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Title: (TP to TR 38.769) A-IoT RAN Architecture aspects

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# Introduction

This contribution provides the TP to capture the agreement achived this meeting on RAN architecture.

# 2 Text Proposal

***--------------------Start of the Change--------------------***

## 6.4 RAN architecture aspects

This clause attempts to identify and describe architectural elements necessary to define a RAN architecture for support of Ambient IoT embedded in the overall 5G system architecture in support of topology 1 and topology 2 (as defined in TR 38.848 [2]).

This chapter also attempts to identify a functional split between RAN and CN.

The logical system architecture for A-IoT consists of the following architectural elements:

**A-IoT device**: Equipment with characteristics outlined e.g., in TS 22.369 [10] and TR 38.848 [2].

**A-IoT RAN**: Hosts certain functions for A-IoT as part of the functional split between RAN and CN.

Editor’s Note 4: Further details regarding A-IoT functions hosted in the A-IoT RAN and the respective functional split to be decided by RAN2, RAN3 and SA2.

**A-IoT radio**: Radio interface between A-IoT device and A-IoT RAN node in topology 1 and between A-IoT device and A-IoT-enabled UE in topology 2.

Editor’s Note 5: Further details on A-IoT radio to be discussed by RAN1 and RAN2.

**A-IoT CN**: Hosts certain functions for A-IoT as of the functional split between RAN and CN.

NOTE: the details of A-IoT CN are subject to SA2.

Editor’s Note 6: Further details regarding A-IoT functions hosted in the A-IoT CN and the respective functional split to be decided by RAN2, RAN3 and SA2.

**XX interface**: Interface between the A-IoT RAN/A-IoT-enabled gNB and the A-IoT CN on which certain A-IoT specific functions are performed.

XX interface is NG interface, NGAP is used between A-IoT RAN and AIoT CN.

NOTE: How the functions represented by the XX interfaces are defined in various solutions and A-IoT CN topologies (direct/indirect connection between AIoT RAN and AIOTF) needs further discussion.

**Common reader function**: A function that communicates with the A-IoT device by means of A-IoT radio.

Editor’s Note 8: Further details on Common reader function is to be discussed by RAN1 and RAN2.

**A-IoT RAN node function**: A function that contains e.g., the control of the A-IoT radio resources used towards the A-IoT device.

NOTE: Aspects concerning coordination of the Upper Layer functions (e.g., Inventory, Command) e.g., in case these functions may to be performed over a multitude of instances of the Common Reader Function, need further discussion.

### 6.4.1 Support of Topology 1

Figure 6.4.1-1 depicts a logical system architecture for topology 1, where the Common reader function and A-IoT RAN node function are deployed within an A-IoT RAN.



Figure 6.4.1-1 Logical system architecture for topology 1

For Toplogy 1, architecture and protocol aspects of split RAN architecture are not studied.

In Topology 1, the XX interface is the NG-C interface.

Figure 6.4.1-2 shows the Protocol stack for Topology 1:



Figure 6.4.1-2. Protocol Stack for Topology 1

NOTE 1: The protocol stack in Figure 6.4.1-2 does not illustrate how A-IoT upper layer information, if any, is transported over XXAP..

For topology 1, the XXAP is terminated at an A-IoT RAN node.

The signalling transport for XXAP at the A-IoT RAN node is SCTP/IP. Other options of signalling transport for XXAP at the A-IoT RAN node (e.g., HTTP/2/TLS/TCP) were discussed, but will not be pursued.

NOTE: Whether “XXAP” is realised by including AIoTF information in NGAP or by carrying a new protocol layer over NGAP, needs further discussion and decision.

NOTE: The A-IoT CN may include AMF and A-IoT related functions which is up to SA2 decision.

In Topology 1, an A-IoT RAN node may serve one or more readers.

The A-IoT RAN node should enable the coordination of the usage of the A-IoT radio resources among readers.

Reader selection may need coordination between A-IoT RAN node and A-IoT CN.

NOTE: How to perform reader selection needs further discussions.

NOTE: In Topology 1, whether the AIoTF needs to be aware of the readers served by the A-IoT RAN node and their location and how this information is provided to the AIoTF needs further discussion.

### 6.4.2 Support of Topology 2

Figure 6.4.2-1 depicts a logical system architecture for topology 2, where the Common reader function is located at an A-IoT-enabled UE, and the A-IoT RAN node function is located at an A-IoT-enabled gNB.

The following definitions apply:

**A-IoT-enabled gNB**: A gNB supporting A-IoT RAN node function in topology 2, which is able to communicate with the A-IoT-enabled UE via NR Uu interface.

**A-IoT-enabled UE**: A UE supporting Common reader function, which is able to communicate with the A-IoTdevice via the A-IoT radio interface.

Figure 6.4.2-1 Logical system architecture for topology 2

NOTE 1: Figure 6.4.2-1 doesn’t illustrate the protocol between A-IoT enabled UE and A-IoT CN, if needed.

NOTE 2: The A-IoT CN could include AMF and A-IoT related functions, which is up to SA2 decision.

NOTE 3: Details of the radio resource management performed by the A-IoT enabled gNB are subject to RAN1 and RAN2 mechanisms.

For Toplogy 2, architecture and protocol aspects of split RAN architecture are not studied.

In Topology 2, XX interface is NG interface.

In Topology 2, the RAN architecture should enable the coordination of the usage of the A-IoT radio resources among readers.

An A-IoT-enabled gNB could support both topology 1 and topology 2, this is an implementation matter.

#### 6.4.2.1 Solutions for Topology 2

##### 6.4.2.1.0 General

To support Topology 2, the following solutions are to be studied for conveying A-IoT upper layer information:

**- RRC based solution.** With this solution, A-IoT CN applies A-IoT upper layer information explicitly over XXAP signaling. A-IoT upper layer information is then relayed explicitly to/from the A-IoT-enabled UE via NR Uu RRC.

- **NAS based solution**. With this solution, there is no explicit termination of A-IoT upper layer information at A-IoT-enabled gNB. A-IoT upper layer information is transmitted over A-IoT enabled UE's NAS.

- **UP based solution**. With this solution, there is no explicit termination of A-IoT upper layer information at A-IoT-enabled gNB. A-IoT upper layer information is transmitted as A-IoT-enabled UE's user plane data.

NOTE: The protocol stack for each solution option does not illustrate A-IoT CN internal architecture and how A-IoT upper layer information is transported, if any.

No evaluation and no down selection for T2 solutions has been performed.

Only if the UE is authorized to perform the A-IoT service, the UE can communicate with the A-IoT device and be configured with AIoT radio resources controlled by the A-IoT enabled gNB.

NOTE: The NGAP protocol functions for the A-IoT-enabled UE authorization needs further discussions.

In RRC based solution, Reader selection may need coordination between A-IoT-enabled gNB and A-IoT CN.

NOTE: How to perform reader selection needs further discussions.

NOTE: In NAS/UP based solution, whether A-IoT CN selects the A-IoT-enabled UE for the selection needs further discussion.

##### 6.4.2.1.1 Solution1: RRC based solution

Upon receiving XXAP: A-IoT related message from A-IoT CN, the A-IoT-enabled gNB transmits the related information towards the A-IoT-enabled UE via NR Uu RRC, and vice versa.



Figure 6.4.2.1.1-1: RRC based solution of Topology 2

In this solution, XX interface is NG-C interface.

NOTE: Whether “XXAP” is realised by including AIoTF information in NGAP or by carrying a new protocol layer over NGAP, needs further discussion and decision.

## 6.5 Impacts on CN-RAN interface

Editor’s Note: Corresponds to the first RAN3 objective in the SID, to identify necessary impacts on signaling and procedures for CN-RAN interface.

### 6.5.1 Information exchanged between A-IoT CN and A-IoT RAN

#### 6.5.1.1 Inventory

Inventory can be sent by the A-IoT CN for a single device, or a group of devices, or all devices.

The Inventory Request from the A-IoT CN to the A-IoT RAN, may include the following:

(1) A-IoT Device Identification (to find a single device, a group of devices, or all devices)

Note 1: The definition of this identification is out of RAN3 scope.

Editor’s Note 1: It is FFS whether A-IoT RAN needs to interpret/store/process it.

(2) Scope of inventory request (e.g., a certain area in which the inventory is to be triggered)

Multiple individual A-IoT Device IDs (one ID per device) can be provided to the A-IoT CN via a single Inventory Report.

Editor’s Note 2: It is up to SA2 whether device ID is sent transparent or not.

#### 6.5.1.2 Command

Command can be sent by the A-IoT CN for a single device.

Editor’s Note 1: it is FFS for command on a group of devices, or all devices.

Editor’s Note 2: it is FFS whether A-IoT RAN can remain agnostic of the type of request from the A-IoT CN (need to differentiate command and inventory).

#### 6.5.1.3 A-IoT radio resource allocation in case of NAS/UP based solutions

In NAS/UP based solutions, A-IoT radio resources can be requested in advance to the NAS/UP based communication with the A-IoT device or can be requested along with the NAS/UP based communication. There are different ways to trigger A-IoT radio resource allocation, e.g., upon CN request or upon UE request, etc. Some aspects of A-IoT radio allocation may be preconfigured by OAM.

### 6.5.2 Signaling and Procedures for Topology 1

NOTE 1: XX communication depicted in the following chapters uses protocol elements (messages and information elements) detailed in section 6.5.1 and are not repeated unless additional description is necessary.

#### 6.5.2.1 Candidate procedures for A-IoT Inventory for Topology 1



Figure 6.5.2.1-1: Message flow for A-IoT Inventory in Topology 1

1a. The A-IoT CN sends an Inventory request message to the A-IoT RAN node, taking into account, among others, the A-IoT transaction scope.

1b. The A-IoT RAN node allocates and coordinates the usage of A-IoT radio resources.

2. The A-IoT RAN node sends an Inventory response message to the A-IoT CN.

NOTE 1: In step 2, the A-IoT RAN node may instead send an Inventory failure message to the A-IoT CN indicating that the inventory procedure could not be initiated towards the A-IoT device(s).

3. The A-IoT RAN node performs the inventory procedure towards the A-IoT device(s) over the A-IoT radio interface.

4a/4b. After receiving the inventory result from the A-IoT device(s), the A-IoT RAN node may send one or multiple Inventory reports towards the A-IoT CN including the received inventory result.

NOTE 2: Steps 4a/4b may happen in parallel with Step 3 for different A-IoT devices.

### 6.5.3 Signaling and Procedures for Topology 2

#### 6.5.3.1 Candidate procedures for A-IoT Inventory for Topology 2

##### 6.5.3.1.1 RRC solution



Figure 6.5.3.1-1: Message flow for A-IoT Inventory in Topology 2 - RRC-based solution

1a. The A-IoT CN sends an Inventory request message to the A-IoT enabled gNB

1b. The A-IoT enabled gNB allocates and coordinates usage of A-IoT radio resources.

1c/2a RRC communication with the A-IoT enabled UE takes place.

Editor’s Note 1: RRC based communication is only depicted schematically, details in RAN2 FFS.

2. The A-IoT-enabled gNB sends an Inventory response message to the A-IoT CN.

NOTE 1: In step 2, the A-IoT-enabled gNB may instead send an Inventory failure message to the A-IoT CN indicating that the inventory procedure could not be initiated towards the A-IoT device(s).

3. The A-IoT-enabled gNB requests the A-IoT-enabled UE(s) to trigger inventory procedure towards the A-IoT device(s).

4a/4b. After receiving inventory result reported from the A-IoT enabled UEs, the A-IoT-enabled gNB may send one or multiple Inventory reports towards the A-IoT CN including the received inventory result.

NOTE 2: Steps 4a/4b may happen in parallel with Step 3 for different A-IoT devices.

Editor’s Note 2: Step 4a/4b between A-IoT-enable UE and A-IoT-enabled gNB can be refined by RAN2.

##### 6.5.3.1.2 NAS/UP solution

Editor’s Note 1: Future discussions on A-IoT Inventory will take place based on the following message flow, working on the content of the messages including ownership, associated functions, scope, etc.



Figure 6.5.3.1-2: Message flow for A-IoT Inventory in Topology 2 (if NAS/UP based solution is used)

Editor’s Note 2: how and where to depict signalling suitable for triggering A-IoT RAN node functions for A-IoT radio resource management needs further discussions for direct communication between A-IoT CN and A-IoT-enabled UE.

***--------------------End of the Change--------------------***