**3GPP TSG-WG SA2 Meeting #170 S2-250xxxx**

**Gothenburg, Sweden, August 25 - 29, 2025 (revision of S2-250xxxx)**

**Source: Ericsson**

**Title: Discussion on Delayed NAS Message**

**Document for: Agreement**

**Agenda Item: 19.14.2**

**Work Item / Release: AmbientIoT-ARC / Rel-19**

*Abstract: This Discussion Paper discusses the Delayed NAS Message issue and the potential solutions.*

**1. Introduction**

RAN2 sent an LS to CT1 and Cc SA2 (R2-2504697: “LS on delayed A-IoT D2R NAS messages”.

The use case is about:

*RAN2 understand that the device may, for example, receive a write command message from the reader, pass the command message to NAS layer, and when the scheduled D2R occasion for the response arrives, transmit the MAC response with an empty SDU if the NAS response has not yet been delivered to MAC as indicated in the agreement above.*

**[Observation-1]** When an AIoT device receives a NAS command request message (e.g., write), the NAS command response message may not be ready when the scheduled D2R occasion arrives.

In the LS, RAN2 mentioned an agreement reached:

1. *The device is expected to send a MAC response to the reader in the D2R occasion. The MAC response contains the NAS message if available at the D2R occasion. If there is no NAS message available to transmit at the D2R occasion then the response contains MAC with 0 SDU and padding as needed.*

**[Observation-2]** According to this agreement, the AIoT device may transmit a MAC response with 0 SDU.

The Potential Solution of “MAC (0 SDU)”

The e2e call flow can be depicted in the figure below for this MAC (0 SDU) approach:



1. The AIOTF sends the NAS Command Request towards the NG-RAN node over NGAP Command Request.

2. The Reader in the NG-RAN node delivers the NAS Command Request over AS layer towards the Device MAC layer.

3. The Device MAC layer passes the NAS Command Request to the Device NAS layer, which is implementation specific.

4. The Device NAS layer parses the NAS Command Request.

5. The Device NAS layer may communicate with the Device MAC layer via implementation specific message for the success of receiving and parsing.

6. After receiving the message from the Device NAS layer, or till the scheduled D2R occasion arrives there is no NAS message ready for transmission, the Device AS layer sends a MAC message with 0 SDU towards the reader.

7. The Device NAS layer executes the Command and generates the NAS Command Response message.

8. The Device NAS layer passes the NAS Command Response to the Device AS layer, which is implementation specific.

9. The Device AS layer has no D2R resource and cannot deliver the NAS Command Response towards the reader.

In this call flow, the Device has no chance to deliver the NAS Command Response towards the reader, due to lack of D2R resource.

**[Proposal-1.1]** Based on the proposal from RAN2, the AIoT device cannot send out the NAS Command Response towards the reader, by sending MAC (0 SDU).

After step 6, can reader take some actions as a remedy?

- If the reader redelivers the NAS Command Request right after receiving the MAC (0 SDU) message, the AIoT device is executing the command, and cannot handle the redelivery message.

- If the reader redelivers the NAS Command Request after waiting for sufficient long (i.e., after the AIoT device finishes step 9, so that the device can handle the redelivery message), the AIoT device will start from step 2 again, and the same story will take place again as well.

**[Proposal-1.2]** As a summary, the redelivery the NAS Command Request from the reader is not helpful

- If the reader informs the AIOTF about such status over NGAP (e.g., by introducing NGAP Command Acknowledge), the AIOTF may take actions similar as the proposal of NAS acknowledge which is going to be analyzed below.

RAN2 further indicates another potential approach:

*As one potential approach, RAN2 considered that the device NAS layer might generate and deliver to the device MAC layer an immediate NAS response upon successful reception of a command (e.g., a write command), without waiting for the command to execute.*

**[Observation-3]** The device NAS layer may generate an immediate NAS response. The immediate NAS response message can be regarded as an NAS Acknowledge message.

The Potential Solution of “NAS Acknowledge”

The e2e call flow can be depicted in the figure below for this NAS Acknowledge approach:



1. The AIOTF sends the NAS Command Request towards the NG-RAN node over NGAP Command Request.

2. The Reader in the NG-RAN node delivers the NAS Command Request over AS layer towards the Device MAC layer.

3. The Device MAC layer passes the NAS Command Request to the Device NAS layer, which is implementation specific.

4. The Device NAS layer parses the NAS Command Request.

5. The Device NAS layer generates a NAS Command Acknowledge message and passes to the Device AS layer, which is implementation specific.

6. The Device AS layer sends the NAS Command Acknowledge message over a MAC message towards the reader.

7. The NG-RAN node transmits the AIOTF about the NAS Command Acknowledge over NGAP.

8. The Device NAS layer executes the Command and generates the NAS Command Response message.

9. The Device NAS layer passes the NAS Command Response to the Device AS layer, which is implementation specific.

10. The Device AS layer has no D2R resource and cannot deliver the NAS Command Response towards the reader.

In this call flow, the Device has no chance to deliver the NAS Command Response towards the reader, due to lack of D2R resource.

**[Proposal-2.1]** Based on the proposal from RAN2, the AIoT device cannot send out the NAS Command Response towards the reader, by sending NAS Command Acknowledge.

After step 7, can the AIOTF take some actions as a remedy?

- If the AIOTF redelivers the NAS Command Request right after receiving the NAS Command Acknowledge, the AIoT device is executing the command, and cannot handle the redelivery message.

- If the AIOTF redelivers the NAS Command Request after waiting for sufficient long (i.e., after the AIoT device finishes step 9, so that the device can handle the redelivery message), the AIoT device will start from step 2 again, and the same story will take place again as well.

**[Proposal-2.2]** As a summary, the redelivery the NAS Command Request from the AIOTF is not helpful

As a remedy, the AIOTF may generate a read command, and delivers the read command towards the AIoT device after waiting for sufficient long. The AIOTF may further compare the read result and the data to write in the write command. Based on whether they are the same, the AIOTF can determine whether the write command has been executed successfully.

Such workaround could be workable. However, it puts quite complex logic inside the AIOTF. The AIOTF needs to have the business orchestration logic to generate a read command based on no response of a write command, and needs to be able to compare the read results and the data to write.

Another option is to defer such business logic to the AF to keep the AIOTF clean. It will make the AF rather complex, which may not be necessary.

**[Proposal-3]** A workaround in the AIOTF or the AF is possible but very complex: the AIOTF/AF generates a read command and compares the read result and the data to write.

The root cause of this issue is because the reader does not have the knowledge of how long the command execution is needed. It cannot schedule the D2R resource properly, which results in the NAS Command Response cannot be sent out from the device. In case the AIOTF can pass such information towards the reader, the reader can schedule D2R resource properly, so that the NAS Command Response is not “delayed”.

**[Proposal-4]** The AIOTF can pass information to the reader about the command execution period, so that the reader can schedule D2R resource properly.

About what information can be passed from the AIOTF towards the reader as assistance information, we see several options:

* Option-1: The AF knows the AIoT devices and the amount data to write. The AF can estimate the command execution period, and include it in the parameters of Naiotf\_AIoT\_Command Request. The AIOTF includes the estimated command execution period as assistance information towards the reader.
* Option-2: The AIOTF understands target AIoT devices and the amount data to write. The AIOTF can estimate the command execution period, and includes it as assistance information towards the reader.
* Option-3: The AIOTF can pass the command type (e.g., read/write/disable) as well as the command-specific parameter(s) (e.g., amount to write) towards the reader as assistance information. The reader can estimate the command execution period based on the assistance information.

In our view, Option-1 brings less impact towards the network. It is a comparable simpler option. But we don’t have a strong view on which option is the way forward and we are open in the discussion.

**[Proposal-5]** SA2 together with RAN2 can determine which entity should be the NF, which is responsible for the estimation of command execution period.

**[Proposal-6]** In the reply LS, SA2 needs to check RAN2’s view about the solution of passing assistance information to the reader, so that the reader can know or determine the estimated command execution period.

**2. Proposal**

**[Observation-1]** When an AIoT device receives a NAS command request message (e.g., write), the NAS command response message may not be ready when the scheduled D2R occasion arrives.

**[Observation-2]** According to this agreement, the AIoT device may transmit a MAC response with 0 SDU.

**[Proposal-1.1]** Based on the proposal from RAN2, the AIoT device cannot send out the NAS Command Response towards the reader, by sending MAC (0 SDU).

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**[Proposal-2.1]** Based on the proposal from RAN2, the AIoT device cannot send out the NAS Command Response towards the reader, by sending NAS Command Acknowledge.

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**[Proposal-3]** A workaround in the AIOTF or the AF is possible but very complex: the AIOTF/AF generates a read command and compares the read result and the data to write.

**[Proposal-4]** The AIOTF can pass information to the reader about the command execution period, so that the reader can schedule D2R resource properly.

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**[Proposal-6]** In the reply LS, SA2 needs to check RAN2’s view about the solution of passing assistance information to the reader, so that the reader can know or determine the estimated command execution period.

It is proposed to approve the reply LS (S2-250xxxx).