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**Source: Qualcomm Incorporated, MediaTek Inc.**

**Title: Way forward for Ambient IoT architecture**

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*Abstract of the contribution: This paper proposes a way forward for the Ambient IoT architecture.*

# 1. Discussion

## 1.1 Overview

SA2#164 concluded that "A new core network function is introduced to support Ambient IoT." (TR 23-700-13, clause 8.1.1 [1]). Hereafter we will refer to this new core network function as AIoT NF.

One aspect that remained open is how a Reader for Topology 1 and a UE-based reader for Topology 2 connect to AIoT NF.

The remainder of this paper will discuss architecture options for Topology 1 and Topology 2 and will propose a way forward.

## 1.2 Topology 1 architecture

For Topology 1 two key directions have been proposed:

- **Option 1:** Readers connects to AIoT NF via the AMF;

- **Option 2:** Readers connects to AIoT NF directly.

The key difference between both options is the following: In case of Option 1, there is no role for the AMF other than acting as as a forwarding node for messages between the Reader and the AIoT NF. This adds unnecessary AMF signalling load while not offering any obvious benefits. With Option 2, this drawback can be avoided.

**Observation 1: For Topology 1, if the Reader was to connect to AIoT NF via the AMF, then AMF would only be acting as a forwarding node for messages between the Reader and the AIoT NF. This adds unnecessary AMF signalling load while not offering any obvious benefits. This drawback can be avoided by having the Reader connect to AIoT NF directly.**

Given Observation 1, this paper proposes to follow Option 2, i.e., the Reader to connect to the AIoT NF directly.

**Proposal 1: For Topology 1, Readers connects to AIoT NF directly.**

From conceptual perspective at least the following procedures need to be supported between Reader and AIoT NF: Reader (de-)registration, Inventory request/response and Command Request/Response. This paper assumes that an AIoT Application Protocol (AIoT-AP) will be defined by RAN3 on top of SCTP to achieve this. This protocol will support procedures and information to be exchanged as specified by RAN2, RAN3 and SA2.

**Proposal 2: Define an AIoT Application Protocol (AIoT-AP) on top of SCTP between Reader and AIoT NF. This protocol will support procedures and information to be exchanged as specified by RAN2, RAN3 and SA2.**

The resulting architecture and protocol stack are depicted in Figure 1.2-1 and Figure 1.2-2, respectively.



Figure 1.2-1: Architecture for Topology 1

Figure 1.2-2: Protocol Stack for Topology 1

## 1.3 Topology 2 architecture

For Topology 2, two key directions have been proposed:

- **Option 1:** UE-based reader to connect to AIoT NF using N1 NAS between UE and AMF as transport.

- **Option 2:** UE-based reader to connect to AIoT NF over the user-plane, based on e.g., the same SCTP-based AIoT Application Protocol (AIoT-AP) as proposed for Topology 1 but using an IP PDU Session between the UE and the UPF as transport.

It is worth highlighting that for both options the AIoT NF is part of the core network, i.e., the operator can manage the subscriptions of AIoT devices and can verify the operator-assigned AIoT Device ID. The only conceptual difference is the transport mechanism used (i.e., N1 NAS versus user-plane).

**Observation 3: Regardless of the transport (N1 NAS or user-plane), the AIoT NF is part of the core network, i.e., in both options the operator can manage the AIoT device subscriptions and can verify the operator-assigned AIoT Device ID.**

Since Option 1 uses N1 NAS as transport for messages between UE reader and AIoT NF, the same drawback as discussed for Topology 1 applies: the AMF is only used as a forwarding node, which leads to unnecessary AMF signalling load.

However, the more severe drawback of Option 1 is that all messages between Reader and AIoT NF are delivered using a Signaling Radio Bearers (SRBs). To understand the significance of this drawback, it is important to consider that specifically for the inventory procedure a large amount of data may need to be sent from a UE reader to AIoT NF. One relevant example are scenarios where a UE reader performs an inventory procedure and a large amount of AIoT Devices respond to the inventory request, e.g., in case a delivery consisting of hundreds or thousands of small goods needs to be inventoried.

**Observation 4: N1 NAS as transport for Reader to AIoT NF signaling is a significant drawback because SRBs are used for NAS messages, which are not designed to carry large amounts of data. Specifically for the inventory procedure the UE reader may need to send inventory responses from many AIoT devices to the AIoT NF. Option 2 avoids this drawback by leveraging the user-plane to connect the UE reader to the AIoT NF.**

Another benefit of Option 2 is that only one common protocol between Reader and AIoT NF needs to be specified and supported by AIoT NF to enable Topology 1 and Topology 2.

Option 1 instead requires 3GPP to specify two variants and AIoT NF to support these two protocol variants for Topology 1 and 2, respectively: a Reader-AIoT NF protocol over IP for Topology 1 and another Reader-AIoT NF protocol variant over N1 NAS.

**Observation 5: In contrast to Option 1 which relies on two protocol variants that 3GPP needs to define and maintain and that AIoT NF needs to support for Topology 1 and 2, Option 2 uses a common protocol for both topologies.**

It is worth noting that Option 2 is conceptually very similar to solutions in existing specifications where the user-plane is leveraged by the UE to connect to operator services, for example LCS over the user-plane (LCS-UP) as defined in Rel-18.

**Observation 6: Other precedents exist where the UE connects to operator services that are part of 5GC using the user-plane, e.g. LCS over the user-plane (LCS-UP) as defined in Rel-18.**

Given observations 3-6, this paper proposes that the UE-based reader connects to AIoT NF over the user-plane, using the same AIoT Application Protocol (AIoT-AP) on top of SCTP as proposed for Topology 1.

**Proposal 3: UE-based reader to connect to AIoT NF over the user-plane, using the same AIoT Application Protocol (AIoT-AP) on top of SCTP as proposed for Topology 1.**

The resulting architecture and protocol stack are depicted in Figure 1.3-1 and Figure 1.3-2, respectively.



Figure 1.3-1: Architecture for Topology 2



Figure 1.3-2: Protocol Stack for Topology 2

# 2. References

[1] 3GPP TR 23.700-13v1.0.0: "Study on Architecture support of Ambient power-enabled Internet of Things".

# 3. Text proposal

It is proposed to agree the following changes to TR 23.700-13.

>>>>BEGINNING OF CHANGES<<<<

## 8.1 Conclusion on Key Issue #1

### 8.1.3 Additional architecture principles for Topology 2

#### 8.1.3.1 General

Two options will be specified for Topology 2:

- User-plane option as defined in clause 8.1.3.2

- RRC-based option as defined in clause 8.1.3.3

#### 8.1.3.2 User-plane option

The following principles apply:

- As depicted in Figure 8.1.3.2-X, the Reader function in the UE connects to the AIoT NF based on the AIoT Application Protocol (AIoT-AP) using an IP PDU Session between the UE and the UPF as transport. The related protocol stack is shown in Figure 8.1.3.2-Y. The AIoT AP protocol will support procedures and information to be exchanged as specified by RAN2, RAN3 and SA2.

NOTE 1: Also in case of Topology 2 the AIoT NF is part of the core network, i.e., the operator can manage the subscriptions of AIoT devices and can verify the operator-assigned AIoT Device ID.



Figure 8.1.3.2-X: User-plane architecture for Topology 2



Figure 8.1.3.2-Y: Protocol Stack for Topology 2

NOTE 2: Which transport protocol to use for AIoT-AP can be decided by CT1 in coordination with RAN3.

NOTE 3: Security for AIoT-AP is assumed to be defined by SA3.

- To connect to the AIoT NF, the UE establishes a PDU Session to a specific DNN/S-NSSAI.

- The DNN/S-NSSAI may be locally configured in the UE, e.g. using existing AT commands.

Editor's note: Other options to determine DNN/S-NSSAI, e.g. based on URSP are FFS.

- Once the PDU Session has been established, the Reader function in the UE registers with the AIoT NF using the AIoT AP protocol.

- The Reader function in the UE selects the AIoT NF based on an FQDN locally configured in the UE.

Editor's note: Additional options for the Reader function in the UE to determine the FQDN are FFS.

- If the AIoT NF detects that the Reader function in the UE does not respond to an Inventory Request or Command Request, then the AIoT NF considers the UE Reader unreachable und locally deletes the registration for the UE Reader.

- If the UE IP address changes, then the Reader function in the UE will re-register with AIoT NF.

#### 8.1.3.3 RRC option

The following principles apply:

- The protocol stack for the RRC option is depicted below.

Editor's note: Further details are FFS.

 Figure 8.1.3.3-Y: Protocol Stack for the RRC option

>>>>END OF CHANGES<<<<