**3GPP TSG-RAN WG2 Meeting #128 \_R2-2411221**

**Orlando, USA, 18th – 22nd November, 2024 *Revision of R2-2409812***

**Agenda Item: 8.2.1**

**Source: Huawei, CMCC, T-Mobile USA**

**Title: TP for TR 38.769 update**

**Document for: Endorsement**

# 1 Introduction

This contribution provides the text proposal on the update of TR 38.769. The new changes done by [POST128][015][AIoT] are marked by “Rapp\_Post”.

# 2 Text Proposal for TR 38.769 V1.1.0 (2024-10)

Start of Change

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TR 38.848: "Study on Ambient IoT (Internet of Things) in RAN".

[R1-1] RP-240826: "Revised SID: Study on solutions for Ambient IoT (Internet of Things) in NR".

[R1-2] 3GPP TR 38.869: "Study on low-power Wake-up Signal and Receiver for NR".

[R1-3] 3GPP TS 38.212: "NR; Multiplexing and channel coding".

[R1-4] EPC Radio-Frequency Identity Protocols Class-1 Generation-2 UHF RFID Protocol for Communications at 860 MHz – 960 MHz.

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# 3 Definitions of terms, symbols and abbreviations

This clause and its three (sub) clauses are mandatory. The contents shall be shown as "void" if the TS/TR does not define any terms, symbols, or abbreviations.

## 3.1 Terms

For the purposes of the present document, the terms given in TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in TR 21.905 [1].

For the purposes of the study, RAN1 uses the following terms:

**Device 1:** ~1 µW peak power consumption, has energy storage, initial sampling frequency offset (SFO) up to 10*X* ppm, neither DL nor UL amplification in the device. The device's UL transmission is backscattered on a carrier wave provided externally.

**Device 2a:** ≤ a few hundred µW peak power consumption, has energy storage, initial sampling frequency offset (SFO) up to 10*X* ppm, both DL and/or UL amplification in the device. The device’s UL transmission is backscattered on a carrier wave provided externally.

**Device 2b:** ≤ a few hundred µW peak power consumption, has energy storage, initial sampling frequency offset (SFO) up to 10*X* ppm, both DL and/or UL amplification in the device. The device’s UL transmission is generated internally by the device.

**D1T1:** Deployment scenario 1 with connectivity topology 1, according to TR 38.848.

**D2T2:** Deployment scenario 2 with connectivity topology 2, according to TR 38.848.

**Inventory**: The service provided by the network to discover and acquire the identifier of A-IoT device(s).

**Command**: The service provided by the network to send the operation instruction to the A-IoT device (e.g., read, write, etc.).

## 3.2 Symbols

For the purposes of the present document, the following symbols apply:

<symbol> <Explanation>

## 3.3 Abbreviations

For the purposes of the present document, the abbreviations given in TR 21.905 [1] and the following apply. An abbreviation defined in the present document takes precedence over the definition of the same abbreviation, if any, in TR 21.905 [1].

1SB Single sideband

2SB Double sideband

A-IoT Ambient IoT

A-IoT RAN Ambient IoT Radio Access Network

BFSK Binary frequency-shift keying

BPSK Binary phase-shift keying

CFO Carrier-frequency offset

CP Cyclic prefix

CW Carrier-wave

CW2D Carrier-wave, or carrier-wave node, to device

D2R Device to reader

DFT-s-OFDM DFT-spread OFDM

DO-A Device-originated autonomous

DO-DTT Device-originated by device-terminated trigger

DT Device-terminated

ED Envelope detector

FAR False alarm rate

FEC Forward error-correction code

FR Frequency Range

IF Intermediate frequency

IoT Internet of Things

LPWA Low-power, wide-area

LTE-MTC Long Term Evolution – Machine Type Communication

MCS Modulation and coding scheme

MDR Missed detection rate

MSK Minimum-shift keying

NB-IoT Narrowband IoT

OOK On-off keying

PDRCH Physical device-to-reader channel

PIE Pulse interval encoding

PRDCH Physical reader-to-device channel

R2D Reader to device

RF Radio frequency

RFID Radio frequency identification

SFO Sampling-frequency offset

ZIF Zero IF

Next Change

## 6.3 Protocol stack and signalling procedures

### 6.3.1 General aspects and overall procedure

The study aims that the design on the A-IoT radio interface between reader and A-IoT device is common for Topology 1 and Topology 2. The difference of topologies is transparent to the A-IoT devices and has no impact on A-IoT devices. Unless explicitly stated, the descriptions in clause 6.3 apply to all A-IoT device types and both Topology 1 and Topology 2.



Figure 6.3.1-1 Overall AS procedures between A-IoT device and reader

The overall AS procedures can be formulated as:

- Step A: A-IoT paging. Based on the service request, the reader sends the A-IoT paging message indicating device(s) that need to respond. See sub-clause 6.3.3.

- 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 sub-clause 6.3.4 (and 6.3.5)..

- Step C1: Possible R2D data transmission (e.g., for sending the command). See sub-clause 6.3.5.

- Step C2: Possible D2R data transmission (e.g., the corresponding response to command). See sub-clause 6.3.5.

Then, above AS procedure can support indoor inventory and indoor command use cases by the following manners:

- For the detailed use case of “inventory-only”, it is supported by the procedure with Step A and Step B as baseline.

- For the detailed use case of “inventory and command”, it is supported by the procedure with Step A, Step B, Step C1 and Step C2, as baseline.

NOTE 1: For the use case of “inventory and command”, it does not imply that the A-IoT paging message includes both the inventory and command and it does not imply the inventory and command are received by the reader at the same time from upper layer.

- For the detailed use case of “command-only”:

- It can be also supported by the baseline procedure with Step A, Step B, Step C1 and Step C2.

- In addition, another candidate to support this use case is following, whose feasibility still depends on the conclusion from [R2-1] and [R2-2]:

- Step A’: A-IoT paging. Based on the service request, the reader sends the A-IoT paging message including the command, indicating device(s) to process/respond the command.

- Step C2: Possible D2R data transmission (e.g., the device ID and/or the corresponding response to command), via the A-IoT random access procedure or without using the A-IoT random access procedure.

The following information are considered useful to be visible to the reader from CN:

NOTE 2: It needs to be further discussed on whether following information is mandatory or optional.

- The A-IoT service type (e.g., inventory, command)

NOTE 3: It needs to be further discussed if more information on command type (e.g. read/write/disable) is useful. The reader needs to know whether a D2R response is expected in D2R direction and, if so, the expected D2R message size. It needs to be further discussed on the details on how the reader gets that information (related to the “expected D2R message size” discussion in sub-clause 6.3.5). It needs to be further discussed on whether the command type, if needed, is explicit or inferred from the “expected D2R message size” if available.

- Whether the service is targeted for one or more than one A-IoT devices

- The approximate number of target A-IoT devices of this service

### 6.3.2 Protocol stack and functionality aspects

For A-IoT, it is assumed the commands (e.g., read/write/disable) and/or inventory information are carried over A-IoT radio interface as the upper layer data. As to the protocol stack for A-IoT radio interface between A-IoT device and reader, it is assumed:

- RRC layer is not supported

- SDAP layer is not supported

- PDCP layer is not supported

- RLC layer is not supported

- A-IoT MAC layer is supported

- A-IoT physical layer is supported

- There is no control plane and user plane differentiation



Figure 6.3.2-1 Protocol stack for A-IoT radio interface between A-IoT device and reader

As to the A-IoT required functionalities, the following functionalities are supported:

- A-IoT paging (see sub-clause 6.3.3)

- A-IoT random access procedure (see sub-clause 6.3.4)

- A-IoT data transmission (see sub-clause 6.3.5)

As to the A-IoT required functionalities, at least the following functionalities are NOT supported (see TS 38.300 [R2-3] for references for any legacy NR functionality):

- AS security (The AS layer design assumes no support of AS security, unless the study in [R2-2] further concludes differently.)

- RRC states

- RRC connection management

- RRM L3 measurement reporting

- Mobility

- ASN.1 encoding/decoding

- Periodical system information and MIB

- Tracking/RAN area update procedure

- Per-packet QoS and per-QoS flow at AS level

- HARQ

- RLC ARQ/AM

- AS-layer (above physical layer) RLC-like/ARQ-like retransmission

- AS-layer (above physical layer) repetition

NOTE 1: It is not precluded that the reader and A-IoT device send the “payload” again as new transmission from A-IoT MAC perspective.

- Multiple A-IoT logical channels for upper layer data

- NR SR, as in TS 38.300 [R2-3]

- NR BSR, as in TS 38.300 [R2-3]

### 6.3.3 A-IoT paging

In A-IoT AS layer, the A-IoT paging functionality is to use A-IoT paging message to indicate device(s) that need to respond.

As to the A-IoT paging message, the identifier may be required to identify the device/group of devices in this trigger message (e.g., for the case of reaching a single or a group of devices). Following cases are studied:

- The A-IoT paging message containing an identifier of a single A-IoT device

- The A-IoT paging message containing a group ID that maps to multiple A-IoT devices

- The A-IoT paging message that does not contain any identifier, i.e., indicating all A-IoT devices that can receive the A-IoT paging message need to respond

- The A-IoT paging message containing multiple identifiers of A-IoT devices. The need for this use case is still to be confirmed/dependent according to the conclusion in [R2-1]. From RAN2 perspective, it is feasible to support paging multiple identifiers of A-IoT devices, pending on TB size and multiplexing design of A-IoT paging message.

NOTE 1: The details of the above identifier and group ID and also the use case/scenario are studied in [R2-1].

As to the A-IoT paging message, it can additionally indicate the information from which the device(s) can determine the resource(s) to be used for D2R response message(s). It can be further considered on more details for the discussion in clause 6.1.

For A-IoT device paging functionality, it is understood that the legacy paging message, legacy paging occasion and legacy DRX from NR are not supported (See TS 38.300 [R2-3] for references for any legacy NR functionality). From RAN2 perspective, it is assumed that the A-IoT device can receive as long as there is enough energy (it can be further considered on the discussion in clause 6.1 and 6.2).

It is supported that the reader can send multiple (subsequent) A-IoT paging messages that are associated with the same service request from the CN. The duplicated response from devices for the same service request should be avoided. The A-IoT paging message can include information to avoid this duplicated response from the device to a reader. It needs to be further discussed on how to design this information in A-IoT paging message (e.g., including stage-3 details and considering the related aspects from other WGs). Then, based on this information, the device determines whether to skip sending the response to A-IoT paging message or not (if the device had successfully responded the same service before). This information should be short and simple. This information is one ID, while it needs to be further discussed whether the ID is generated by the reader or by the core network. It needs to be further discussed on the size of this information.

It needs to be further discussed for the scenario that different readers may send A-IoT paging messages, which are associated with the same service request from the CN, to the same device for response. If this scenario is in the scope, it needs to be further discussed, by considering the progress from all the WGs.

It needs to be further discussed on whether other information is included in A-IoT paging message to indicate service type/command type or to indicate whether there will be subsequent messages.

### 6.3.4 A-IoT random access procedure

A-IoT random access procedure is used for the Ambient IoT device(s) to access the network for data transmission.

The A-IoT random access procedure is triggered by the reader, including triggering the access for a single A-IoT device, group of A-IoT devices, or all A-IoT devices under the coverage of the reader.

The slotted-ALOHA is the baseline for A-IoT random access procedure.



Figure 6.3.4-1 General framework of slotted-ALOHA for A-IoT random access procedure

**Access occasion**: An opportunity of time-frequency resource for A-IoT device(s) to perform access (e.g., transmitting the A-IoT Msg1 by the device). A set of access occasion(s) for different A-IoT device(s) is scheduled via the R2D message (referring to the “R2D transmission triggering random access” in sub-clause 6.1.4) by the reader.

When the A-IoT device is selected to respond in accordance to the sub-clause 6.3.3, the A-IoT device performs the following procedure:

- **Step 1**: Random access type (i.e., contention-free or contention-based) and access occasion/resource determination:

- The A-IoT device determines the random access type from the A-IoT paging message, in accordance to sub-clause 6.3.3. The reader can configure either contention-free access or contention-based random access (and the corresponding configurations). It needs to be further discussed on whether it is explicitly or implicitly.

- 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 sub-clause 6.3.5.

- If the random access is contention-based random access:

- Performs access occasion/resource selection: as the baseline for CBRA, at least for TDMA case, the device can randomly select one access occasion for A-IoT Msg1 within the access occasions provided/assigned by the reader. It needs to be further discussed if this is applicable to FDMA case. Further enhancement option(s) can be also considered after more physical layer detailed design on TDMA and FDMA;

- Performs the Step 2 for contention resolution.

- **Step 2**: Contention resolution of contention-based random access:

- There are two candidate solutions being studied for the contention resolution, as below (it needs to be further discussed on the down selection and/or the unified design):

- ***Solution 1: A-IoT Msg1 without data***

- A-IoT Msg1: When the A-IoT device identifies the start of its own access occasion, it sends one 16-bit random ID generated by the A-IoT device to the reader.

- A-IoT Msg2: The reader responds with the successfully received random ID.

If the A-IoT device receives the A-IoT Msg2 including a random ID, which is the same as the previously transmitted one in A-IoT Msg1, it considers the contention resolution as successful.

- ***Solution 2: A-IoT Msg1 with data***

- A-IoT Msg1: When the A-IoT device identifies the start of its own access occasion, it sends the A-IoT Msg1 including the upper layer data, which can be the device ID and/or any other upper layer data, in addition to one 16-bit random ID generated by the A-IoT device to the reader.

- A-IoT Msg2: The reader may respond with the successfully received random ID.

If the A-IoT device receives the A-IoT Msg2 including a random ID, which is the same as the previously transmitted one in A-IoT Msg1, it considers the contention resolution as successful. If the A-IoT Msg2 is not received by the device, the re-access is not autonomously performed i.e., the re-access is always controlled by the reader.

- ***Solution 3: A-IoT Msg1 optionally includes data (unified solution supporting both Solution 1 and 2)***

- A-IoT Msg1: When the A-IoT device identifies the start of its own access occasion, it sends one 16-bit random ID generated by the A-IoT device to the reader. In addition, it is controlled by the reader on whether to also include the upper layer data, which can be the device ID and/or any other upper layer data.- A-IoT Msg2: The reader responds with the successfully received random ID.

If the A-IoT device receives the A-IoT Msg2 including a random ID, which is the same as the previously transmitted one in A-IoT Msg1, it considers the contention resolution as successful.

NOTE 1: The random ID is randomly generated by the A-IoT device.

NOTE 2: The A-IoT Msg2 is used for contention resolution, since it is assumed that the size of random ID in A-IoT Msg1 should be sufficient for contention resolution purpose. It is assumed that, with the sufficient range for random ID, the probability of multiple A-IoT devices selecting the same access occasion and the same random ID for A-IoT Msg1 transmission will be sufficiently low.

NOTE 3: It is up to the reader implementation whether A-IoT Msg2 is sent in random access *Solution 2*.

NOTE 4: Further information may be included in A-IoT Msg2 by considering the discussion in clause 6.1.

NOTE 5: For the advantage and disadvantage of the above solutions, it is understood that: *Solution 1* can support relatively large coverage for A-IoT Msg1 than *Solution 2*. *Solution 2* has the message number efficiency in case of low probability of A-IoT Msg1 collision (e.g. it can reduce one step for data transmission interaction in case of success).

After the A-IoT device considers the contention resolution as successful if the contention-based random access is used, or if the contention-free access is used, it may perform the upper layer data transmission with the reader, which can be the device ID and/or any other upper layer data, if any, in accordance to sub-clause 6.3.5.

It is also studied for the possible unification between the above contention-free access and contention-based random access, from the device perspective. In this solution, when the A-IoT device identifies the start of its own access occasion, it sends at least one 16-bit random ID generated by the A-IoT device to the reader (regardless of the contention-free or contention-based access occasion). The motivation and disadvantage to include the random ID in contention-free access are still to be further discussed. For instance, one disadvantage is that the reader may not know whether the intended device is responding on the given resources.

It is supported for the A-IoT device to re-access in another opportunity controlled/provided by the reader (i.e., to retry the random access above), in case of D2R data transmission failure and contention resolution failure of contention-based random access.

The A-IoT device is not expected to autonomously re-access. The re-access is always controlled by reader. It is supported for reader to use the optional explicit R2D failure/success feedback indication to determine the re-access of device:

- This indication can be used at least to determine the re-access for addressing the transmisison failure of the first D2R message, which contains the device ID and/or any other upper layer data (i.e. “Msg3”);

- This indication can be also used for the following D2R data (as described in sub-clause 6.3.5), to determine the re-access for addressing the transmisison failure.

The R2D message is used by the reader to provide access occasion(s), which can be used for re-access purpose. It needs to be further discussed if additional information is needed in this R2D message to differentiate the re-access purpose.- A-IoT paging message is one of the options for this R2D message (e.g., see the “subsequent A-IoT paging message” in Figure 6.3.4-1).

- Another option can be some R2D messages between A-IoT paging (e.g., see the other “R2D message” in Figure 6.3.4-1).

### 6.3.5 A-IoT data transmission

According to the protocol stack and functionalities in sub-clause 6.3.2, more detailed data transmission functionalities are studied in this sub-clause.

The handling of data transmission failure has been studied. It is understood that the subsequent R2D data transmission after the D2R data transmission does not need to be always sent. In case of D2R data transmission failure, the A-IoT device follows the reader subsequent R2D instruction, if any.

- For instance, the reader can repeat the R2D upper layer “command” to trigger the A-IoT device to re-send the same D2R upper layer “response” (i.e., the A-IoT device just follows the received R2D to transmit following D2R).

- For instance, the reader can re-send A-IoT Msg2 to specific device(s) to echo the random ID(s), in case of failure reception of corresponding D2R data transmission (i.e. “Msg3”) after the initial A-IoT Msg2, together with the corresponding D2R resource scheduling. This can trigger the A-IoT device to re-send the same D2R data transmision (i.e. “Msg3”). If it is supported to include the echoed random IDs for multiple devices, the re-sent A-IoT Msg2 only includes the random IDs of the devices, whose “Msg3” is not successfully received.

It is studied on the functionality of segmentation. It is understood that segmentation and reassembly would add complexity. Therefore, the simplified segmentation in the A-IoT MAC layer is studied, considering following studies in physical layer:

- In both R2D and D2R directions, there is no lower bound on the minimum TB size, and a maximum TB size of around 1000 bits can be supported.

- How large TB that can be transported at a given time depends on target coverage/data rate, energy consumption/device availability, etc.

The segmentation study focuses on D2R direction (it can be further considered on R2D direction). For the candidate solution for segmentation:

- The sequence number, the segment number and the number of segments are not supported;

- An indication is used to indicate to the reader on whether the data is segmented and whether the MAC PDU is the last segment. It needs to be further discussed on the size of this indication (one or two bits) and the corresponding further details;

- It is beneficial for the reader to be able to trigger a re-transmission of a segment;

- It is assumed that the A-IoT device will not support AS layer buffering for A-IoT segmentation functionalities, i.e., all segment(s) are stored in upper layer(s).

The use of the following assistance information is studied (the need of each is still to be decided):

- The energy status report from the A-IoT device to the reader, which indicates that the A-IoT device, if the A-IoT device can determine this, does not have sufficient energy to perform the remaining/follow-up procedure.

- The A-IoT device may report a 1-bit energy status indication to the reader in a D2R message. It needs to be further discussed if and how the reader control this indication of such report.

- The reader may take this indication into account for the remaining/follow-up procedure (up to the reader implementation), e.g., the reader may choose not to transmit the subsequent messages for some time, or the reader may choose to not do anything in particular, etc.

- It is beneficial for the reader to know an estimate of expected D2R message size. This D2R message size information would be beneficial but it is not essential. Two options are studied:

- Option 1: The estimate of expected following D2R message size from the CN to the reader;

- Advantages/disadvantages of option 1: If this information is available from CN, it saves the overhead/latency caused by Option 2 in AS layer. It can be also used by the reader as early as for the first D2R message, if needed.

- Option 2: The simple message size indication from the device to the reader.

- Advantages/disadvantages of option 2: It is useful in case the CN is not able to provide or does not provide the expected D2R message size. Limited granularity is supported considering the AS layer overhead. It requires D2R message to carry this information in advance, before the reader can actually use this size information for scheduling.

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 sub-clause 6.3.4, if technically possible):

- Option 1: a random ID (if used in first D2R message) can be reused;

- Option 2: the reader assigns this “AS ID” to the device. It needs to be further discussed via which R2D message.- Option 3: It is up to the reader whether to reuse the random ID (if used in first D2R message) as the “AS ID” or to assign a new “AS ID”. It needs to be further discussed via which R2D message.

NOTE 1: The further down-selection for “AS ID” needs to consider the involved message and whether the reader needs to handle the collision.

### 6.3.6 Topology 2 aspects on the interface between UE reader and RAN

For Topology 2, the architecture/protocol stack options in [R2-1] are studied (also corresponding to the studies in sub-clause 6.4.2.1), while no new AS layer architecture/protocol stack options will be studied:

- RRC based solution: A-IoT upper layer information is explicitly forwarded via UE reader’s NR Uu RRC message.

- NAS based solution: A-IoT upper layer information is transmitted over UE reader's NAS message.

- UP based solution: A-IoT upper layer information is transmitted as UE reader's user plane data.

It is assumed that the intermediate UE authorization is performed by upper layers, according to [R2-1] and [R2-2]. It is not studied, from RAN2 signalling perspective, the scenario to support bistatic mode of operation (e.g., D2T2-A1).

The radio resources used by A-IoT radio interface between the A-IoT device(s) and UE reader are controlled by the network. The radio resources, which are dedicated for a UE reader, are only configured to the UE reader via dedicated signalling. The mechanisms for shared resource pool amongst UE readers are not considered in this release. The UE reader in coverage of BS scenario is supported. The UE reader may perform the A-IoT procedure on A-IoT radio interface between the reader and the device(s), only if the radio resource configuration is valid in the cell, which is under network control. The radio resource validity across multiple cells is not supported in this release. Hence, for all options below, the resources remain valid only in the same cell in which the resources were configured.

For the case when the radio resources are allocated semi-statically by the network, the radio resource validities are studied in the following scenarios with candidate options (down-selection can be decided in the WI phase):

- Scenario 1: In RRC\_CONNECTED, the UE reader can perform A-IoT operations using the allocated A-IoT radio resource for A-IoT radio interface:

- Option 1: UE reader receives the resources configuration in NR Uu dedicated RRC signalling. The radio resources remain valid until the network releases them explicitly. This would be supported by the NR Uu RRC reconfiguration; and/or

- Option 2: UE reader receives the resources configuration in NR Uu dedicated RRC signalling, which configures a time period in which the corresponding resource can be used. The UE reader considers that the resources remain valid for that time period, unless the resource configuration is explicitly released by the network by the NR Uu RRC reconfiguration.

- Scenario 2: In RRC\_CONNECTED, the UE reader can perform A-IoT operations using the allocated A-IoT radio resource for A-IoT radio interface, upon its temporary out of connection scenarios (e.g., RLF and handover cases):

- Option 1: The UE reader considers the resources as temporarily invalid during the temporary out of connection condition. The resource may become valid again after the UE recovers from the condition.

- Option 2: The UE reader considers that the resources remain valid for a time period. It needs to be further discussed on whether this time period belongs to the one in Option 2 for Scenario 1 or is a different time period. It needs to be further discussed on whether the duration of this time period is related to the ongoing A-IoT operations.

NOTE 1: The A-IoT radio resource can be (re)configured by UE reader’s RRC reconfiguration (including during handover procedure, after re-establishment of the UE reader, etc.)

- Scenario 3: In RRC\_ INACTIVE, the UE reader can perform A-IoT operations using the allocated A-IoT radio resource for A-IoT radio interface:

- Option 1: UE receives the resources configuration in NR Uu dedicated RRC signaling, before moving to RRC\_INACTIVE. The radio resources remain valid until the network releases them explicitly. This would be supported by the NR Uu RRC reconfiguration (the UE may need to resume or be paged by the network back to RRC\_CONNECTED before that).

- Option 2: UE reader receives the resources configuration in NR Uu dedicated RRC signalling, before moving to RRC\_INACTIVE, which configures a time period in which the corresponding resource can be used. The UE reader can consider that the resources remain valid for that time period.

- Scenario 4: In RRC\_ IDLE, the UE reader can perform A-IoT operations using the allocated A-IoT radio resource for A-IoT radio interface.

- If this scenario 4 is supported, the options of scenario 3 can be the candidates.

- The support of scenario 4 (UE reader performing A-IoT operations in RRC\_IDLE) is down-prioritized. It can be considered in WI phase, if feasible with minimum specification impact.

For the radio resources allocation request, following alternatives are studied:

- Alternative 1: BS configures/allocates a set A-IoT radio resource to the UE reader, in response to a request from the UE reader; and/or

- Alternative 2: BS configures/allocates a set A-IoT radio resource to the UE reader, based on the service request from CN.

NOTE 3: The above two alternatives can co-exist. The configuration for radio resource allocation may also include the validity criteria (if applicable, see the time period in previous option 2 of those scenarios)

For the UE reader selection, it is up to RAN3 and SA2 on whether BS or CN selects the UE reader(s) and what information is shared between BS and CN. From RAN2 perspective, it is assumed, at least for RRC based solution, there may be radio related reasons for the BS to be involved in the UE reader selection.

Next Change

## 6.10 DO-A assessment

*Editor’s note: This clause will capture the statements from any WG.*

The study included an assessment of whether the harmonized air interface design can address the DO-A use case, only to identify which part(s) of the harmonized air interface design is/are not sufficient for the DO-A use case.

From the RAN1 perspective, at least the following aspect of the air interface for DO-DTT and DT traffic types is not sufficient for the DO-A traffic type: For DO-DTT and DT traffic types, the D2R resource(s) for D2R transmission is/are indicated in a R2D transmission, but this is not applicable at least for the first D2R transmission for DO-A traffic.

The study focusses on the traffic types of DO-DTT and DT. From RAN2 perspective, the DO-A traffic type/use case cannot be supported with the current design in the study item. It is assessed that, from RAN2 perspective, at least the A-IoT paging is an aspect/part of the current design which is not sufficient for the DO-A use case.

Next Change

# 8 Conclusions and recommendations

From RAN2 perspective, RAN2 has studied Topology 1 and Topology 2, and has concluded they are feasible. In details:

- General AS procedures, A-IoT paging, A-IoT random access, A-IoT data transmission and Topology 2 aspects have been studied:

- See sub-clause 6.3.1 for the overall AS procedure and the information useful to be visible to the reader from CN, etc.

- See sub-clause 6.3.3 for the A-IoT paging function, including paging message content, paging monitoring behavior, multiple (subsequent) A-IoT paging messages for the same service, etc.

- See sub-clause 6.3.4) for the A-IoT random access, including the contention-free access and contention-based random access procedure, the message contents, the re-access solutions, etc.

- See sub-clause 6.3.2 and 6.3.5 for protocol stack for A-IoT radio interface between A-IoT device and reader, required functionalities, and A-IoT data transmission functionalities, etc.

- See sub-clause 6.3.6 for the Topology 2 specific aspects, including the architecture options and management of radio resources in A-IoT radio interface, etc.

- From RAN2 perspective, the descriptions under clause 6.3 and 6.10 are considered as the baseline conclusions.

- Following is further concluded:

- At least following features are recommended for the normative phase in the A-IoT MAC layer:

- A-IoT paging

- A-IoT random access:

- For contention-based random access, further down-selection between *Solution 1* (3step-only) and *Solution 3* (unified solution) in sub-clause 6.3.4.

- A-IoT data transmission

- For Topology 2, at least the following aspects are considered:

- Forwarding of A-IoT upper layer data and A-IoT radio resource management.

- No further down-selection for Topology 2 architecture options (which are feasible) from RAN2 perspective (the final decision depends on TSGs/WGs outcome).

End of Change