**3GPP SA WG2 Meeting #162 S2-2405150**

**Apr 15th - Apr 19st, 2024; Changsha, China (was S2-2404463)**

**Source: China Mobile**

**Title: KI #3, New sol: Solution for support of Ambient IoT services**

**Document for: Approval**

**Agenda Item: 19.X**

**Work Item / Release: FS\_AmbientIoT /Rel-19**

*Abstract: Proposed solution to support KI#3 support of* Ambient IoT Services*.*

# 1. Introduction/Discussion

5.3 Key Issue #3: Support of Ambient IoT Services

5.3.1 Description

This Key Issue pertains to the AIoT services. Considering that AIoT Devices are a new type of reduced capabilities devices, the services/use cases to be supported include:

- Inventory.

- Command.

Editor's note:the name to call "Inventory" and "Command" is FFS, e.g. Ambient IoT service, use case, etc.

The key issue will study the following aspects:

- Study how to support information transfer for Ambient IoT services and related system functionality, including the information transfer for an Ambient IoT device and for a group of Ambient IoT Devices.

NOTE: Including whether there is a need to support session based transfer between Ambient IoT Device and the network considering the device types and capabilities.

- Study which of the enabled Ambient IoT services are exposed to AF and how, e.g. for the case AF requests Ambient IoT service for an Ambient IoT Device and for a group of Ambient IoT Devices.

# Text Proposal

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

\* \* \* \* First change (all new) \* \* \* \*

# 6 Solutions

## 6.0 Mapping of Solutions to Key Issues

Table 6.0-1: Mapping of Solutions to Key Issues

|  |  |
| --- | --- |
|  | Key Issues |
| Solutions | KI#1 | KI#2 | KI#3 |
| X |  |  | √ |
|  |  |  |  |

## 6.X Solution #X: Solution for support of Ambient IoT services

### 6.X.1 Description

This solution resolves Key Issue #3 about the Support of Ambient IoT Services. As we know, the following two connectivity topologies as defined in TR 38.848 [7] are to be studied:

- Topology 1: BS <--> Ambient IoT Device;

- Topology 2: BS <--> intermediate node <--> Ambient IoT Device: Only a UE can act as an intermediate node that is under the network control.

The third Ambient IoT AF triggers the Ambient IoT service toward ambient IoT devices via 5GS. In some Ambient IoT services, such as inventory, read, and others, one Ambient IoT service request from AF will cause numerous responses from ambient IoT devices, which may cause a severe signal storm in the 5GS. In order to mitigate the signal storm impact, we suggest that gNB supports response signal packet aggregation at the IP transportation level if gNB can’t look into the response packet content. If gNB can decode the response packets, gNB supports aggregation at the content level. At the same time, the AMF or new Ambient IoT NF supports content-level aggregation too to significantly reduce signal storm impact.

Besides, this solution aims to solve the issue of how the serving gNB or UE allows access from the different operators’ ambient IoT devices. The third ambient IoT AF has the information on the serving operator and the operators list of who provides ambient IoT devices in each location. The third ambient IoT AF includes EPC, an operator ID list, and location info in the service request toward the serving operator NEF. Based on SLA agreement between the third ambient IoT AF and serving operator, the NEF will check the operator ID list to allow it or not. If allowed, then serving operator NEF will forward the both EPC and operator ID list to gNB or UE. gNB or UE will utilize both EPC info and the operator ID list to identify the targeted ambient IoT devices in the service operations. Once the ambient IoT devices are matched by both EPC info and the Operator ID list (the device ID contains Operator ID info), they will respond to the request. Please note that if only EPC is matched, but operator ID is not matched, the ambient IoT device should not respond to the request. In this way, serving operator can control and allow the access from the different operators’ ambient IoT devices.

The principles related to Ambient IoT services are depicted below:

- The Ambient IoT device has a unique ambient device ID which consists of MNO operator ID, Company info, and instance ID. Device ID will not be exposed to the third Ambient IoT AF.

- Ambient device ID is stored in the “user” section in ambient IoT device.

- The third Ambient IoT AF will use EPC , location info and operator ID list to perform flexible Ambient IoT service. EPC is used to define a specific ambient IoT device or a group of ambient IoT devices. Operator ID list is used to allow access from the different operators’ ambient IoT devices.

- To mitigate signal storms in the 5GS, the UE, gNB, and AMF/New Ambient IoT NF can perform aggregation based on transaction ID.

- Both Leveraging existing AMF and Introducing new Ambient IoT NF apply to this solution.

### 6.X.2 Procedures

#### 6.X.2.1 Ambient IoT service --- Network initiated Ambient IoT service procedure

AMF or New

Ambient IoT NF

10.gNB may aggregate the Ambient IoT Devices’ response info at the rough packet level or precise content level

5. Ambient IoT Service Request (Transaction ID, Service Type, TAC lists, Operator ID list, TID List, EPC info, Aggregation indication, time, periodical indication…)

7. Ambient IoT service request (Transaction ID, Service Type, Operator ID list, EPC info, TID List, Aggregation indication, time, periodical indication…)

9. gNB performs service operations with Ambient IoT Devices based on the Operator ID list and EPC or TID list info; Matched ambient IoT devices will respond with the device ID, TID, EPC info, and so on

devices based on User ID lists

8. gNB decides targeted Ambient IoT devices based on both the Operator ID list and EPC info or TID info

6. Obtain targeted gNB based on TA lists;

Ambient AF

fd

UDM

NEF

gNB

UE

Ambient IoT

Devices

2. Ambient IoT Service Request (Transaction ID, Service Type, EPC info, location list, Operator ID list, TID List, Aggregation indication, time, periodical indication…)

1. Ambient IoT Device Activation and Registration Procedure

4. NEF communicates with UDM to obtain serving AMF or Serving new Ambient IoT NF lists based on TA lists ….

13. Ambient IoT service response (Transaction ID, aggregated Ambient IoT devices’ response Content…)

11. Ambient IoT service response (Transaction ID, response info)

14 Ambient IoT service response (Transaction ID， aggregated Ambient IoT devices response content…)

3. AF authentication and authorization/ Operator ID list check

12. Device ID checks and duplicated response records remove and aggregate the Ambient IoT Devices response info based on aggregation indication

 Figure 6.X.2.1-1: Network Initiated Ambient IoT service procedure.

1. Ambient IoT devices perform activation and registration procedures. Ambient IoT devices will have the EPC info and device ID (device ID info will be stored in the “User” section in Ambient IoT device), and UDM will have the Ambient IoT device profile info indexed by device ID after successful Ambient IoT devices activation and registration procedures. Besides, the device ID contains operator ID info, Company info, and instance ID. Ambient IoT device ID will not be exposed to the third AF, and it is used in Ambient IoT devices and 5GS as internal ambient IoT device identification for access, routing, and so on.
2. The third Ambient AF has the store location information and relevant AIoT serving operator info. The third Ambient AF launches an Ambient IoT service request towards NEF belonging to the AIoT serving operator. In the Ambient IoT service request, the third Ambient AF will provide Transaction ID, Service Type, EPC info, Location info, Operator ID list, Aggregation indication, time, periodical indication, and other parameters to NEF:

 Service Type: This information is used to define Ambient IoT service types, such as Inventory, Read, Write, and so on.

 EPC info: This information is used to define the targeted ambient IoT devices in the service from the products' perspective. it could be one specific ambient IoT device or a group of ambient IoT devices

 Operator ID list: This information is used to define the targeted ambient IoT devices in the service from the operator's perspective, supporting multiple operator ambient IoT device access. It could be one specific operator or a list of operators.

 TID list: The information can be used to define the targeted ambient IoT devices, such as in the write or read service command.

 Location info: This information is used to define locations where service happens.

 Aggregation indication: It is used to tell the 5GS how to handle the response messages -- aggregation response or not

 Time: when the service will be carried out exactly

 Periodical indication: the service operation will be executed periodically.

1. NEF will perform the below actions towards the third Ambient AF:

Perform authentication to the third Ambient AF to decide whether it is allowed to access 5GS or not.

Check the authorization to decide whether the third Ambient AF is allowed to perform certain Ambient IoT service operations or not.

Check the authorization to see whether multiple Operators' ambient IoT device access is allowed or not.

 Converting location information to TA List information.

 ……

1. NEF will obtain serving AMF or serving New Ambient IoT NF based on TA lists
2. NEF forwards Ambient IoT service requests to serving AMFs or Serving New Ambient IoT NFs. Both leveraging existing AMF and introducing new ambient IoT NF can be applied to this solution.
3. AMF or New Ambient IoT NF determines the serving gNBs based on TA lists. AMF or New Ambient IoT NF decides to perform aggregation operations in terms of aggregation indication.
4. AMF or New Ambient IoT NF forwards the Ambient IOT service request to the serving gNBs.
5. gNB decides what kind of service operation to perform based on Service Type, and gNB decides to perform aggregation operations in terms of aggregation indication. gNB decides when to execute service operations based on time parameters, whether to perform periodical operations based on periodical indication and so on.
6. gNB performs service operations toward the serving ambient IoT devices. Both EPC info and the Operator ID list will be used in the service operation to identify the targeted ambient IoT devices. Once the ambient IoT devices are matched by both EPC info and the Operator ID list (the device ID contains Operator ID info), they will respond with the full device ID, TID, EPC info, and so on based on service operation type.
7. gNB will perform the response packet aggregation operation at the rough packetlevel based on transaction ID in terms of aggregation indication to mitigate signal amounts between gNB and 5GC if gNB can’t decode the response packets to look into the content. If gNB can decode the response packets to look into the content, gNB should perform the aggregation operation at the content level based on the transaction ID in terms of aggregation indication to further deduce signal amounts significantly between gNB and 5GC. gNB can decide the aggregation waiting time based on local configuration or AF indication.
8. gNB responds with an Ambient IoT service response message with parameters—transaction ID, Aggregated Inventory content, and so on—to AMF or the new Ambient IoT NF.
9. The AMF or new Ambient IoT NF will implement the Ambient IoT device check, remove duplicate Ambient IoT device records, and implement an aggregation operation at the content level based on the aggregation indication.
10. The AMF or new Ambient IoT NF continues to forward the response to NEF.
11. NEF will forward the response to the third Ambient AF.

Editor’s Note 1: This solution focuses on Topology 1. How to expand the solution to support Topology 2 is in FFS.

### 6.x.3 Impacts on services, entities, and interfaces

This solution impacts the following entities.

NEF：

- Capability to support the selection of the serving AMF or serving new Ambient IoT NF based on location information.

- Capability to aggregate the retrieved Ambient IoT devices' EPC contents based on transaction ID.

- Capability to support Ambient IoT service-related procedures.

- Capability to authentication and authorization to the third ambient IoT AF.

- Capability to support verification on operator ID list.

AMF or New Ambient IoT NF:

- Capability to support Ambient IoT service-related procedures.

UDM:

- Capability to manage the subscription information of Ambient IoT devices indexed by ambient device ID.

UE:

- Capability to support ambient IoT service procedures in terms of EPC and operator ID list

- Capability to aggregate the retrieved Ambient IoT devices' response at content level

- Capability to support Ambient IoT service-related procedures with 5GC.

gNB:

- Capability to support ambient IoT service procedures with Ambient IoT devices in terms of EPC and operator ID list.

- Capability to aggregate the Ambient IoT devices' response at IP transportation level or content level

- Capability to support Ambient IoT service-related procedures with 5GC.

\* \* \* \* End of changes \* \* \* \*