[98e-11-Ambient-IoT] - Version 0.0.1

RAN1

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3GPP TSG RAN TSG Meeting #98-e RP-22xxxx

e-Meeting, December 12th – 16th, 2022

Agenda Item: 9.2.3

Source: Moderator (Huawei)

Title: Summary of email discussion [98e-11-Ambient-IoT]

Document for: Discussion and Decision

1 Introduction

This first meeting of the RAN Ambient IoT SI is scoped to discuss the TR 38.848 skeleton, and have initial discussions on (1) use cases, and deployment scenarios; and (2) device characteristics and categorization.

2 Topic 1 - TR skeleton

2.1 Initial round

A draft TR skeleton is available in RP-223073. It was distributed on the RAN reflector around 2 weeks before the meeting. No comments are made on it in any submitted paper.

Feedback Form 1: Question 1: Any objection to endorsing RP-223073 as v0.1.0 of TR 38.848?

3 Topic 2 - Handling of SA1 use cases in RAN

3.1 Initial round

The draft TR skeleton in section 4.2.2 proposes to describe the SA1 use cases that have been included in the RAN SI. Moderator suggests this can be done later in the SI, by taking into account the agreements actually

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made in RAN and SA1.

Topic 2-1: Representative use cases

The SID notes that so-called 'representative use cases' (rUCs) can be developed, for groups of use cases (UCs) that have similar requirements. In the moderator's understanding, the purpose of this process is to reduce the total number of use cases to consider in the RAN SI, to a set which focus on the aspects among the SA1 UCs which come within the expertise of TSG RAN. Those rUCs will put RAN in a position to derive deployment scenarios, guide device categorization, and see the RAN design targets that are required across the SA1 set.

Most companies have taken one of three approaches to grouping the SA1 UCs:

(A) Group first by deployment environment described by SA1 in the UC

- FFS the deployment environments, e.g. indoor/outdoor, service area size

(B) Group first by functionality/application

- FFS the functionalities / applications to group by, e.g. inventory, sensor report, … etc.

(C) Group first by applicable industry

- FFS the industries to group by, e.g. agricultural, personal, etc

One company suggests picking representative use cases based on the envelope of the SA1 potential requirements, such as the most demanding positioning target, or the highest/lowest data rate, etc. Moderator suggests such analysis is considered under the 'RAN design targets' objective.

Hence, in this first round, the moderator would like to understand companies views and preferences among the 3 grouping approaches listed above.

Feedback Form 2: Question 2 – What are companies' views and preferences on these first-level ways to group the SA1 UCs into representative use cases?

4 Topic 3 - Deployment scenarios

The SID states that a deployment scenario has at least the following aspects:

- Indoor/outdoor environment
- Basestation characteristics, e.g. macro/micro/pico cells-based deployments
- Connectivity topologies, including which node(s) e.g. basestation, UE, relay, repeater, etc. can communicate with target devices
- TDD/FDD, and frequency bands in licensed or unlicensed spectrum
- Coexistence with UEs and infrastructure in frequency bands for existing 3GPP technologies
- Device originated and/or device terminated traffic assumption

The SID also tasks RAN to identify which deployment scenarios are applicable to a (r)UC.

4.1 Initial round

A number of companies have presented tabulated descriptions of a deployment scenario, which include similar points. In some cases, they also present a direct linkage to UCs or rUCs.

Hence, in order to describe a deployment scenario consistently with the aspects given in the SID, moderator suggests we can use a tabulated form as follows. In subsequent meetings, we can then populate the aspects and decide how many deployment scenarios to capture.

Moderator's note: the use cases column could be a merged single-cell in the TR. NWM cannot display this correctly.

Table 1: Table for Deployment Scenario X

Applicable representative use cases	**Characteristic**	**Value**
	Environment (of device)	
	Basestation characteristic	
	Connectivity topology	
rUC1, rUC2, …, …	Spectrum	
	Coexistence with existing 3GPP technologies	
	Traffic assumption	

FFS: whether/which rows can be indicated with more than one value, e.g. Environment = Indoor/Outdoor

FFS: Possible values for each characteristic row (see following questions)

Feedback Form 3: Question 3: Do companies think this overall table structure needs any major refinement (note that the possible values of each row are considered in subsequent questions)?

5 Topic 4 - Deployment scenario characteristics

5.1 Initial round

Moderator would like to understand what potential values we need to capture for the deployment scenarios aspects listed in the SID. It is suggested to take this discussion in parallel with the separate discussion on how to represent a deployment in Question 3.

Companies in some aspects state their views on prioritization among options. Moderator suggests at this stage of the SI, we can collect a general set of inputs, and prioritization can be discussed when writing recommendations and conclusions later in the SI.

Topic 4-1: Environment

The SID tells us that deployment scenarios have an “indoor/outdoor environment”. Companies do not appear to have any different view in their papers. Moderator understands the SID is referring to the environment of the device in this aspect, whereas the location of the basestation or other reading node is taken in the next row of the table, “Basestation characteristic”.

Feedback Form 4: Question 4-1: Is it agreeable that ‘Environment (of device)’ can be indoor or outdoor?

Topic 4-2: Basestation characteristic

Companies express various views on which types of basestation are applicable to which UCs, etc., but in total it seems that macro, micro, and pico-cellular deployments are going to be considered within the SI. Moderator understands that reference to these dimensions of deployments refers mainly to inter-site distance of ambient IoT basestation nodes, and can be reflected in more detail when considering ‘RAN design targets’ on communication range.

Moderator suggests it is not necessary to include, for example, a restraint that macro is for outdoor, since such obvious inter-relationships will be evident when the deployment scenarios are constructed in the tables from Question 3.

Feedback Form 5: Question 4-2: For basestation deployments, is it agreeable that 'basestation characteristic' can be: macro-cell based deployment, micro-cell based deployment, or pico-cell based deployment?

Topic 4-3: Coexistence with UEs and infrastructure

The SID includes a deployment characteristic of whether ambient IoT deployment coexists with existing UEs and infrastructure. Moderator suggests the following handling of those points.

(a) In-band, guard-band, standalone

Coexistence with UEs can be addressed in noting that a number of companies propose Ambient IoT should take an assumption that it can be deployed in-band, guard-band, or standalone from NR. This should be reasonable since in-band and guard-band allow re-use of existing spectrum assets, while the potential for new bands in the future should not be precluded at this stage.

For this meeting, moderator suggests agreeing that all three deployment modes are considered, and that further study is needed to determine the possible relationships with deployment scenarios.

Feedback Form 6: Question 4-3a: Is it agreeable that the study considers Ambient IoT deployment in-band to NR, in guard-band of NR, and standalone from NR, and FFS: relationship to deployment scenarios?

(b) Co-deployment with existing 3GPP deployment

The papers which address coexistence with existing infrastructure take the assumption that it is a potential way to serve certain use cases, such as in a warehouse where an existing 3GPP small cell deployment can be present, onto which an Ambient IoT deployment is added.

For basestation deployments, to allow "coexistence with existing 3GPP technologies" could be described as:

- *Deployed on the same sites as an existing 3GPP deployment corresponding to the basestation type*
- *Deployed without an assumption of an existing 3GPP deployment.*

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Feedback Form 7: Question 4-3b: For basestation deployments, is it agreeable to allow "coexistence with existing 3GPP technologies" to be described as above?

Topic 4-4: Connectivity topology

A large number of connectivity topologies are discussed in papers. They fall essentially into two families, according to whether air-interface transmission to, and reception from, the Ambient IoT device are at the same or different node(s). Some companies term these respectively mono-static or bi-/multi-static, of which in the latter case most companies consider bi-static. There are additional considerations of whether there is a node which only supplies RF energy for backscattering at the Ambient IoT device, what functions an assisting node plays in the bi-/multi-static topologies (e.g. data and/or energy), and whether transmission to and reception from the Ambient IoT device are at the same or different nodes.

The moderator believes that the following set of 4 generalized connectivity topologies covers all the proposals that companies have made, by carefully considering the NOTEs attached to each.

Topology (1) BS <-> Ambient IoT device

NOTE 1: Includes the possibility of BS Rx and BS Tx in different BSs

NOTE 2: The Ambient IoT device may be provided with energy from another node(s)

Topology (2) BS <-> intermediate node <-> Ambient IoT device

NOTE 1: Intermediate node can be relay, IAB, UE, etc. which is capable of ambient IoT

NOTE 2: The Ambient IoT device may be provided with energy from another node(s)

Topology (3) BS <-> assisting UE <-> Ambient IoT device <-> BS

NOTE 1: The link from assisting UE to the Ambient IoT device can provide energy for the device's transmission

NOTE 2: Assisting UE can be either bidirectional or unidirectional operation to others

Topology (4) UE <-> Ambient IoT device <-> {BS or none}

NOTE 1: The links may be bidirectional or unidirectional operation

Feedback Form 8: Question 4-4: Is it agreeable to capture the above connectivity topologies in TR 38.848, and for use in the deployment scenario tables?

Topic 4-5: Spectrum

Papers discuss in general terms that licensed and unlicensed spectrum should be included in the study, with a few comments on the applicability of unlicensed, and/or on priority between licensed and unlicensed. No company raises a concern on including FDD and TDD bands in the study.

For the first meeting(s), Moderator suggests we decide what is included in the study. Issues of prioritization can be addressed when writing conclusions and recommendations towards potential future SI/WIs.

Feedback Form 9: Question 4-5: Is it agreeable that 'Spectrum' in a deployment scenario is: licensed FDD, licensed TDD, or unlicensed?

Topic 4-6: Traffic assumption

The SID gives traffic types of device-originated and/or device-terminated. Companies address both types across the submitted papers. Some submissions further look at the purpose of the traffic, e.g. to distinguish a device-terminated reporting trigger (wherein some give examples such as inventory or data report) from a device-terminated command message (wherein some give examples such as for control).

Some papers also discuss traffic pattern and payload size.

Since the SID already tells us that 'Traffic assumption' types for the deployment scenarios are at least DO and DT, Moderator's suggestion is to see if companies are ready to agree a further level of detail relating to the traffic purpose, since this can be inferred from SA1 UCs, as is seen in companies' papers.

For traffic patterns, payload sizes, and other further detail levels, Moderator encourages companies to look into these aspects for further discussion in the next meeting, whether under further study of (r)UCs, deployment scenarios, or RAN design targets.

Q4-6: For "Traffic assumption" of a deployment scenario, additional to "device-originated" and "device-terminated", what are companies view on also having:

- *Device-terminated command (for which the TR can state e.g. of positioning, actuation, etc.)*
- *Device-terminated reporting trigger (for which the TR can state e.g. of inventory, sensor report, etc.)*

Feedback Form 10: Q4-6: For "Traffic assumption" of a deployment scenario, additional to "device-originated" and "device-terminated", what are companies view on also having Device-Terminated command and Device-Terminated reporting trigger, as described above?

Topic 4-7: With or without core network

Moderator suggests that with or without a CN connection is discussed under 'assumed functionality' in the next two RAN meetings.

6 Topic 5 - Devices

6.1 Initial round

Topic 5-1 - Characteristics

At least the following characteristics have been widely identified for characterizing and categorizing Ambient IoT devices:

- Energy storage (with or without)
- Generation of RF signal for transmission (by backscattering or by active transmission)
- Device function (Tx only, Rx & Tx)

Feedback Form 11: Question 5-1: Is it agreeable to capture in the TR that at least the above characteristics are studied for Ambient IoT?

Topic 5-2 - Categorization

Papers have primarily categorized devices using some of these characteristics, in one of three ways:

Method 1: Combination of energy storage and device transmission method

- Passive device A: No energy storage, backscattering transmission
- Passive device B: Energy storage from harvesting ambient sources, backscattering transmission
- Active device: Energy storage from harvesting ambient sources, active RF components for transmission.

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FFS: Whether to include device function

Method 2: Consider only energy storage capability

- Device A: No energy storage
- Device B: Limited energy storage from energy harvesting
    - Device B1: Backscattering transmission only
    - Device B2: Active RF components for transmission

FFS: Whether to include device function

Method 3: Categorize only by device transmission method

- Device A: Backscattering transmission only
- Device B: Active RF components for transmission

FFS: Whether to include device function

Feedback Form 12: Question 5-2: Moderator invites views on which of/among the above methods to pursue for device categorization, as well as the content of a respective method.

7 Topic 6 - Design targets

A number of papers discuss design targets for devices, and/or the ambient IoT system in general. Such inputs are welcomed, while the related objective of the SI is not for discussion this meeting, according to RAN#97e decision. Moderator encourages further offline discussions in preparation for RAN#99.

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