design with CBRA. This unified design may lead to unified R2D/D2R MAC PDU format design, unified device behavior to some extent, which will reduce the device implementation complexity. |
| Samsung |  | In Option 2, we need understand the usage of RN16 first. For CFRA, the device responding to the A-IoT paging message is a dedicated one. When the reader receives the Msg1, the resource carrying Msg1 can uniquely identify the device. Thus, **we didn’t see the need of including RN16 in Msg1 for CFRA**.  With the above understanding, the pros. is not a real pros. Instead, the RN16 in Msg1 brings additional signalling overhead. |
| Ericsson | Yes, comment | Multiple devices may have selected the same RN16 in Msg1. In that case, think RN16 cannot be used for addressing in the “new Msg2” depending on collision targets.  AS-Id is needed for the case when the procedure needs to extend across access occasions or rounds so that a device can process and respond to a subsequent command, or CFRA, an uplink Id is not really needed for most cases. |
| Futurewei | See comments | We think another Con for sending back a random number each time on the fly is the extra energy consumption. A good RNG consumes more energy than just truncating the device’s ID. Another Con is that we will forced to use 16 bits for AS ID, while echoing back a truncated device’s ID as the AS ID may be shorter than 16 bits and more flexible for different device densities.  In addition, we recommend that we do not use the term “Msg1” on the first D2R transmission in the discussion and design of CFRA. From message/PDU format design’s PoV, when we talk about Msg1 carrying inventory response, which is an AIoT-NAS PDU, we really talk about Msg3 (as in CBRA) or D2R data transmission thereafter. We should try to keep Msg1 as a special MAC PDU that does not carry any AIoT-NAS PDU. |

Regarding the impact of Msg 1 Inventory Response message, it is related to whether AS ID should be contained in D2R message. Rapporteur would like to check companies’ view on this.

##### Q1-2. Do companies see the need to contain AS-ID in D2R message when it is available?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes | Some sort of ID should be included in MSG1. It can be either RN16 or some other ID. So, whatever is the content of MSG1, it can be called ASID for this purpose. |
| OPPO | No | For CFRA, the reader knows exactly in which time-frequency resource to find the D2R transmission, and there is only one A-IOT device involved.so it seems that AS ID is not needed to be carried in the D2R message for the reader to identify the A-IOT device. |
| Lenovo | Yes | We think the purposes for introducing such AS ID are for scheduling and data transmission between device and reader, to avoid including device ID or RN16 in each D2R/R2D transmission, for security or collision consideration. Then If AS ID is allocated, AS ID will be included in D2R transmission. |
| NEC | See comments | It depends on whether there are other devices’ A-IoT procedures (including D2R transmission) being performed in parallel from the reader perspective. If no other devices' D2R transmissions are being performed in parallel, then there is no need to include an AS-ID in the D2R message. |
| vivo | No | Since the R2D message contains an AS ID for a device and the subsequent D2R resources allocation scheduled by this AS ID, the associated D2R resources for D2R message transmission are enough to identify the device. |
| CATT | No | The AS ID is the ID which is assigned from reader to device. The first RN 16 in D2R which is mentioned by ZTE is not AS ID yet which is out of scope of this question. The AS ID which is assigned from reader to device is for distinguishing which device is being scheduled. However, the AS ID is not needed in D2R because the reader knows which device is being scheduled by the allocated time-frequency resource(s) before as OPPO mentioned.  In summary, there is no need of AS ID which is assigned by reader in the following D2R message. |
| MediaTek | No for Msg1, other D2R transmissions need discussion | We agree with OPPO’s point about Msg1.  Later D2R transmissions are also scheduled by the reader as noted in CATT’s comment, so in principle it seems that the reader may know which device it’s hearing without an explicit indication. However, if we consider that collisions are possible (e.g., between devices scheduled by two different readers in proximity), then the AS ID could be sent as a disambiguation of which device is transmitting. |
| CMCC | Yes, with comment | We think the motivation of allocating AS ID to devices is for D2R/R2D data transmission and R2D scheduling. If the reader assigns AS ID to device, it should be contained in D2R message. However, it does not mean it has always been assigned. |
| Huawei, HiSilicon | No | The motivation/agreement to introduce AS ID is ‘for purpose of D2R scheduling and R2D reception’, i.e. to help the device to tell which R2D message/D2R scheduling is for itself. Then for the D2R message transmitted on a dedicated resource scheduled by a reader, the reader only expects the transmission from the scheduled device, i.e. no need of the AS ID. This is the same situation for both of the CBRA and CFRA, i.e. all D2R messages except msg1 of CBRA.  For further clarification to the **multi-reader scenario** mentioned by companies, **adding AS ID does not help much**. If assuming two D2R transmissions collide on the same resource, none of them can be decoded correctly, since the physical layer signal (e.g. OOK based) basically has no ability to resist interference. Therefore, if the network wants to deploy overlapping multiple readers, **the only way is to assign them with separated radio resources**. |
| Apple | No | We think this adds more complexity in device side, and also adds signalling overhead. The CFRA is supposed to be contention-free and even for the rare chance of collision in multi-reader scenario, it is not a big deal and the reader can recover this failure by re-initiating the R2D message again. |
| Spreadtrum, UNISOC | No | As OPPO’s mention, AS ID is not need in D2R message except for Msg1. Because reader will schedule the device by allocated time-frequency resource(s). The reader can identify which device is. |
| InterDigital | Yes, See comments | This may depend on the validity discussion. If AS ID can exist for multiple operations and the device has a stored AS ID, it should transmit it in the first message.  If this case is not supported, our understanding is that this “AS ID” is a random ID that would eventually become the AS ID if subsequent command is performed. In this case, both options (including the ID in MSG1 or not) would work. There would still be an advantage to include a random ID in the first message as it would avoid the need for defining a subsequent message in the case of CFRA (the need for the reader to allocate the AS ID is to support collision case for CBRA, and so the random ID could always be used as the AS ID for CFRA). |
| ETRI | No, with comments | The AS ID is mainly used for scheduling, Considering dedicated resources allocation in D2R transmission we think AS ID is not necessary for D2R message. |
| Panasonic | No | Except Msg1 in case of CBRA, we don’t identify need to include AS ID in D2R transmission, because it is always scheduled by reader in a dedicated resource. We also agree with Huawei on the case of D2R resource collision, having AS ID in D2R may not help. |
| Qualcomm | Yes except Msg1 | Not for A-IoT Msg1. Because no AS ID assigned before.  For the other D2R transmission(s), AS ID is needed. We share the similar view with MediaTek that AS ID is for collision case in the case that two readers in proximity may schedule the same resource to devices. |
| Nokia | No | Unless for msg1, no AS ID should be needed from device to reader. It is anyway the reader providing the resources for the D2R. |
| HONOR | Yes, with comments | We share similar concern with MTK about the collision issue caused by multiple reader scenario. |
| LGE | No | Since D2R transmission is indicated via R2D transmission (DO-DTT), we think that basically AS ID doesn’t need to be contained in D2R transmission.  Regarding the collision case mentioned by MediaTek, we think that the possibility depends on how well network coordinates radio resources among readers to avoid collision. If network coordination for avoiding parallel on-going services between multiple readers is well performed, no collision between D2R transmission can be assumed. |
| Fujitsu | Yes | For potential issues in multi-reader scenario, it is better to include AS ID in D2R message to identify the device in general. |
| Samsung | No | The AS ID is used for the D2R scheduling/R2D reception, and such operation is performed per device under the same reader. The D2R message is transmitted over the dedicated resource assigned to a device, and the reader can identify the transmitter of the received D2R message according to the resource carrying the D2R message. There is no need to include the AS ID in D2R message.  Some companies mentioned the multi-reader scenario. The collision can occur when e.g., two readers send the R2D messages containing the same AS ID and same assigned resource towards two different devices at the same time. This can be considered as a rare case. Even if it happens unfortunately, as mentioned by HW, the reader cannot receive the D2R message correctly, regardless of whether AS ID is included in D2R message or not. Thus, including AS ID in D2R message introduce additional overhead without much value (considering the rare case caused by multi-reader scenario).  **In summary, we don’t see the need of including AS ID in D2R message.** |
| Ericsson | No | Only needed for reader specific D2R messages in case we do not have device specific resources. |
| Futurewei | No | Even for multi-reader scenarios, the readers still need to coordinate with each other to ensure that their R2D-D2R transactions are not interrupting each other. Otherwise, there may be issues of interference, disrupting PHY timing, etc., which can not be solved by AS ID alone. On the other hand, if the readers’ coordination ensures their R2D-D2R transactions are not interrupting each other, then each device will be able to follow its own reader’s trigger(s) to finish the service transaction with the reader without the help of an AS ID. |

In addition, RAN2 has agreed that

|  |
| --- |
| 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. |

If RN 16 can be reused as the AS ID, the size of AS ID should be same as RN 16, i.e. 16 bits. RAN2 discussed the issue during online discussion, but no conclusion. Rapporteur assumes to support max around 60000 devices, 16 bits ID is needed at least for CBRA. And it could be good to have common ID size for CFRA and CBRA.

##### Q1-3. Do companies agree that the AS ID size is same as RN 16, i.e. 16 bits for both CFRA and CBRA?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes | Having a fixed and uniform length of ID across all options would be simpler. |
| OPPO | Yes | CFRA could be applied to the multi-device case in the next release, so it is to keep the same AS ID across CBRA and CFRA |
| Lenovo | Yes | Since for CBRA, RN16 may be reused for AS ID. Then we also expect that the reader may allocate AS ID with the size of 16 bits for unification consideration. Otherwise, there will be different AS ID formats which will increase the complexity. |
| NEC | Yes |  |
| vivo | Yes | The AS ID size is better to be shared for both CFRA and CBRA for a reader to uniquely identify a device under its coverage. |
| CATT | Yes |  |
| MediaTek | Yes | We think it’s important for device simplicity to have the ID in one place and with a consistent size for all cases, so that parsing the address of an R2D message and matching it to the stored ID is a single automatic operation. |
| CMCC | Yes | Uniform size for CBRA and CFRA can be beneficial to device implementation. |
| Huawei, HiSilicon | Yes | Though we think a shorter AS ID is beneficial for the signalling overhead, ok to follow majority view to align with the size of random ID. |
| Apple | No | We think AS ID is not always needed. For certain devices a reader wants to maintain a long-term AS context, a shorter 8-bit AS ID is enough. |
| Spreadtrum, UNISOC | Yes |  |
| InterDigital | Yes | Having the reader change the AS ID size would lead to additional complexity at the device side with little added benefit. A unified ID size, regardless of how it is assigned, should be the target. |
| ETRI | Yes |  |
| Panasonic | No | It is true that random ID has 16 bits for reducing possible contention. But if reader assigns AS ID, what really matters is the actual number of “active” devices in the procedure that are currently supported by the reader. A shorter length is sufficient. |
| Qualcomm | No | Firstly, we share similar view as Apple and Huawei in a previous question that AS ID may not always be needed. When it is needed, a shorter length of AS ID is preferred. e.g., 8-bit. The 16-bit random ID is used for contention resolution. When AS ID is determined by Reader, the contention resolution should’ve already been resolved. So, the size of the contention resolution successful A-IoT devices is not expected to the be the same as that before contention resolution. |
| Nokia | (No) | We believe that a shorter ID could be a solution. The 16 bits used in CBRA was selected since this would almost diminish the risk of collision, and with the option of the reader reallocating, we may not need the redundancy.  A solution could be to select the least significant x bits of the RN16 though. |
| HONOR | No | We do see signalling benefits to have a short size for the AS ID, but we could compromise if companies want a unified design. |
| LGE | Yes | We consider using a single AS ID size for less complexity, and the size should be large enough to support all possible cases. We think it’s 16 bits. |
| Fujitsu | Yes |  |
| Samsung | Yes | The size of 16 is useful for CBRA in case of large number of devices. Thus, if Option 2 is selected for CFRA, we prefer to use a unified design on RN length for both CFRA and CBRA. |
| Ericsson | Yes, comment | Considering validity of AS ID within one access occasion, in CBRA, we think that the size of AS ID can be much shorter than 16 bits, given not all devices attempt to access in the same occasion (i.e., X\*Y in RAN1 discussion, where X is number of time slots for D2R message and Y is the number of frequency offsets for the D2R message).  However, considering the additional overhead related to AS ID assignment (i.e., RN16 is anyway needed for addressing device in CBRA), we are fine with 16-bit AS ID size. |
| Futurewei | No | Don’t see a strong need to keep them the same size. |

Note: Q1-2 and Q1-3 are more or less related to RAN1 discussion on whether CRC is not needed. If AS ID is always contained in D2R message, the alternatives listed in option 1 cannot be met, i.e. only option 2 can work.

|  |
| --- |
| **R1-2501437** Summary #3 for coding aspects of physical channel design Moderator (CMCC)  Agreement  When CRC is attached to a PRDCH or PDRCH transmission,   * When the number of information bits is ≤ X bits, CRC-6 is used. Otherwise, when the number of information bits is > X bits, CRC-16 is used. Down-selection by RAN1#120bis from the following for X considering the balance of overhead and probability of undetected error:   + Alt. 1: 24   + Alt. 2: 56 * FFS impact of segmentation, if any   + Note: impact may not be in RAN1   **R1-2501592** Summary #5 for coding aspects of physical channel design Moderator (CMCC)  Agreement  One or both of the following options are supported to determine when no CRC is used,   * Option 1: A threshold of number of information bits Y. When the number of information bits is ≤ Y bits, no CRC is used. Down-selection from the following for Y:   + Alt. 1: 16   + Alt. 2: 8   + Alt. 3: 6 * Option 2: Specified condition(s), e.g., device transmits PDRCH for Msg 1 upon receiving a PRDCH triggering random access. FFS specified condition(s) and/or how to determine the specified condition(s). |

**Option 3**: “New Msg” for AS ID assignment, work with/without option 2

**Pros**:

* The AS ID assigned in the “new Msg “can be used for “the first Command message, i.e. Msg 2 Comand message, and “subsequent R2D Command messages” to associate the resources and identify the device;
* No impact on Msg 1 (Inventory Response) if option 2 is not supported;

**Cons**:

* Additional delay/overhead/procedure due to the new message;
* Device ID needs to be contained in “new Msg” in order to identify the device, to associate with the newly assigned AS ID in new Msg if option 2 is not supported;

##### Q1-4. Do companies agree the above analysis on Pros/Cons of option 3 (“New Msg” for AS ID assignment)?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes, and… | One of the main disadvantages with these approaches is that the device procedure starts to diverge for various RACH options. i.e. the device has to follow different procedure between CBRA and CFRA. This should be captured as a Con. |
| OPPO | No | Device ID is not needed to be contained in the ‘msg’. In the last RAN2 meeting, we already agreed that parallel service requests by the same reader is not supported, so in a certain time duration, we think that there is no need to address the R2D message to specific A-IOT device for the CFRA procedure. Due to the same reason, we doubt the need of AS ID in the R2D message also in the CFRA procedure. |
| Lenovo | Yes | Agree with the analysis provided by the Rapp, and compared with Option 4, we think option 3 has no advantages, which only increase the signalling overhead and introduce additional procedure and delay as analysed by the Rapp. |
| NEC | Yes |  |
| vivo | Yes |  |
| CATT | Yes | If we go with option 3, we generally agree to the rapporteur’s analysis on the pros/cons of this option. New MSG is low efficient. But further comments please see our Q1-0 response. |
| MediaTek | Mostly yes | Agree with ZTE’s comment about divergence.  Regarding OPPO’s comment, we are not sure if it works to send the new message without some form of explicit addressing. The assumption seems to be that there will be certain R2D resources that are reserved for only this message, so the device can know “this is for me”?  Finally, the first pro (ability to use the AS ID for the first command message) is literally true but doesn’t seem to give a practical benefit over option 4, so we find it to be a bit of an empty advantage. |
| CMCC | Yes, with comments | We agree with the pros and cons listed by Rapp. However, we tend to agree the comments from ZTE. the devices complexity may increase if considering different AS ID assignment procedure for CBRA and CFRA. |
| Huawei, HiSilicon | Yes, except the 2nd bullet in Cons | We in general agree with Rapp that the pro is compared to option2, option3 has no impact to inventory response, i.e. no impact to pure inventory procedure, and the con is compared to option4, option3 introduce one-message more delay.  But for the 2nd con, we do not see the need to include device ID. As commented by many companies in the above Q&A, in this release, only one device is paged in a paging round, which means all the resources are supposed to be used for this device, thus the device can just assume all the R2D messages is for itself. And this would be the same assumption for both of option3 or option4, otherwise, option3 and option 4 does not work at all.  Then for the unification, only option 4 is unified with CBRA (although this AS ID doesn't serve any real purpose, at least from message format/procedure prospective, the device data transmission/reception behaviour is unified for accessing via CFRA and accessing via CBRA.) |
| Apple | Yes | This new Msg 2 can work by associating the new AS ID to either a RN16 (w/ option 2) or Device ID (w/o option 2). Exposing device ID in MAC layer signalling is another con, though. |
| Spreadtrum, UNISOC | Yes, except the 2nd bullet on Cons | New message is not necessary compared with option 4. For cons-2, we also think that device ID in “new msg” is not necessary because there is no other parallel procedure and CFRA only support to page one device. |
| InterDigital | Yes |  |
| ETRI | Yes |  |
| Panasonic | Yes | We agree with Rapporteur on pros and cons. However, we don’t see advantage of option 3 compared to option 4.  Some companies above disagree with 2nd bullet of Cons. To our understanding, even for CFRA, without any identifier included in R2D message, it can only work in a single reader isolated area or multi-reader coordinated TDM of R2D transmission. In case of more general case where no coordination between readers, device would be confused by another unintended R2D message from neighbouring reader. |
| Qualcomm | Yes | Because of the Cons like increased signalling, need of new message and increased latency, we do not prefer this option. |
| Nokia | Follow majority |  |
| HONOR | Yes | Generally, agree. One more pro from our side is that the message size could be smaller if we have this new message with AS ID and device ID compared with option 4 which the “Msg2” could additionally include the command. This could be more severe especially when multiplexing is supported. |
| LGE | No | For cons, we think that Device ID is not needed. We assume that new msg immediately follows MSG1. |
| Fujitsu | Generally yes | We also think the device ID in “new message” is not needed. |
| Samsung | Yes | Compared to Option 4, this method didn’t show additional benefit. Instead, it causes additional signalling overhead and complexity at the device side (e.g., introduce new message for AS ID assignment). |
| Ericsson | Yes | Not preferred option. |
| Futurewei | No | We prefer the AS ID assignment is piggy-back on a subsequent R2D trigger message to reduce latency and the number of messages to be defined. AS ID assignment can be as simple as 1-bit to confirm the device-provided ID is unique enough to be its AS ID. The reader-assign AS ID could also be shorter. It would be too wasteful to use a new message to send just this 1-bit or a short AS ID, not mention the added latency to complete the whole procedure. |

**Option 4**: Msg 2 (Command message) for AS ID assignment, work with/without option 2

**Pros**:

* The AS ID assigned in the “Msg 2 Command message “can be used for “Msg 4” and subsequent R2D Command message” to associate the resources and identify the device;
* No impact on Msg 1 (Inventory Response) if option 2 is not supported;
* Not need to introduce new procedures;

**Cons**:

* Device ID needs to be contained in “Msg2” in order to identify the device, to associate with the newly assigned AS ID in Msg2 if option 2 is not supported, i.e. AS ID cannot be used for the first Command message;

##### Q1-5. Do companies agree the above analysis on Pros/Cons of option 4 ( Msg 2 (Command message) for AS ID assignment)?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes |  |
| OPPO | No | The same opinion as mentioned for Q1-4 |
| Lenovo | Yes | Anyway command message needs to contain device id for the target AIoT device, since the device id is expected included by core network together with command message. |
| NEC | Yes | Pros: the last bullet can be revised to  “no additional delay/overhead/procedure compared to Option 3” |
| vivo | Yes |  |
| CATT | Yes | If we go with option 4, we generally agree to the rapporteur’s analysis on the pros/cons of this option. But further comments please see our Q1-0 response. |
| MediaTek | Yes | Regarding OPPO’s comment (referring back to Q1-4), we think the handling of Msg2 in CFRA may need to be clarified. In CBRA, Msg2 of course contains contention resolution information, and every device in random access needs to receive every instance of Msg2 and check to see if its RN16 is included. Do we assume the same for CFRA? Or is “Msg2” in CFRA just an ordinary R2D data transmission that needs to be addressed to the device? |
| CMCC | Yes |  |
| Huawei, HiSilicon | Yes, except the 1st bullet in Cons | As our comment for the previous question, we do not see the need to include device ID, at least in this release. Since in this release, only one device is paged in a paging round, which means all the resources are supposed to be used for this device, thus the device can just assume all the R2D messages is for itself. And this would be the same assumption for both of option3 or option4, otherwise, option3 and option 4 does not work at all.  If there has to be an association between device ID and AS ID for multi-reader CFRA, it can be in paging message. |
| Apple | Yes except Con | We think the upper layer “command” payload itself contains the device ID part, it is NAS layer message for a single device, so that device must be indicated in NAS layer signaling. |
| Spreadtrum, UNISOC | Yes, except cons | Share with Apple’s view. For Msg2 with command, device ID is originally contained in command message. It is not increase the signalling overhead. |
| InterDigital | Yes |  |
| ETRI | Yes |  |
| Panasonic | yes | Question to Apple and Spreadtrum, how about the case of segmentation of D2R? For every R2D to schedule a segment, always including upper layer device ID would increase signalling overhead too much. In our view, reader should be able to use short AS ID to schedule D2R after receiving command request from CN. |
| Qualcomm | Yes | The Msg2 with command message may assign AS ID for the subsequent data communication |
| Nokia | Follow majority |  |
| HONOR | Yes |  |
| LGE | No | For cons, we think that Device ID is not needed. We assume that MSG2 (command msg) immediately follows MSG1 when it is used for AS ID assignment. |
| Fujitsu | Yes |  |
| Samsung | Yes except cons | Similar view as Apple, the device ID is included in the upper layer command message. The above cons is not a real one. |
| Ericsson | Yes | Upper layer device ID contained in the Command request has impact on A-IoT NAS design, i.e., in case Command request for CBRA does not contain upper layer device ID, reader needs to indicate CN to do that when initiating CFRA |
| Futurewei | See comments | We prefer not to use the term of “Msg2” here. Instead, we could call it the first (or subsequent) R2D trigger after Msg0. From message/PDU format design’s PoV, we should try to keep Msg2 as a special R2D message solely for the purpose of contention resolution (i.e., it echoes back the RN16(s) without carrying an AIoT-NAS PDU). Since there is no contention here, it is a messy design to have Msg2 in CFRA carrying command, which is an AIoT-NAS PDU, while in CBRA, it doesn’t carry any AIoT-NAS PDU, only the RN16(s).  In addition, as we said before, the AS ID assignment is piggy-back on this R2D trigger message. |

## AS ID assignment for CBRA

During the online discussion, RAN2 concluded that

|  |
| --- |
| **Agreements**   1. 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. 2. From device perspective, it is only required to use one AS ID. |

To assign a new AS ID, there were different options, e.g. AS ID is assigned in Msg2 together with RN 16, option 3 or 4 listed for CFRA.

The successful Inventory+Command procedure for CBRA is shown as below:



##### Q2-0: Do companies agree with the above AS ID assignment procedure for CBRA which will be used for further analysis?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes |  |
| OPPO | Yes |  |
| Lenovo | Yes | In the bracket after command, it should be *read* instead of *reader*? |
| NEC | Yes |  |
| vivo | Yes |  |
| CATT | Yes |  |
| MediaTek | Yes |  |
| CMCC | With comments | For option 3, we wonder whether the “new message” is sent after the Msg3 or not? If the new AS ID is assigned after the Msg3 transmission, does that mean the Msg3 should contains the Random ID and device ID? |
| Huawei, HiSilicon | See comments | Procedure wise, three options seem all possible, but we feel option3 and option4 may not work in some circumstances.  For instance, AS ID is supposed to include device identification if there are multiple devices waiting for D2R scheduling info/R2D messages, and AS ID reallocation is to address the collision issue if the same AS ID is used (promoted from the same random ID) by multiple devices, then adding the reallocated AS ID in a unicast R2D message seems is not able to solve the problem of uniqueness. (Attaching the device ID in the reallocation message is not a good idea to us, considering device ID is an upper layer ID and better not visible to AS.) |
| Apple | Yes with comments | It seems Option 1 is unnecessary, because Msg 3 is agreed to contain RN16 and device ID, why the reader will pre-emptively assign a new AS ID in Msg 2 before Msg 3 transmisison |
| Spreadtrum, UNISOC | Yes |  |
| InterDigital | Yes |  |
| ETRI | Yes |  |
| Panasonic | Yes |  |
| Qualcomm | Comments | Suggest removing the terms like msg4/5/6/7 which we never used in SI. Moreover, Msg6 may not be ‘command’ but a re-trigger with resource allocation for further D2R segment transmissions in case of D2R segmentation. Regarding the comments from Huawei, AS ID is allocated at or after the contention resolution. |
| Nokia | Yes |  |
| HONOR | Yes | Also, the option 4 could be used for confirmation especially when combined with option 2 or assign the AS ID. |
| LGE | Yes | In option 1, the reader decides whether to include AS ID additionally in msg2. If the procedure is inventory, only RN16 is included in msg2. Else if the procedure is inventory and command, AS ID may be included in msg2 together with RN16. |
| Fujitsu | See comments | We don’t think option 3 or option 4 can work, at least under some scenarios.  It seems only option 1 will work properly. In option 1, if two devices use the same random ID but using different access occasions in the same access occasion set, the reader may accept both devices and allocate new AS ID(s) to one/both of them with association to the access occasion used in Msg1, in Msg2. The device may use the mapping of the access occasion used in Msg1 to identify the new AS ID received in Msg2. In option 3 or 4, if reader wants to allocate a new AS ID to a device to address the collision in this scenario, it has no association information to this device, since the device ID is transparent to the reader.  In summary, in option 3 or 4, the reader cannot address the device if there is random ID collision. |
| Samsung | Yes |  |
| Ericsson | Yes |  |
| Futurewei | Yes |  |

During online discussion and offline discussion, companies already explained the Pros/Cons of each option. Rapporteur try to summarize them as below:

**Option 1**: Msg 2 for AS ID assignment;

**Pros:**

* The AS ID assigned in the “Msg2 “can be used for “the first Command message i.e. Msg 4 and subsquent Command messages” to associate the resources and identify the device;
* Not need to introduce new procedures

**Cons**:

* Additional signalling overhead in Msg 2, especially when multiplexing is supported;

##### Q2-1. Do companies agree the above analysis on Pros/Cons of option 1 (Msg 2 for AS ID assignment)?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes | Additional disadvantage is that assigning ASID in MSG2 unnecessarily impacts inventory procedure and yet for inventory purpose, reader assigned ASID is not useful/necessary. |
| OPPO | No for cons | AS ID allocation always requires signalling overhead, no matter if it is Msg2 |
| Lenovo | Yes, with comments | We generally agree with the Pro and Cons provide by the Rapp. Additional concern from our side on option1 is that: since Msg2 is used of the contention resolution during CBRA procedure, the reader may not know whether there have subsequent commands target to this device when sending the Msg2. If no subsequent commands, whether the AS ID allocated in MSG2 is necessary for MSG3/MSG4 or not needs to be considered. |
| NEC | Yes |  |
| vivo | Yes |  |
| CATT | No for cons | Same view as OPPO |
| MediaTek | Mostly yes, but see comment | We agree with OPPO that there will always be some overhead somewhere, and we don’t see a big problem with the cases where no assignment is needed. To keep the PDU format fixed, maybe the easiest thing is for a reserved value to mean “don’t change” (e.g., all-bits-zero means the device should keep its RN16 as the AS ID). So we consider the con listed above to be literally true but not very important. |
| CMCC |  | Same view as OPPO on cons. |
| Huawei, HiSilicon | Yes, and | We would like to highlight that this reallocation procedure (regardless which option) is optional as agreed by RAN2, and reader can decide whether to preform reallocation. For inventory service, the reader will not initiate this AS ID reallocation, as the AS ID is not to be used for inventory at all. |
| Apple | Yes with comments | We agree with the con of additional signaling overhead. The AS ID is not needed for many of the responding devices, so it is an overkill to assign a ASID in Msg 2  There are two more con for Option 1:   1. the device’s Msg 3 transmission now have to support either RN16 or AS ID, adding the complexity of device side. 2. The reader may be trapped in a scenario that AS ID is assigned (as the devices received Msg 2), but no Msg 3 received successfully, so this AS ID can neither be used nor released. |
| Spreadtrum, UNISOC | Yes |  |
| InterDigital | Yes with comments | An additional con for this approach is the need to support MSG2 which may or may not include the AS ID. Since MSG2 is needed regardless of whether subsequent command is issued or not, designing MSG2 to support this case would seem unnecessary if we could use one of the other two options. |
| ETRI | Yes |  |
| Panasonic | Yes | We share view with ZTE and Lenovo, assigning AS ID in Msg2 could be a waste. |
| Qualcomm | Yes with comments | Similar view with MediaTek. When new AS ID is assigned, the ‘overhead’ is somewhere. Further, as the agreement in the last meeting, it is up to Reader to decide whether to reuse the echoed random ID as AS ID (w/o new assignment).  In response to Apple’s comment, if the AS ID is not going to be used anyway, it is same as if Reader implicitly indicated that the RN16 is promoted to ASID, which results in no increased signalling. Only when the AS ID is needed further, the Reader can allocate and assign a shorter AS ID as explained in previous questions. |
| Nokia | Yes | We don’t want a lot of messages, and msg2 seems to have a reasonable size even with multiplexing |
| HONOR | Yes |  |
| LGE | No for cons | AS ID is not always included in msg2. It is included in msg2 by reader’s decision. See our comment in Q2-0. |
| Fujitsu | See comments | Not sure about the cons. Maybe it depends on MAC PDU design of Msg2. |
| Samsung | Yes |  |
| Ericsson | Yes | It may result in different msg2 message types (inventory only/inventory + command), not sure if this is the best option. |
| Futurewei | Yes |  |

**Option 3 (reuse the number of CFRA)**: “New Msg” for AS ID assignment

**Pros**:

* The AS ID assigned in the “new Msg “can be used for “the first Command message, i.e. Msg 4 Comand message, and “subsequent R2D Command messages” to associate the resources and identify the device;
* No impact on Msg 2;

**Cons**:

* Additional delay/overhead/procedure due to the new message;
* Device ID or RN16 needs to be contained in “new Msg” in order to identify the device, to associate with the newly assigned AS ID in the new Msg; FFS on RN 16 collision case

##### Q2-2. Do companies agree the above analysis on Pros/Cons of option 3 (“New Msg” for AS ID assignment)?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes |  |
| OPPO | Yes |  |
| Lenovo | Yes | Agree with the Pros and Cons provided by the Rapp. |
| NEC | Yes |  |
| vivo | Yes |  |
| CATT | Yes |  |
| MediaTek | Yes, but | We don’t see these pros as very meaningful. Of course the AS ID can be used to address any message after it is assigned, but there seems to be no intrinsic gain from introducing another message so that we can use the AS ID to address a later Msg2. |
| CMCC | Yes |  |
| Huawei, HiSilicon | See comments | As we commented for Q2-0, the main case to trigger AS ID reallocation is that a device who accesses later is using the same random ID as the AS ID used by a device who accessed earlier, then using option 3 and option 4 ‘with RN16 contained’ means the same AS ID reallocation procedure will apply to both devices, and cannot address the uniqueness problem. Then attaching the device ID in the reallocation message is not a good idea to us, considering device ID is an upper layer ID and not supposed to be visible to AS. |
| Apple | Yes | In this case, RN16 or device ID can be included in the new Msg. RAN2 can discuss if this device ID exposed is a “temp Device ID” as discussed in SA3. |
| Spreadtrum, UNISOC | Yes | In this case, RN16 or device ID can be included in the new Msg. |
| InterDigital | Yes |  |
| ETRI | Yes |  |
| Panasonic | Yes | We don’t see advantage of using additional message of option 3 compared to option 4. |
| Qualcomm | Yes |  |
| Nokia | Yes |  |
| HONOR | Yes with comments | One more con for this option is that the if we have the Msg3 segmented, the AS could not be used for the scheduling of the segments. |
| LGE | Yes |  |
| Fujitsu | See comments | Please see our reply to Q2-0. |
| Samsung | Yes | Compared to Option 1 and Option 4, we didn’t see additional benefit for Option 3. Meanwhile, from procedure point of view, Option 2 has no fundamental difference with Option 1, and the only difference is whether using a new message or Msg 2. |
| Ericsson | Yes | About the cons regarding addressing in the new Msg, we think RN16 can be assumed considering that device ID is likely not visible to reader. |
| Futurewei | Yes |  |

**Option 4 (reuse the number of CFRA)**: Msg 4 (First Command message) for AS ID assignment

**Pros**:

* The AS ID assigned in the “Msg 4 Command message “can be used for “Msg 6” and subsequent R2D Command message” to associate the resources and identify the device;
* No impact on Msg 2;
* Not need to introduce new procedures;

**Cons**:

* Device ID or RN16 needs to be contained in “Msg 4 Command message” in order to identify the device, to associate with the newly assigned AS ID in the new Msg; FFS on RN 16 collision case
* The reader has to reuse RN16 or device ID for the first Command message;

##### Q2-3. Do companies agree the above analysis on Pros/Cons of option 4 ( Msg 4 (First Command message) for AS ID assignment)?

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No** | **Remark (add your view if any)** |
| ZTE | Yes |  |
| OPPO | Yes | The second bullet on the cons is a serious problem, using device ID to address A-IOT device will lead to the problem of large signalling overhead; using NR16 can not solve the problem of RN16 collision across different access occasions. |
| Lenovo | Yes | Agree with the Pros and Cons provided by the Rapp. |
| NEC | Yes |  |
| vivo | Yes |  |
| CATT | Yes |  |
| MediaTek | Yes, and | We have a similar concern to OPPO about this option. The problem scenario is that device A has RN16=X, in a different access occasion device B also selects RN16=X, and they both pass through CBRA successfully, but the reader has no opportunity to assign an AS ID to either of them yet. Then an R2D message (remembering that Msg4 is just an R2D data message) comes addressed to X, and both devices think it is for them.  This scenario shouldn’t happen with options 2 and 3, since a device in random access will only process the new message/Msg2, and a device not in random access will never process the new message/Msg2. Considering this issue, we think it looks a bit dangerous to delay the assignment of the AS ID to outside the actual random access procedure. |
| CMCC | Yes |  |
| Huawei, HiSilicon | See comments | Same comments as to Q2-2. |
| Apple | Yes | Same comment as Q2-2. Regaring OPPO’s concern, we think the (temp) device ID can be used instead of RN16 |
| Spreadtrum, UNISOC | Yes |  |
| InterDigital | Yes |  |
| ETRI | Yes |  |
| Panasonic | Yes | Question to MTK: how options 2 and 3 can resolve the collision mentioned? If reader assigns a new AS id via Msg2, the msg2 will be use the same RN16=X for both devices, then both devices will be assigned with the same new AS ID, so collision happen again. We think if reader identifies the collision, the reader can simply not respond to such collided RN16 and to let device re-access in future pagings. |
| Qualcomm | Yes |  |
| Nokia | Yes |  |
| HONOR | Yes |  |
| LGE | Yes |  |
| Fujitsu | See comments | Please see our reply to Q2-0. |
| Samsung | Yes with comments | “The reader has to reuse RN16 or device ID for the first Command message”, why “RN16 or device ID” is reused in the first command message (in the figure, the first command message contains the AS ID)? |
| Ericson | Yes | We assume reader is aware of whether there are messages after Msg5 (with command response) within the ongoing access occasion, e.g., in case of mutual authentication or temporary device ID (re)allocation. Thus, reader can determine if AS ID allocation in Msg4 or not accordingly. |
| Futurewei | Yes |  |

## Validity of AS ID

In last RAN2 meeting, validity of AS ID was discussed during offline discussion. But different from the discussion on AS ID assignment, we did not discuss the details of each option. Based on the options mentioned by companies during offline discussion, and proposals from companies in their contributions, Rapporteur listed following options for further discussion.

**Option 1**: The device releases the AS ID upon receiving Paging with new transaction id, i.e. different session/service

|  |  |
| --- | --- |
| **Company** | **Arguments** |
| IDC R2-2500495 | Instead, release could be based on reception of a specific D2R message such as the occasion start message or paging message,  Once a device has determined/stored its AS ID, it should remember it for a finite period. Specifically, use of the same AS ID indefinitely may pose a security risk. Furthermore, we can expect that the storage of the AS ID may consume some energy at the device, and it should be avoided if unnecessary. |
| Xiaomi R2-2500253 | • Reception of paging message with a different session ID |
| Lenovo R2-2500387 | Slightly negative  For opt2, the device may maintain more than one AS ID if re-access is triggered in the same round, which may then cause misalignment between reader and device. |

Considering we did not discuss the details of the option during the meeting, Rapporteur would like to collect companies’ view on the Pros/Cons of the option.

##### Q3-1. Companies are invited to provide Pros/Cons for option 1 (The device releases the AS ID upon receiving Paging with new transaction id).

|  |  |
| --- | --- |
| **Company** | **Pros/Cons** |
| ZTE | If this is the only way to release the ASID, then the problem is for the case where the device misses the paging message. Can the reader then reuse the ASID for a different device without impacting the other devices (across paging cycles) or not?  i.e. the protocol seems to rely on all devices correctly receiving the paging messages all the time, which is not preferrable. |
| OPPO | Cons:  after receiving paging targeted to itself with new transaction ID, definitely the A-IOT device will obtain a new AS ID in the new access procedure, releasing the AS ID upon receiving paging with new transaction ID seems an unnecessary operation. The time difference between receiving the paging message with new transaction ID and the subsequent R2D message for allocation of the new AS ID is quite short. |
| Lenovo | Pros: It’s reasonable to release AS ID upon receiving Paging associated with a new service request. Based on our agreements, when Paging with new transaction id is received by device, device will trigger RACH for response and generates random ID, and reader determines whether to re-use the random ID as AS ID or assign new AS ID. This option aligns well with our agreed procedures.  Cons: This option cannot support AS ID update during the current service period. |
| NEC | We think Option 1 here is the basic mechanism to avoid devices store unnecessary ASID. Do not see any Cons. |
| vivo | For Pros: **Option 1** is straightforward. There is no use case for the reader to use the same AS ID for a device across different paging rounds with a new transaction ID.  For Cons: **Option 1** requires the device to maintain an AS ID with an unnecessary duration. The arrival interval before receiving paging with a new transaction ID is uncertain and also can be very long. |
| CATT | Cons: This option seems to be not friendly to the device energy. If the device acquires one AS ID during a certain service procedure, the device will keep this AS ID until it receives next service request with new transaction ID that triggers a new service procedure. The concern is that how soon the new service request will occur? The device will keep this AS ID in vain for a time period until it receives the new service request triggered by paging with a new transaction ID. |
| MediaTek | First, we think we should stick to the agreement that the device maintains only one AS ID (including RN16) at a time, and when something happens that causes it to acquire a new ID (e.g., re-access or new paging causing generation of a new RN16), it should forget/overwrite the old ID.  Pros: The device does not need to maintain multiple AS IDs (simple implementation).  Cons: (1) By itself, this option does not enable AS ID update after random access. (2) Requires a way to release the ID in case of missed paging. |
| CMCC | Pros: Neither additional timer nor signalling is needed, which minimizes the overhead and complexity. |
| Huawei, HiSilicon | To us, this is the **most basic/bottom-line solution**.  If the AS ID is to be stored by the device for a longer time than its own access occasion/access occasion set, the reader does not aware when the energy is depleted and the device goes to charge and will get back with all context released, so paging procedure should be a way to get aligned between reader and device about the device status.  To answer the question from ZTE, if the device missed one paging message, and continue using the AS ID to monitor R2D message, there is a possibility that the device may misuse other’s D2R scheduling with the same AS ID, but this can be resolved naturally after the device re-charge and reset.  A missing sub-option is that upon reception of paging message **with same/different transaction ID**, the device releases the AS ID, which means there will be no R2D command procedure across paging-round. |
| Apple | A lot of cons for this option:  1. The reader has been constrained to only issue a re-paging to change AS ID, which is very inefficient and not flexible for reader implementation.  2. This creates a linkage between transaction ID and AS ID timeline, which is not needed. Basically, we do not think AS ID has to be renewed with every new transaction ID.  3. This means the device will abandon its current valid AS ID as long as a new RN16 is generated, which creates an unnecessary mutual exclusivity of AS ID and RN16. This is wrong.. RN16 is valid only for CBRA Msg1/2/3, and AS ID is used for both CBRA and CFRA ***after inventory procedure***, we do not see why those two IDs are mutually exclusive. |
| Spreadtrim, UNISOC | Pros: this way is efficiency way to release the AS ID. AS ID will be released when the device receives the paging msg with new transaction ID.  Cons: if the device miss the paging message with new transaction ID. AS ID may be maintain in new paging round until the device receives the paging with new transaction ID or device is power-off. So AS ID may be collision with other device in new paging procedure. |
| InterDigital | Pros: Straightforward/simple design with minimal signalling overhead. It should be expected that if a new paging transaction is started, it means commands from the previous paging transaction will not longer be received. No additional signalling is needed.  Cons: It’s expected that this method cannot be used alone, since RAN2 already assumed reader can assign the AS ID. |
| ETRI | We think it is reasonable to release AS ID upon receiving Paging associated with a new service request and it would be basic mechanism. |
| Panasonic | We support Apple’s view above. |
| Qualcomm | If A-IoT device receives the paging with new transaction ID, A-IoT device should respond to this paging message and then a new AS ID is acquired after the inventory procedure. I.e. it seems reasonable that the AS ID is released upon receiving paging with a different transaction ID. Missing paging message and not releasing the AS ID needs further discussion. |
| Nokia | We believe this is a low complexity solution which should be sufficient. Any procedures for updating etc should only be due to SA3 security concerns |
| HONOR | Cons: This solution rely on the device behaviour without interactions with reader. The device may miss the first different paging or even the following several pagings with different transaction ID and the device would regards the AS ID is still valid for another paging with the same transaction ID. This is more severe when the transaction is short. |
| Fujitsu | Pros: simple and work properly in case device monitors every paging message.  Cons: unclear behavior if devices miss a paging message, or store AS ID unnecessarily if there is no new paging for a long time. |
| Samsung | Pros.:   * Simple device design. Intuitively, a new service will trigger new A-IoT paging message, it is naturally to release the AS ID assigned before. Thus, the device only need to check the Paging message.   Cons.:   * this requires that the device stores the AS ID with uncertain period since the device does not know when the new service (corresponding new transaction ID) is coming * there maybe misuse of AS ID. If the paging message with new transaction ID is transmitted, while the device misses the initial paging message (s), the device will use the old AS ID to receive the R2D message from the reader, and it will result in that the device uses the scheduled resource for other devices. |
| Ericsson | In Option 1, even if the device is done with its procedure (inventory + command), its AS ID cannot be reused for other devices during the ongoing paging round (i.e., but subsequent access occasion) or in subsequent paging round(s) associated with the same service request. |
| Futurewei | If the AS ID remains valid only for a single service transaction, then we really doubt whether it is needed. Any claimed gains are negated by the extra signaling required to assign it in the first place. |

**Option 2**: The device releases the AS ID upon timer expiry; The Timer could be configured by the reader, or pre-defined in the specification;

|  |  |
| --- | --- |
| **Company** | **Arguments** |
| Vivo R2-2500131 | Furthermore, the AS ID can also be released based on a pre-defined/configured timer expiry. The timer will be restarted upon each R2D/D2R transmission and separate timers can be maintained at both device and reader side. When timer expires, the AS ID is released respectively at device and reader side without explicit release signaling. |
| Lenovo R2-2500387 | Negative  For opt4, it may be difficult to configure a suitable timer value considering the service time is dynamic. |
| Panasonic R2-2500672 | Negative on timer  There was another proposal in previous meeting to introduce a timer for the validity of AS ID. However, in our view, such scheme is not preferred because it further increases the complexity of AS ID maintenance in device and it is difficult to set the appropriate timer value.  Positive on predefined timer?  **The device shall keep volatile memory contents including AS ID for the certain duration.** |

Considering we did not discuss the details of the option during the meeting, Rapporteur would like to collect companies’ view on the Pros/Cons of the option.

##### Q3-2. Companies are invited to provide Pros/Cons for option 2 (The device releases the AS ID upon timer expiry, predefined or configured timer).

|  |  |
| --- | --- |
| **Company** | **Pros/Cons** |
| ZTE | The advantage of this is that this doesn’t rely on the devices receiving (or not receiving) certain messages.  The disadvantage is that the device needs to maintain a timer. But, we think the device will need to have the means to maintain some (even if coarse) timers for other AS purposes anyway. |
| OPPO | Cons:  1.Timer based solution requires the A-IOT device always countdown the timer, which may bring additional complexity to the A-IOT device.  2.the running length of the timer could be in long-term, e.g., in seconds. As mentioned by other companies, in such cases, the probability of setting an inaccurate time length for this timer is large.  3.the timing synchronization performance of A-IOT device is questionable, which implies that the timer running time, in practice, may be deviated from the set value. |
| Lenovo | Cons: As proposed in our contribution, it’s difficult to configure a suitable timer value considering the AIoT service time is dynamic. Moreover, it also increases the device complexity to maintain a timer additionally. |
| NEC | Agree with OPPO. Not sure about the syn. requirements of A-IoT devices. Basically, timer-based mechanism should be avoided in our understanding. |
| vivo | For Pros: **Option 2** is complementary to other options which rely on certain messages to release the AS ID fails, e.g., due to the device moving out of its serving reader’s coverage.  Besides, we think timer length is typically in seconds level (e.g., 1-10s) by referring to the Max. allowed end-to-end latency requirement (see SA1 TS 22.369 Table 6.2-1 KPIs for inventory). |
| CATT | Cons: difficult to determine the suitable value of this timer. |
| MediaTek | Pros: Allows synchronized ID maintenance between the reader and the device.  Cons: (1) Requires the device to run a timer. (2) Timer value would need to be configured to the device per service, complexifying the paging/access procedures. |
| CMCC | Cons: Device cannot maintain accurate timing, which may result to mismatch between reader and device.  To our understanding, the minimum time to store AS id in VM should be a requirement for devices, which should be captured in specification. |
| Huawei, HiSilicon | Cons: to maintain a timer requires the device to reserve additional registers which add device costs and power consumption. |
| Apple | Timer-based option is infeasible. |
| Spreadtrum, UNISOC | Cons: It is difficult for a device to maintain an accurate timer. |
| InterDigital | We also think timer-based option is infeasible for these devices. |
| ETRI | The timer-based approach is not applicable because the timer value cannot be predicted. |
| Panasonic | Same view as Huawei and Spreadtrum, InterDigital above. |
| Qualcomm | Agree with the Pros and Cons listed by companies above. It requires device to maintain a timer that requires additional resource which impacts device power consumption. In terms of Pros, it could be a way if autonomous release of AS ID is needed. However, there seems no strong motivation for needing autonomous release. E.g. if AS ID is released when paging is received later or new AS ID from reader as discussed elsewhere, timer-based release may not be needed. |
| Nokia | We don’t really see what we should count down and how the reader and device should be aligned on the countdown. In this case, we could rely on number of pagings, but still seems infeasible |
| HONOR | Cons: 1) the inaccurate counting due to the device capability would result in misalignment between reader and device. 2) hard to find a proper time length to strike a balance considering the limited number of AS ID and relative.  Thus, the timer-based solution could only be the supplementary solution with a relative long timer. But we don’t have strong view about this enhancement. |
| Fujitsu | Cons: Agree with OPPO and CATT. |
| Samsung | Cons.: the maintenance of the timer adds additional complexity at the device side. Moreover, it is difficult to set a suitable timer length since the starting time of the timer at each device side is different. |
| Ericsson | We are negative on such a timer mechanism as it adds complexity unnecessarily. We think the use of AS ID is for addressing and scheduling only within one procedure/access occasion. |
| Futurewei | The device’s timer suffers from drifting issue. Therefore, the reader and device will sooner or later out of synch in term whether the AS ID is still valid or not. Besides, running a timer increase energy consumption, which is undesirable for AIoT devices. |

**Option 3**: The device releases the AS ID upon receiving new assigned AS ID from the Reader

|  |  |
| --- | --- |
| **Company** | **Arguments** |
| Lenovo R2-2500387 | **Proposal 12:** From device side, AS ID is valid until reader assigns a new AS ID. From reader side, it’s up to reader implementation to determine the validity of AS ID. |

Considering we did not discuss the details of the option during the meeting, Rapporteur would like to collect companies’ view on the Pros/Cons of the option.

##### Q3-3. Companies are invited to provide Pros/Cons for option 3 (The device releases the AS ID upon receiving new assigned AS ID from the Reader).

|  |  |
| --- | --- |
| **Company** | **Pros/Cons** |
| ZTE | This can work but it is unclear why we need to assign a new ID and release the previous one. The device ID can simply be released (without assigning a new one), otherwise, ASIDs will be occupied unnecessarily. |
| OPPO | Pros: this reduces the complexity of the A-IOT device. Naturally, when a new AS ID is received from the reader during another access procedure triggered by a subsequent paging message, the old AS ID shall be deleted |
| Lenovo | For clarification: Proposal 12 is based on the assumption that AS ID is always assigned by the reader. Since we have agreed that reader determines whether to re-use random ID as AS ID or assign new AS ID in RAN2#129 meeting, the option needs to be updated as: The device releases the AS ID upon new random ID is generated or receiving new assigned AS ID from the reader.  Pros: This option is straightforward and flexible. It can achieve similar effect as option 1. When device receives Paging associated with new service request, device generates random ID and the previous AS ID is released. In addition, this option can support reader updates AS ID when needed by assigning new AS ID. |
| NEC | We think Option 3 is the basic mechanism too. Do not see any Cons. |
| vivo | For Cons: It is not justified the use case/scenario for the reader to reassign a new AS ID to the device. During one inventory and command procedure, the reader may assign an AS ID to a device just once and use it until the completion of the procedure. |
| CATT | Cons: similar view as our comment in Q3-1**.** The device needs to wait for the new service request to trigger the update of the AS ID. From our point of view, the AS ID should be unchanged within a certain service procedure. |
| MediaTek | Pros: Straightforward implementation if there is a way to assign a new AS ID at any time.  Cons: Seems incomplete and can lead to “zombie” AS IDs that are not being used for anything but persist for a long time, unless option 6 is also specified. |
| CMCC | Cons: No clear what the use case is to assign AS ID twice. We should avoid over-design. |
| Huawei, HiSilicon | Based on the clarification from opponent (Lenovo), this option is exactly the same as the option1, just with different style of description? |
| Apple | This is the simplest solution and easy for both reader and device to implement. We do not see any cons.  Regarding the “Zombie AS ID” issue, any R2D message may get lost in PRDCH or the device may move out of range of the ID-assigning reader, so there is no 100% way to avoid this. The device will self-recover from this by power off and on. |
| Spreadtrum, UNISOC | It seems that option 3 is the same as option 1, except that when the AS ID is released. For option 1. Device releases the AS ID upon receiving new paging message with new transaction ID. For option 3, device releases the AS ID upon receiving “msg2/new msg 2”. |
| InterDigital | This option is by default supported based on agreement related to case when the AS ID is assigned by the reader during the random access procedure. The device assumes RN16 is the AS ID until it receives another message which re-assigns it.  Therefore, no reason to discuss pros and cons for this solution.  We don’t think this is the same as option 1, as the release in option 1 may not be followed up with a new device ID. |
| ETRI | We cannot identify any use cases where the reader needs to reassign a new AS ID to the device. |
| Panasonic | We support this option. To answer question by some companies why reader needs to re-asign a AS ID, this could be for security reason to avoid unauthorized tracking. |
| Qualcomm | This should be the baseline. |
| Nokia | We believe that anyway the device will need to respond to the paging, so why overengineer? |
| HONOR | Generally, we agree the reader controlled AS ID management. But we don’t see the necessity about always assigning a new AS ID. Considering the limited number of the AS ID, the reader could release the ID. |
| Fujitsu | Cons: contradict with RAN2 agreement that a random ID can be used as AS ID. In a new paging for a new service, whether a random ID or previous AS ID is used in Msg1 in CBRA? |
| Samsung | Similar view as HW, this option has no fundamental difference compared to Option 1. The only difference is that in option 1, the release of AS ID occurs when receiving paging message with new transaction ID, while in option 3, it occurs when new AS ID is received.  Pros.: similar to option 1  Cons.: similar to option 1. |
| Ericsson | We are negative on this option as it requires the device to maintain the AS ID unnecessary long, leading to additional device complexity unnecessarily. We think the use of AS ID is for addressing and scheduling only within one procedure/access occasion. |
| Futurewei | This should be obvious behaviour on the device. But again, we prefer that the re-assignment is also piggy-back on a subsequent R2D trigger message carrying a command. |

**Option 4a**: The device releases the AS ID upon reaching the max number of received Command Messages

Collected via offline discussion.

Considering we did not discuss the details of the option during the meeting, Rapporteur would like to collect companies’ view on the Pros/Cons of the option.

##### Q3-4a. Companies are invited to provide Pros/Cons for option 4a (The device releases the AS ID upon reaching the max number of received Command Messages).

|  |  |
| --- | --- |
| **Company** | **Pros/Cons** |
| ZTE | Not sure what the advantage of this is compared to other options. |
| OPPO | Cons: it is questionable how to set a proper value of the max umber of received Command Messages. |
| Lenovo | Cons: This option seems not reasonable. It’s possible that the max number of received Command Messages is reached and AS ID is released, but the AIoT service is not completed, which degrades the system performance. So it is hard to configure a suitable max number, and additionally the device needs to store such parameter. |
| NEC | Cons: Devices have to count/store the number of received Command Messages which may result in complexity increasing. |
| vivo | For Cons: Not clear how to specify the max number of received Command messages. It is also noticeable that no such service requirement/KPI was found according to SA1 TS 22.369. |
| CATT | Cons: same view as Lenovo. |
| MediaTek | We don’t understand this proposal too well, and we agree with the comments above. |
| CMCC | Not needed and not support. It is over design. |
| Huawei, HiSilicon | It seems to be a specific way to determine the whole command procedure is finished (as in option4b)? In this case, the intention does make sense, but the question is how to determine the number of the command messages as others commented. Maybe the way using explicit message in option6 is more compatible. |
| Apple | Cons: this is an unnecessary complication. The device has to remember the number of commands received |
| Spreadtrum, UNISOC | It is not necessary and adds unnecessary device complexity. |
| InterDigital | Agree with Huawei that the intention is as option 4b and agree with the rapporteur in grouping the two options together. |
| ETRI | Cons: same view with Lenovo. |
| Panasonic | It is not so reasonable. |
| Qualcomm | This option is not necessary. Similar views as other companies. |
| Nokia | Similar (negative) views as other companies |
| HONOR | Cons as above. |
| Fujitsu | Cons: not sure how to set the max number of received Command Messages |
| Samsung | Cons.: add additional complexity at the device side since the device needs to count the number of command messages, and such counting relies on the upper layer. |
| Ericsson | We are negative on this option as it requires the device to maintain the AS ID unnecessary long, e.g., spanning for several paging rounds. In addition, device also needs to maintain a counter for the number of received command messages. We think the use of AS ID is for addressing and scheduling only within one procedure in response to the A-IoT paging message in both CBRA and CFRA. |
| Futurewei | Due to errors, this does not guarantee that the reader and device are always in synch. |

**Option 4b**: The device releases the AS ID after completion of the command procedure

|  |  |
| --- | --- |
| **Company** | **Arguments** |
| IDC R2-2500495 | As a result, the device could release the AS ID after completion of the command procedure. If multiple commands need to be issued to the device, such approach may be cumbersome. |
| Xiaomi R2-2500253 | * ***Complete the transmission of the D2R response to a “command”*** |
| CATT R2-2500272 | Proposal 3b: The device should release the AS ID, if it determines the service is completed.  If the device confirms that it had completed the service triggered by the reader, the device should release the AS ID.  So this optional feedback indication can be used by the device to determine the successful reception of the last data transmission by the reader, i.e., the service has been completed by the device. |

Considering we did not discuss the details of the option during the meeting, Rapporteur would like to collect companies’ view on the Pros/Cons of the option.

##### Q3-4b. Companies are invited to provide Pros/Cons for option 4b (The device releases the AS ID after completion of the command procedure).

|  |  |
| --- | --- |
| **Company** | **Pros/Cons** |
| ZTE | The advantage is that there is a well defined message to release the ASID and hence the reader and device can be always in sync  The disadvantage is that this message may be missed by the device. In which case, we need to discuss whether we also need a timer or not. i.e. it is unclear whether we can solely rely on a reader based mechanism when the DL message may be missed. |
| Lenovo | Pros: It’s reasonable that AS ID is valid during the current service period, e.g., before completion of the command procedure.  Cons: However, we need to consider how does device determine the completion of the command procedure.  To make this option clear, more details related to the completion of command procedure need to be defined, e.g., the device releases the AS ID upon receiving the ‘end’ indication from reader, or upon completed the last D2R message transmission. |
| NEC | Cons: Not sure how devices to determine the procedure is completed. It may result in complexity increasing. |
| vivo | For Cons: the completion of the command procedure is known by the reader but not known at the device. Anyway, reader indication to the device to release the AS ID is needed, e.g., Option 6 is a way to achieve such a purpose. |
| CATT | As one of the source companies, our intention is to emphasise the AS ID is only valid in device during the on-going of a certain service. Then the issue is converted to how to determine the completion of the service by the device.  A candidate solution is that an indication of end of this service for this device is sent from reader to device. So the target device will release AS ID. If the indication is unfortunately missed by the target device which doesn’t always happen, the AS ID has to be maintained until the device runs out of power or the device receives a new paging message. |
| MediaTek | Pros: (1) Unambiguous (as long as the end of the procedure is well-defined). (2) Complies with the “one ID” principle. (3) Does not introduce overhead to signal an ID field in extra messages.  Cons: Requires a clear definition of the end of the procedure (last segment of response transmitted?). |
| CMCC | Cons:   1. As long as device has energy, it should keep monitoring, even if the device is released. 2. If the release message is lost, it will cause misalignment. In such case, it still rely on other solutions such as paging with new transaction id or timer. |
| Huawei, HiSilicon | The key point is how to determine the service is finished. So, this option lacks details, which could be option6+option1. |
| Apple | Cons:  1. The completion of command procedure is unclear to the device. The device does not know if the reader has another command for it or not. It needs new signalling from reader side, then this is as same as option 6.  2. The reader has to assign a AS ID for every new command procedure. |
| Spreadtrum, UNISOC | Cons: it is not sure how devices to determine the command procedure is finished. |
| InterDigital | Pros: Avoids explicit indication associated with the “end of the command” and the associated overhead.  Cons: The command procedure would need to be associated with a single command message (or a maximum number of command messages that would be sent following any inventory). |
| ETRI | Cons: same view with NEC. |
| Panasonic | Share the same view as Apple. |
| Qualcomm | This is reasonable in principle and should be a baseline, however how to determine the end of the procedure by the device may be one issue. |
| Nokia | Can be reasonable, but then we have to handle many corner cases compared which may make spec more complex |
| HONOR | The details about the complete detection by the device should be discussed first. |
| LGE | It is well-aligned with the purpose of AS ID and it can be a baseline of AS ID validity. AS ID is used for R2D reception and D2R resource scheduling after paging and random access. We understand that those R2D and D2R transmission are for handling a command procedure. The AS ID needs to be valid during the command procedure. We think that the AS ID is not needed any more after completion of the command procedure. It can be considered as invalid.  However, we need to further discuss how to determine completion of the command procedure and how to handle the case that the command procedure is not completed successfully. |
| Fujitsu | Cons: device does not know if there is any further command for itself. |
| Samsung | Cons.:   * The device needs a mechanism to determine the completion of procedure, which is unclear to us. |
| Ericsson | We are positive to this option. Completion of command procedure indicates the AS ID is no longer needed in ongoing paging round. We assume command procedure may include several steps of command request and command response, e.g., a write operation after read operation, or disabling after read operation. |
| Futurewei | We think this may be a reasonable solution, provided that this is indicated by the reader, implicitly or explicitly. |

**Option 5**: The device releases the AS ID upon power off

|  |  |
| --- | --- |
| **Company** | **Arguments** |
| Xiaomi R2-2500253 | * ***when the device is powered off, all information stored in the register memory needs to be cleared including the AS ID.*** |

Considering we did not discuss the details of the option during the meeting, Rapporteur would like to collect companies’ view on the Pros/Cons of the option.

##### Q3-5. Companies are invited to provide Pros/Cons for option 5 (The device releases the AS ID upon power off).

|  |  |
| --- | --- |
| **Company** | **Pros/Cons** |
| ZTE | This is needed anyway. I guess ASID is in volatile memory and whenever the device runs out of power, the ASID is released. So, regardless of pros and cons, we have to discuss how the protocol should actually support this case (i.e. this is something the protocol has to live with). |
| OPPO | Pros: such operation is simple, if we agree that AS ID shall be stored in the volatile memory |
| Lenovo | Pros: This option is natural if AS ID is stored in the volatile memory.  However, we understand this option should be used together with other solutions, i.e., only option 5 is not a complete AS ID release solution. When device has energy, it’s also possible the AS ID is not valid and should be released. |
| NEC | We think it is the basic mechanism too. Do not see any Cons. |
| vivo | For Pros: Option 5 is straightforward. Similar to normal UE, the assigned AS ID is part of the AS context, which is released upon power off (i.e., out of energy). No spec impact is foreseen for this case. |
| CATT | Same view as ZTE. This option may work together with option 4b. |
| MediaTek | Pros: Seems inevitable unless we specify that AS ID shall always be stored in NVRAM, which looks like an unreasonable requirement.  Cons: (1) Difficult to guarantee sync with the reader. (2) AS ID may persist for a really long time if the device can harvest enough energy to stay powered on, even if it is not engaged in any procedures.  We agree with Lenovo: This is a valid condition but not a complete solution. |
| CMCC | Pro: no additional signalling or overhead introduced.  In addition, we think the minimum time to store AS id in VM should be a requirement for devices, which should be captured in specification. |
| Huawei, HiSilicon | We agree with others, the AS ID is to be stored in volatile memory, and will be released upon power-off. |
| Apple | This is not a solution, but a physical constraint. |
| Spreadtrum, UNISOC | Pros: Agree with others. if we agreed that AS ID shall store in volatile memory, AS ID will be released upon power off. |
| InterDigital | Agree with others that these cases should be supported and the reader cannot assume that the AS ID can be used after the device powers off. |
| ETRI | Agree to InterDigital’s view. |
| Panasonic | This is a basic mechanism that is needed anyway. |
| Qualcomm | OK |
| Nokia | We don’t believe there is a reasonable definition of “off” to agree to this |
| HONOR | It is the consequence of power-off. Need to work with other solutions. |
| LGE | We think that AS ID is stored in volatile memory. ‘power-off’ is a necessary condition. |
| Fujitsu | This is a baseline. Other solution is still needed. |
| Samsung | This is a natural way, and it should be naturally supported.  However, the discussion on validity of AS ID is to figure out additional solution on top of this. |
| Ericsson | Yes. We think AS ID should not be stored in long-term memory (NVM) to avoid additional device complexity considering the use of AS ID is addressing and scheduling device in the AS level. Thus, if the device is powered off, AS ID is not maintained. But device should not be required to keep the AS ID after use in an access occasion. |
| Futurewei | Agree with others that the AS ID should be stored in volatile memory, therefore the device losing it upon depleting its energy. But it is a consequence when device depleting its energy, not a mechanism for releasing AS ID (i.e., the reader will not intentionally cause the device’s energy to be depleted to release the AS ID assignment). |

**Option 6**: The device releases the AS ID upon receiving explicit release indication from the Reader

|  |  |
| --- | --- |
| **Company** | **Arguments** |
| Vivo R2-2500131 | Explicit release indication from reader is the most straightforward solution, e.g., upon reader reception of service ending indication from CN. |
| IDC R2-2500495 | we could rely on an explicit indication by the reader (e.g., included with the data transmission scheduling). |
| Lenovo R2-2500387 | Negative  For opt5, it may be unnecessary to use an explicit indication (e.g., AS ID release indication). |

Considering we did not discuss the details of the option during the meeting, Rapporteur would like to collect companies’ view on the Pros/Cons of the option.

##### Q3-6. Companies are invited to provide Pros/Cons for option 6 (The device releases the AS ID upon receiving explicit release indication from the Reader).

|  |  |
| --- | --- |
| **Company** | **Pros/Cons** |
| ZTE | Need for an explicit message is unclear (e.g. if implicit release upon completion of certain procedures is sufficient). |
| OPPO | Cons: one additional R2D command is needed for the A-IOT device to release AS ID, which is not friendly to resource usage, especially considering that the R2D message could occupy all the frequency band, i.e., FDM may be not possible for the R2D direction, according to RAN1 current process. |
| Lenovo | Pros: this option is straightforward.  Cons: however, it’s not necessary to introduce an explicit signalling for AS ID release, which increases signalling overhead. The implicit conditions/signalling like option 1/3/4b is enough. |
| NEC | Pros: it is a simple and straightforward solution. Devices just follow the reader command to release the previous AS-ID. |
| vivo | Pros: The AS ID management, including assignment and release, is all controlled by one node, i.e., reader. |
| CATT | Pros: straightforward  Cons: need additional R2D message for this purpose. |
| MediaTek | Pros: (1) Straightforward. (2) Guarantees sync.  Cons: Requires a bit in the R2D data MAC header. (A separate message should be usually avoidable if the release instruction piggybacks on the last R2D transmission.) |
| CMCC | Cons:   1. Increase additional signalling overhead and device behaviour. 2. If the release message is lost, it will cause misalignment. In such case, it still rely on other solutions such as paging with new transaction id or timer. |
| Huawei, HiSilicon | About the signalling overhead mentioned by others, we understand the agreed feedback message has the similar the same functionality. To be specific, feedback message is supposed to indicate the failure/success of the service, when the device should know the service is finished. So there could be no additional signalling overhead or standard effort by reusing feedback message. |
| Apple | Con: we think this adds a new signalling format for UE to handle.  But we can accep: Option 6 as a complementary to Option 3 for reader to choose, if Option 3+6 is the majority view of RAN2... |
| Spreadtrum, UNISOC | Cons: requires additional R2D signalling to release AS ID. |
| InterDigital | Pros: May be easier to define the “end of the command” phase in this way, allowing the device to keep the AS ID only when needed.  Cons: Increase signalling overhead and design complexity. Also, as mentioned by CMCC, we may need to rely on paging with new transaction ID anyways because the explicit indication may be missed. |
| ETRI | Pros: straightforward  Cons: increasing signalling load due to additional R2D message. |
| Panasonic | We see option 3 (device releases the AS ID upon receiving new assigned AS ID from the Reader) as main mechanism. In addition, option 6 can be used, for example, to free some ID spaces. |
| Qualcomm | OK in principle, but we do not see the need for explicit AS-ID release message from the Reader. |
| Nokia | We don’t really see the need for the release as there are simpler methods |
| HONOR | As we stated before, we agree with the reader-controlled AS ID management. The detail of this solution could be further discussed.  Pros: The AS ID release relies on explicit signlling from the reader which avoids misalignment caused by the device-determined solution.  Cons: 1 more bit or a message is required. But we think it is acceptable since the AS ID which is much shorter than the device ID is a limited resources and could be recycled by the reader. |
| Fujitsu | Pros: simple device behavior.  Cons: may introduce more signaling overhead. (can be avoided by reusing/enhancing other R2D message) |
| Samsung | Pros.: It can overcome the Cons. of other options except Option 5.  Cons.: this needs a new signalling field in R2D message or a new R2D message. |
| Ericsson | We see no need for explicit indocation |
| Futurewei | Again, piggy-backing a 1-bit indication in the final R2D transmission may be fine. |

##### Q3-7. Companies are invited to add if any options are missing.

|  |  |
| --- | --- |
| **Company** | **New options** |
| ZTE | Combination of some of the options above.  e.g. a reader-based release (either implicitly or explicitly) + device releasing it upon expiry of a timer (e.g. like an inactivity timer).  Pros: This works for all cases and covers the cases where the R2D message is missed by the device |
| vivo | Share a similar view as ZTE. The above options are not exclusive and can be complementary to each other. The questionnaire in the next phase discussion is better to collect views on a reasonable list of option combinations instead of down-selecting one option. |
| MediaTek | We agree that combinations of the options should be considered. 3+5+6 looks like it works, for example. |
| Huawei, HiSilicon | As we commented in Q3-1, one missing option is that upon reception of paging message **with same/different transaction ID**, the device releases the AS ID, which means there will be no R2D command procedure across paging-round. |
| InterDigital | Same view as others, combinations of methods should be supported. |

## Others

Rapporteur would like to check companies’ view on whether any other aspects need to be considered in this email discussion.

##### Q4-1: Any other aspects on AS-ID need to be considered in this email discussion?

|  |  |
| --- | --- |
| **Company** | **Comment** |
| ZTE | One of the requirements for ASID management is for the reader to have a well-known point when the ASID can be reassigned/reused. There should be no ambiguity at the reader whether the ASID is still in use by some other device or if it is released and hence can be reused for a different UE. |
| OPPO | For ZTE’ s concern, we think that the AS ID bit space could be large enough to remove the need of a well-known point when the ASID can reassigned. |
| vivo | There is a remaining issue regarding if AS ID can be based on partial upper layer device ID (see highlighted below). Not sure if it can be handled in this email or not.  *From TR 38.769*  From higher layer perspective, it is assumed that "AS ID" (if defined according to the design in clause 6.1) is used at least for purpose of D2R scheduling and R2D reception. From higher layer perspective, it is assumed that this "AS ID" should be a short AS layer ID, rather than the full upper layer device ID. It needs to be further discussed if this "AS ID" can be based on partial upper layer device ID. It needs to be further discussed on the length of this "AS ID". From higher layer perspective, following options are possible for this "AS ID" (it is aimed to define one common design for all access procedures in clause 6.3.4, if technically possible): |
| MediaTek | We agree with ZTE’s concern. Enlarging the ID doesn’t fully address the problem, since the reader will still want to reuse ID values eventually and it should know which values are available. |
| Apple | Regarding ZTE concern, we may have a large enough ID space to mitigate this. But this problem cannot be fully eliminated due to the unreliable channel and mobility. We prefer not to further optimize the design of AS ID for this in this release. |
| Qualcomm | The issue raised by vivo also needs to be concluded. We can try in this email phase 2. |

# Phase 2 Discussion

After phase 1 discussion, Rapporteur will provide summary based on the inputs from companies during Phase 1. Companies are invited to provide further comment on the summary and new questions from Rapporteur.

# Conclusion

# Reference

[1] R2-2501510 [AT129][020][AIoT] AS ID (XiaomiHuawei) Xiaomi, Huawei

[2] R2-2500131 AIoT Data Transmission vivo

[3] R2-2500495 Data Transmission and General Aspects for Ambient IOT InterDigital

[4] R2-2500253 Protocol design principle and considerations on Data transmission Xiaomi

[5] R2-2500272 Discussion on the A-IoT Data Transmission and Other General Aspects CATT

[6] R2-2500387 Discussion on A-IoT data transmission and other general aspects Lenovo

[7] R2-2500672 Discussion on AS ID, segmentation and control signaling format Panasonic

# Annex – RAN2 AS ID related agreements

RAN2 #127 meeting

|  |
| --- |
| **Agreements on AS ID**   1. RAN2 assumes that if “AS ID” is defined it is used at least for purpose of D2R scheduling and R2D reception. Up to RAN1 to decide whether a “AS ID” is defined. 2. RAN2 assumes this “AS ID” should be a short AS layer ID, rather than the full upper layer device ID. FFS on the length. FFS if AS ID can be based on partial upper layer device ID. |

RAN2 #129 meeting

**Agreements**

1. 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

|  |
| --- |
| **Agreements**   1. 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. 2. From device perspective, it is only required to use one AS ID. 3. CFRA is not supported for group ID 4. RAN2 assumes, AS ID is needed for CFRA at least for inventory + command procedure 5. 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 |