

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?

1 – KT Corp.
No objection
2 – Samsung Electronics Co.
We are ok with endorse based on current SID but for chapter 5 of KPI. Based on SA1's requirements, we propose to include latency as the key target KPI for next update. From SA1's use case and also other companies Tdoc in this plenary, latency should be considered together with other KPIs in ambient IoT service.
3 – VODAFONE Group Plc

on objection
4 – MediaTek Inc. The overall structure is ok - however as Samsung commented, other KPIs (as documented in the draft SA1 TR) may need to be considered.
5 – Spark NZ Ltd No objection
6 – Huawei Tech.(UK) Co.. Ltd No objection, and we note that Clause 5 of the TR, and the SID wording, already allows for additions.
7 – Futurewei Technologies No objection.
8 – Apple France No Objection
9 – vivo Communication Technology OK
10 – NTT DOCOMO INC. No objection
11 – Kyocera Corporation We're fine with the TR skeleton proposed in RP-223073.
12 – Spreadtrum Communications We suggest to improve chapter 4 structure a bit clearer: <ol style="list-style-type: none">1. Swap section 4.1 and 4.2 (it is a normal order)2. Take section 4.2.1 (Device categorization) out as section 4.3 (as Device categorization is a different level with use case)
13 – Motorola Mobility España SA [Lenovo] No objection
14 – CATT OK

<p>15 – Telstra Limited</p> <p>We are ok with the proposed TR skeleton.</p>
<p>16 – China Mobile Com. Corporation</p> <p>OK.</p> <p>As TR rapporteur, we are open for adding additional KPIs if agreeable.</p>
<p>17 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>Generally ok.</p> <p>But don't see there is a need of "4.2.3 Further use cases/services". In SA1, there have already 30 use cases (28 use cases+2 traffic scenarios). Based on the input paper, not see the need for additional new use cases on top of SA1. In addition, as a new technology, the will be impact on other group for a new use case, suggest to propose the use case in SA1 to check the impact on all the downlink working groups(SA2/SA3/SA5 ...).</p>
<p>18 – LG Electronics Inc.</p> <p>No objection</p>
<p>19 – China Telecommunications</p> <p>No objection</p>
<p>20 – Nokia Denmark</p> <p>Nokia is fine with the proposed skeleton for the TR.</p>
<p>21 – Sony Europe B.V.</p> <p>No objection.</p>
<p>22 – ZTE Corporation</p> <p>Also fine to endorse RP-223073 as v0.1.0 of TR 38.848.</p> <p>We further suggest to clarify the relationship between the section 4.1 Deployment scenarios and 4.2 Use cases/services (maybe during the late discussion stage).</p> <p>Moreover, according to our observation on the latest use cases from SA1 (diverse requirements), for chapter 5 of RAN design targets, we are fine with adding latency as suggested by Samsung and want to further suggest adding connection density, mobility and security.</p>
<p>23 – Intel Belgium SA/NV</p> <p>We share Samsung's view to include latency as KPI</p>

<p>24 – Panasonic Holdings Corporation</p> <p>No objection</p>
<p>25 – Orange</p> <p>No objection</p>
<p>26 – TURKCELL</p> <p>No objection</p>
<p>27 – KPN N.V.</p> <p>No objection</p>
<p>28 – Ericsson LM</p> <p>Regarding clause 4, we think that subclauses 4.2.2 and 4.2.3 can be removed and only keep a single sub-clause 4.2 called ‘Use cases/services’ (or just ‘Use cases’), since it does not seem correct to us to refer to the SA1 TR in the heading like this.</p> <p>Regarding clause 5 on ‘RAN design targets’, the SID notes that <i>“Other RAN design targets in relation to connection density, mobility, security, latency, reliability etc. may be discussed, if necessary for the relevant use cases”</i>. We would like to at least add a subclause on ‘Service availability’ or similar in the ‘RAN design targets’ clause to better capture that data communication may only be possible under certain conditions, i.e., when a smartphone or reader is located close to device for the passive solution track, and when the device is not energy-depleted for the active solution track (assuming energy harvesting).</p> <p>Regarding clause 6 on ‘Comparison and assessment’, we wonder whether this clause will also treat how the proposed device categories fit the targeted deployments and how well they meet the performance design targets. In that case, it should be clarified in the Editor’s note. Otherwise, a new clause for this may be needed.</p>
<p>29 – Philips International B.V.</p> <p>In general, we are ok with the structure. For clause 5, we would suggest to add something about peak power.</p>

2.2 Initial round summary

Companies are positive to endorsing the TR skeleton. There are a few suggested changes:

- To swap 4.1 and 4.2, i.e. make the order “Use cases”, followed by “Deployment Scenarios”.
 - Moderator response: I understand the skeleton chose this order since we are supposed to identify which deployment scenarios can go with which use cases. The order of 4.1 and 4.2 does not seem critical, so should be OK to swap them.

- On section 4.2 -
 - Make 4.2.1 (Device categorization) into its own sub-clause in section 4, e.g. 4.3.
 - Moderator response: I understand this arrangement was suggested since device categorization is not a SI objective in its own right. But seeing how companies have discussed it in their papers, it seems fine to make it into clause 4.3.
 - Delete clause 4.2.2 (as well as clause 4.2.3)
 - Moderator response: It seems that RAN is not going for a process of including/excluding among the SA1 use cases, so we could remove this section.
 - Delete 4.2.3 (Further use cases/services), i.e. any agreed beyond SA1's list.
 - Moderator response: Indeed no such additions have been proposed, and the editor's note implies potential removal. So, we can delete 4.2.3 and, if discussion according to the rapporteur's workplan in RAN#99 results in agreement to such an addition, the clause can be re-instated.
 - Overall, this would leave only 4.2.x – Representative UCs. This could then become the whole content of section 4.2.
- Add additional RAN design targets to clause 5, e.g. latency, connection density, mobility, security.
 - Moderator response: The RAN#97e decision indicates no discussion on RAN design targets in this meeting. Since the TR skeleton already allows extension of clause 5 (thanks to '5.z - <RAN design target z>'), the moderator will not propose any alteration this time, and invites companies to freely discuss in subsequent meetings, when we will continuously update the TR as needed.

2.3 Intermediate round

Based on the moderator's responses to the first round, the following is proposed:

Proposal 1:

- Update the TR skeleton in RP-223073 as follows, and agree that update as v0.1.0 of TR 38.848:
 - Make clause 4.2.1 (Device categorization) into new clause 4.3, with consequent renumbering within 4.2.
 - Delete clauses 4.2.2, 4.2.3
 - Rename 4.2 to be "4.2 Representative use cases".
 - Reverse the order of the clauses for "deployment scenarios" and "use cases/services"
 - Delete clause 4.2.3.

- Responses are only necessary if any remaining concern, otherwise we can agree as above.
- The overall revised skeleton (by the moderator) is in the draft folder at the following link:
https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_98e/Inbox/Drafts/%5B98e-11-Ambient-IoT%5D/TR%20skeleton/Moderator_Draft_RP_22xxxx%20TR%2038.xxx%20skeleton%20v0.0.1.docx

Feedback Form 2: Is proposal 1 agreeable?

1 – Beijing Xiaomi Mobile Software Yes, we think the current TR sturcture is OK and agree with the proposal 1
2 – Beijing Xiaomi Mobile Software Yes, we think the current TR sturcture is OK and agree with the proposal 1
3 – vivo Communication Technology Support.
4 – Spreadtrum Communications Yes, agreeable.
5 – Nokia Denmark Support
6 – Nokia Denmark Support
7 – Nokia Denmark Support
8 – Panasonic Holdings Corporation We support the proposal.
9 – NTT DOCOMO INC. Agree
10 – VODAFONE Group Plc support

<p>11 – VODAFONE Group Plc</p> <p>support</p>
<p>12 – VODAFONE Group Plc</p> <p>support</p>
<p>13 – Apple France</p> <p>Support</p>
<p>14 – Kyocera Corporation</p> <p>We support the update.</p>
<p>15 – Ericsson LM</p> <p>Regarding clause 6 on ‘Comparison and assessment’, we wonder whether this clause will also treat how the proposed device categories fit the targeted deployments and how well they meet the performance design targets. In that case, it should be clarified in the Editor’s note. Otherwise, a new clause for this may be needed.</p>
<p>16 – China Telecommunications</p> <p>Support</p>
<p>17 – NOVAMINT</p> <p>Agree</p>
<p>18 – ZTE Corporation</p> <p>Most are fine, but suggest to generalize the title of section 4.2 to be “4.2 Use cases and performance requirements”.</p> <p>With reference to the discussion in Feedback Form 3: Question 2, now we are not sure yet whether we will result in identifying representative use cases or identifying use case categories/groups, so we think it’s better to use a general title for the section of use cases.</p>
<p>19 – Samsung Electronics Co.</p> <p>Support</p>
<p>20 – Intel Belgium SA/NV</p> <p>We are supportive to the current TR structure and the proposal 1</p>
<p>21 – MediaTek Inc.</p> <p>OK!</p>

22 – Motorola Mobility España SA ok
23 – China Mobile Com. Corporation Agree with the proposal and updated TR.
24 – KPN N.V. Support
25 – Philips International B.V. Ok

2.4 Intermediate round summary

Nearly every company is fine, hence the skeleton seems pretty stable. We should remember that the TR will be subject to further updates from the TR editor, including section title details, etc., so we do not have to tweak every aspect.

- ZTE ask to change 4.2 to “Use cases and performance requirements”.
 - Moderator response: As previously explained, RAN design targets are in section 5, in later meetings. SA1 deals with requirements. Let’s reserve further changes to this section title until we see text being captured there.
- Ericsson: The potential fitting of device categories to deployments is already an FFS under the deployment scenarios table. Can resolve that, before needing to tweak at TR skeleton level, since the TR will anyway be updated. How/if deployments meet design targets is already in the clause 6 note.

2.5 Final round

Based on the moderator response, we should endorse the TR skeleton, and hold further changes to later updates to the TR. Moderator notes that in a f2f, we would probably have discussed this rather more briefly!

Proposal 1-v2: Agree the /drafts folder content at this link as v0.1.0 of TR 38.848.

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_98e/Inbox/Drafts/%5B98e-11-Ambient-IoT%5D/TR%20skeleton/Moderator_Draft_RP_22xxxx%20TR%2038.xxx%20skeleton%20v0.0.1.docx

Feedback Form 3: Can we agree the linked draft TR skeleton as v0.0.1 of TR 38.848?

1 – Spreadtrum Communications Yes, agree.

2 – NTT DOCOMO INC. Agree
3 – vivo Communication Technology OK
4 – Apple France Agree
5 – Samsung Electronics Co. ok
6 – Shenzhen Heytap [OPPO] ok
7 – THALES Agree
8 – Nokia Denmark Agree
9 – Huawei Tech.(UK) Co.. Ltd Yes.
10 – China Unicom Yes, agree.
11 – China Mobile Com. Corporation agree
12 – ZTE Corporation Ok.
13 – Intel Belgium SA/NV OK
14 – Panasonic Holdings Corporation Ok
15 – Kyocera Corporation We agree.

16 – Ericsson LM Agree
17 – NOVAMINT Agree
18 – MediaTek Inc. Agree
19 – Telia Company AB Yes we agree.
20 – Philips International B.V. Agree.

2.6 Final round summary

All companies agree. Chair will be requested to endorse the TR skeleton, which the TR editor has kindly prepared as RP-223526, in the inbox. According to MCC, this will in fact be v0.0.2 of TR 38.848.

No extended round.

Proposal 1-v2 for agreement: Agree RP-223526 as the next version 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 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 4: Question 2 – What are companies' views and preferences on these first-level ways to group the SA1 UCs into representative use cases?

1 – VODAFONE Group Plc

similar to what analyses in RP-223072 [CMCC], the use case grouping can be based on (B) functionality/application

2 – MediaTek Inc.

A)
Not B), Not C)

The grouping should be representative of the use case characteristics (in terms of range, latency, data rate etc.) such that a use case does not end up listed in a group with characteristics different from those required by said use case, that could artificially inflate the need for a particular characteristic.

E.g. we note in RP-223072 that use case #23 end up listed in a group with a communication range up to 200m that this particular use case clearly does not require.

We think the communication trigger for a Tag to communicated is also an important criterion in the grouping - as the vast majority of use cases display a common MT trigger.

3 – Spark NZ Ltd

we agree with MediaTek and support group A

4 – Huawei Tech.(UK) Co.. Ltd

We think grouping (A) is good.

The purpose of representative use cases is to group the SA1 use cases such that they facilitate properties which are of interest to RAN for development of deployment scenarios (especially connectivity topologies), design targets, and functions. Whereas, to us, the purpose is not so much to serve as a secondary SA1 identifying business purposes, services, service requirements, etc.

In general, different applications or functionalities may share very similar deployments scenarios. For example, environment monitoring in electrical substation (wireless sensing) and asset tracking in airport terminal/shipping port may both be supported by a local area network based on e.g. micro-cell BS, with similar requirements on communication range. Meanwhile, the same applications or functionalities may be fulfilled with distinct deployment scenarios and design targets. For example, personal belonging finding requires object tracking in both indoor and outdoor scenarios, which may be supported by different node types and connectivity topologies, with different requirements on communication range and positioning accuracy.

Consequently, as in RP-223397, we grouped the SA1 UCs first by approach (A) deployment environment, including indoor/outdoor and service area size (continuous coverage over a large area, small area by one or only a few nodes, personal applications).

While with approach (B)/(C), sensing, inventory, actuator are more about the traffic model. The use cases under same group may have very different requirements. For example, “sensor report” includes different applications of wide area (e.g. smart agriculture), small area (e.g. cow monitoring in stable) , and personal/home area (e.g. smart home).

5 – Samsung Electronics Co.

To have clear work in RAN, group A is best among other alternatives.

6 – Sierra Wireless. S.A.

Group A.

7 – KT Corp.

Group A

8 – Apple France

Group B is our first preference, but Group A is also fine for us

9 – Futurewei Technologies

Approach A for grouping is preferred. This is more relevant for RAN study.

10 – vivo Communication Technology

Option-(B) Group first by functionality/application is preferred.

the representative use case could be a group of use cases with similar functionalities and traffic characteristics. The use cases can be grouped as follows

- inventory and management of large number of objects
- data reporting from Ambient IoT device
- positioning
- Actuator

based on above grouping, we can further define different KPIs for different deployment scenarios, e.g., indoor/outdoor, and identify mandatory /optional functionalities for each group of use case, if needed.

11 – NTT DOCOMO INC.

Group A is preferred considering that representative use cases are used to identify the suitable deployment scenarios, formulate a set of RAN design targets, and identify assumptions on required functionality to be supported as stated in the SID

12 – Spreadtrum Communications

We do see benefit of A and B. So we suggest combining A&B. While we are also fine with only B for simplicity.

13 – Motorola Mobility España SA

[Lenovo] Support B – Grouping of use case according to functionality such as inventory tracking based on RFID technology, commercial positioning and wireless sensor network to transmit sensor data

14 – CATT

We support B grouping by functionality. There is no definite case for A grouping for the deployment environment, e.g., indoor/outdoor. Some Ambient-IoT could be deployed in different deployment environment.

15 – Telstra Limited

We prefer option A)

16 – China Mobile Com. Corporation

We prefer Group B, which is also adopted in our contribution.

The use cases sharing same motivation and function mostly sharing similar requirement and deployment scenario. For example, inventory requires local deployment and battery-less devices. While, positioning/-tracking requires wide area deployment. Sensor perception requires the device has limited energy storage capability, which can guarantee the working power of sensor.

Regarding to MTK's comments on use case #23, we observe in SA1 TR 22.840, the communication range for smart livestock farming is 250m. So we classify it into category of sensor perception with communication range of 50 m (indoor), 200 m(outdoor).

To be honest, the most important thing is to work out the RAN design targets and RAN deployment architecture. The use case classification is just a way to narrow down the large number of SA1 use cases into limited number of operable use case categories, each of which share different requirements.

17 – Qualcomm Incorporated

Although normally Approach (B) "Group first by functionality/application" would be the natural first step when considering new verticals, given the fundamental impact the deployment environment has on our discussions, it makes sense to make Approach A be the first step for Ambient IoT. Then Approach B and after that Approach C can follow.

18 – LG Electronics Inc.

Basically, deployment environment as in (A) can be a starting point but it should be also considered whether/how this grouping can reflect other issues such as required functionality

19 – Shenzhen Heytap

[OPPO]

Group B shall be adopted as the first step.

Different function has different requirement of the system (both the tag and the gNB). For example, identification only need the transmission of the ID of the tag, but for sensors, higher power is needed to drive the sensor and the payload will be also larger. For positioning, it will involve positioning function of the tags and the gNB.

On top of group B, we can further derive the specific requirement for indoor and outdoor.
this is the most natural and clear way to categorize the use cases and derive the RAN requirements.

20 – Sony Europe B.V.

A and B are useful for RAN to consider.

- A will provide some guidance on RAN design targets (e.g. range).
- B will provide guidance on RAN functionality (e.g. whether both MO and MT need to be considered).

21 – Nokia Denmark

Nokia support (B) Group first by functionality/application.

This helps to define the technical requirements which is one of the key objectives for the RAN led SI.

22 – ZTE Corporation

We support option (B) Group first by functionality/application.

Option A) for grouping the SA1 use cases seems to be repeating the discussion for deployment scenario (and some service requirements are hidden).

So we think it's better to firstly make some summary on the application/use cases themselves and try to identify the service requirements, e.g., data rate, communication range, mobility, security and positioning function/accuracy etc., which can further help to identify the possible impacts/requirements on the design of 3GPP network structure and functionalities.

We [RP-223264] use similar way to categorize the use cases captured in SA1 as that in RP-223072 [CMCC] as below:

- **Category#1 of logistics and warehousing based on tag and with simple services**
- **Category#2 of device monitoring/supervision and control in Smart agriculture, livestock farming, Smart City etc.**
- **Category#3 of lost and found with ranging and positioning requirements.**

For Category#1, it may be more suitable to use logistics and warehousing as the naming of such application type or use case category while the inventory can be the typical service of the ambient IoT devices in this category. Moreover, We have a bit different observation on the use cases which can belong to the Category#1. We observe that the Message size and also the range of service area, communication range vary a lot. Therefore, only 30 meters for communication range for such category as mentioned in RP-223072 may be not enough.

For Category#2, we are fine to separate it into the category of environment perception sensor and category of activator/controller as they may have very different traffic model.

23 – Panasonic Holdings Corporation

For RAN plenary level discussion, grouping by A can be started, although the grouping by B also necessary in the course of the discussion.

24 – Intel Belgium SA/NV

Option A is slightly preferred. The different functions/applications may have similar characteristics that are interested in RAN study which motivate Option A. Option A also fits better with the discussion on deployment scenarios in topic 2/3

25 – Orange

Group A is preferred.

26 – TURKCELL

We prefer to start with Option A. Then continue with B and C.

27 – Telia Company AB A+B
28 – China Telecommunications Group B is slightly preferred
29 – Ericsson LM Approach B seems best to us, since we think this would increase the likelihood that a single technical solution/deployment scenario can address all the use cases in a given use case group.
30 – KPN N.V. Option A is slightly preferred als grouping approach of the UCs.
31 – Philips International B.V. We prefer to group use cases by A) deployment environment, which will help derive deployment scenarios later. For example, use case 5.8 on finding remote lost item and use case 5.12 on Ambient IoT service for personal belongings finding in TR 22.840 can happen both indoor and outdoor.

3.2 Initial round summary

17 companies supported approach A: group first by deployment environment. The consideration is that representative use cases are intended to formulate clear work in RAN, including suitable deployment scenarios, RAN design target and assumption on required functionalities to be supported as stated in SID.

11 companies supported approach B: group first by functionality/application. The consideration is also mentioned as to identify KPIs and required functionalities for each group of use cases.

No company supported approach C. One company mentioned that communication trigger for a Tag to communicate is also an important criterion in the grouping.

3.3 Intermediate round

Since the proposals for Groupings A and B are relatively well-converged in their respective papers, and both have a lot of support, we could allow both to be represented in the TR. If companies prefer only one grouping, then we could group: first by deployment environment and second by functionality/application.

Question 2 - Which of these two approaches do companies prefer.

- Approach 1: Have Grouping A, and Grouping B in the TR.
- Approach 2: Group first by A, and second by B, i.e. for each group in A, a series of sub-groups from B.

NOTE: The moderator thinks we should choose Approach 1 if we can, as the combination work in Approach 2

may be too much for not a clear purpose. Hence if preferring Approach 2, please help explain how it can be done simply enough.

Feedback Form 5: Question 2: which approach do you think is better?

1 – Qualcomm Incorporated

We slightly prefer Approach 2.

We see the following difference between Approach 1 and 2.

In our understanding, Approach 1 does grouping twice; once based on Grouping A and another separate grouping based on Grouping B. This results in all use cases be categorized by two different grouping methods; i.e., each use case appears twice. Does this mean that the study needs to be performed for all sets of groups by A and B?

Whereas, Approach 2 has each use case appear **only once** in the grouping process, since grouping is a two-step process.

In Approach 2, if a given deployment scenario doesn't have to be sub-categorized in grouping B (e.g., different functionality of use cases does not require sub-grouping), then, we can stop in the first step.

2 – vivo Communication Technology

We may start with approach 1 in the next meeting, to see the difference between grouping A and grouping B and possibly decide which grouping method is better for the selection of representative use cases.

Approach 2 can also be discussed if it can help to reduce the redundancy for the TR.

3 – CATT

We support Approach 1.

4 – CATT

We support Approach 1.

5 – Shenzhen Heytap

[OPPO]

Between approach 2 and approach 1, We prefer to approach 2. We don't see the need to group one use case twice with approach 1 and what is the benefit for further study.

We still prefer to apply group B first and then group A. We can decide which function we will support and then for one function we can see the indoor and/or outdoor requirement. This is the normal procedure. The motivation to grouping the use cases in a study with indoor and outdoor is not clear.

6 – LG Electronics Inc.

Approach 1 is clear and preferred. We think that SI can start with Approach 1 first and then combination can be studied, if needed.

<p>7 – Spreadtrum Communications</p> <p>We prefer approach 2.</p>
<p>8 – Nokia Denmark</p> <p>We support the view of Qualcomm with same arguments of avoiding double grouping.</p>
<p>9 – NTT DOCOMO INC.</p> <p>We share the view with vivo</p>
<p>10 – VODAFONE Group Plc</p> <p>We prefer approach 1. Further discussion could be based on the analysis/differences of group A and B in the next meeting.</p>
<p>11 – Apple France</p> <p>We prefer approach 1 to avoid two independent groupings. Rather approach 2 is preferable to have sub-grouping within a group.</p>
<p>12 – Huawei Tech.(UK) Co.. Ltd</p> <p>We prefer Approach 1, though if Approach 2 is adopted, we would share in the reminder from Qualcomm that there only has to be the second-level grouping when it is needed.</p>
<p>13 – Kyocera Corporation</p> <p>We slightly prefer Approach 1. Approach 2 may be discussed later, if needed.</p>
<p>14 – Tejas Networks Ltd.</p> <p>We prefer Approach 1.</p>
<p>15 – Panasonic Holdings Corporation</p> <p>For TR structure perspective, our view is approach 1. The reason behind to start approach A and then approach B is not "for each group in A, a series of sub-groups from B". Our intention is just the order of the discussion. To list deployment environment can be easier to described and functionality/application would be based on the discussion.</p>
<p>16 – NOVAMINT</p> <p>We tend to prefer Approach 1</p>

17 – Ericsson LM

We prefer Approach 2. We think that one purpose of the use case grouping is to eliminate the element of duplication or overlap that occurs among some of the use cases listed in the draft SA1 TR. Either one of Grouping A and Grouping B can achieve this. So, the approach suggested by Qualcomm, to first consider Grouping A for the topology and deployment scenario discussion, and at a later stage consider Grouping B for the functionality if needed.

18 – ZTE Corporation

We think the expected results of Grouping B is clear, e.g., like the examples given in RP-223072 [CMCC], but we are still not so clear the expected results of Grouping A. So we are acceptable to Approach 1 and agree with vivo's suggestion on the way forward.

In next meeting, we can further clarify the Grouping A's specific classification methodology and then see whether we need to combine the Grouping B and Grouping A, and how.

19 – Samsung Electronics Co.

We prefer Approach 2

20 – Intel Belgium SA/NV

We slightly prefer Approach 2.

After doing grouping A, the use cases with similar RAN interested requirements are grouped. Then, the second step of grouping B serves as clarification on the related functionality/application. In fact, if the classified functionality/application in second step are jointly considered across all groups of the first step, we can obtain a grouping as if it is done using grouping B directly.

Approach 1 is less preferred since it seems duplicated works. It is also not clear which grouping should be referred in the discussion of other topics

21 – MediaTek Inc.

We support Approach 2. We would advise against going with Approach 1 - for the same reason as Qualcomm explained above.

22 – Motorola Mobility España SA

we prefer approach 2

23 – China Telecommunications

We prefer approach 1. Grouping A and grouping B can be both captured first, and the priority of them could be further discussed.

24 – China Mobile Com. Corporation

We slightly prefer approach 1. Approach 2 will have a huge amount of groups and sub-groups, which looks not so helpful.

If approach 2 is finally selected by RAN, we prefer to group first by B, and second by A. Because we need first to identify what use case functions will be studied, e.g., inventory, sensor, tracking, then, as a second step, to identify indoor/outdoor scenario for each use case category.

25 – Sony Europe B.V.

Approach 1.

Agree with moderator that Approach 2 increases workloads for no clear purpose.

26 – Philips International B.V.

Slightly prefer approach 2

3.4 Intermediate round summary

Approximately 15 companies (vivo, CATT, LG, Docomo, Vodafone, Apple, Huawei, Kyocera, Tejas, Panasonic, Novamint, ZTE, China telecom, China mobile, Sony) suggest approach 1: Having Grouping A, and Grouping B. it was mentioned that option 2 can be discussed if it can help to reduce the redundancy.

Approximately 9 companies (Qualcomm, Spreadtrum, Nokia, Ericsson, Samsung, Intel, MTK, Motorola, Philips) suggest approach 2: Group first by A, and second by B. It was mentioned that for approach 2, first consider Group A, there only has to be the second-level grouping when it is needed.

Moderator notes that either way, the group elements of Grouping A and Grouping B need to be identified. If we can outline that in this meeting **at starting-point level**, companies can think further about how/if to combine them to the next meeting. It may not be necessary to actually list out the mapping of use cases from SA1 to our groups in RAN, and this avoids a lot of the question.

3.5 Final round

The moderator suggests the following high-level group elements, as a start point which can be refined/expanded/contracted in the next meeting. Companies' attention is drawn to "as a start point"!

Proposal:

- *Define the groups of Grouping A as follows, as a start point:*
 - Indoor
 - Outdoor
 - Indoor/outdoor

- *Define the groups of Grouping B as follows, as a start point:*
 - Inventory

- Sensors
 - Positioning
 - Command
-
- *Whether to incorporate Grouping A and Grouping B according to Approach 1 (include both separately) or Approach 2 (Group first by A, and second by B) will be decided in RAN#99.*
 - *Mapping of SA1 use cases to the groups of each grouping will be discussed in the next meeting, including whether RAN needs to attempt that mapping, or only has to define the groups.*

Feedback Form 6: Can we take this as a way forward in this meeting?

1 – Qualcomm Incorporated We agree
2 – Spreadtrum Communications Yes, agree.
3 – NTT DOCOMO INC. Agree
4 – vivo Communication Technology OK
5 – Apple France Fine
6 – Samsung Electronics Co. ok
7 – Shenzhen Heytap [OPPO] ok
8 – THALES Agree
9 – Nokia Denmark OK

10 – China Unicom Agree
11 – VODAFONE Group Plc Agree
12 – China Mobile Com. Corporation Agree
13 – Huawei Tech.(UK) Co.. Ltd We agree with this.
14 – ZTE Corporation Ok.
15 – Intel Belgium SA/NV We are OK with the proposal. For the first two bullets, is it intended to limit to the 3 or 4 groups or further increasing the groups can be considered? For the last bullet, we believe it is helpful to conclude on a mapping between SA1 use cases and the RAN groups
16 – Panasonic Holdings Corporation Ok
17 – Kyocera Corporation We agree.
18 – Ericsson LM Agree
19 – NOVAMINT OK
20 – MediaTek Inc. OK - let's come back to this in March
21 – Telia Company AB Yes we agree.

22 – Philips International B.V.

Agree.

3.6 Final round summary

All companies agree. Chair will be requested to endorse the proposal. No extended round.

To Intel: Right, it's a starting point. The moderator explanation at the final round was: "a start point which can be refined/expanded/contracted in the next meeting".

Proposal 2 for agreement:

- ***Define the groups of Grouping A as follows, as a start point:***
 - ***Indoor***
 - ***Outdoor***
 - ***Indoor/outdoor***

- ***Define the groups of Grouping B as follows, as a start point:***
 - ***Inventory***
 - ***Sensors***
 - ***Positioning***
 - ***Command***

- ***Whether to incorporate Grouping A and Grouping B according to Approach 1 (include both separately) or Approach 2 (Group first by A, and second by B) will be decided in RAN#99.***

- ***Mapping of SAI use cases to the groups of each grouping will be discussed in the next meeting, including whether RAN needs to attempt that mapping, or only has to define the groups.***

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 7: 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)?

<p>1 – VODAFONE Group Plc</p> <p>the proposed tabular form for capturing deployment scenarios is ok.</p>
<p>2 – MediaTek Inc.</p> <p>Tabular format is ok. Base station characteristic may not necessarily be applicable though (e.g. for tags communicating directly with a reader device) - or alternatively "base station" should be defined.</p>
<p>3 – Spark NZ Ltd</p> <p>we agree that the tabular structure form as suggested by the moderator for the deployment scenarios is a good way to proceed.</p>
<p>4 – Sierra Wireless. S.A.</p> <p>Tabular structure looks good.</p>
<p>5 – Apple France</p> <p>Proposed tabular structure is fine from our perspective and provides good starting point.</p>
<p>6 – Futurewei Technologies</p> <p>The overall table structure looks fine.</p>
<p>7 – vivo Communication Technology</p> <p>Looks good in general.</p> <p>For clarification, since the title of the table is "Table for deployment scenario X", is the intention that there will be different tables for each deployment scenario, e.g. indoor , outdoor, etc?</p>
<p>8 – Qualcomm Incorporated</p> <p>We have a few comments.</p> <p>The first column could include information categorized based on approach (A) and partially approach (B). A new row "UE characteristics" would be necessary to capture UE related characteristics, e.g., full duplex capability requirement, etc.</p> <p>We wonder how to capture Ambient IoT device related aspects in the deployment scenario. Currently, we don't see any row related to Ambient IoT device capability. Ideally, it should be also the part of deployment scenarios. We suggest to discuss deployment scenario and device categorization in parallel, and later we capture Ambient IoT device related aspects in deployment scenarios.</p>
<p>9 – NTT DOCOMO INC.</p> <p>OK with the table structure</p>

10 – Kyocera Corporation

We're fine with the table, in general. Although it's not a strong opinion so far, we wonder if the device categorization will be added at the end (i.e., the categorization is fixed).

11 – Spreadtrum Communications

Table structure is OK for us.

12 – Motorola Mobility España SA

[Lenovo] Similar to Basestation characteristic in the table to implement the reader functionality, the UE characteristic can also be added as the reader functionality can also be integrated in UE.

13 – CATT

Use cases by SA1 are only references. RAN should take SA1 use cases as bases and develop the use cases based on Ambient IoT technologies. Tabulate format is too restricted.

14 – Telstra Limited

We are ok with the proposed table structure

15 – China Mobile Com. Corporation

We are ok with the table structure for deployment scenario.

16 – LG Electronics Inc.

Ok with the proposed tabular form.

17 – Shenzhen Heytap

[OPPO]

OK with this form.

18 – Sony Europe B.V.

We are basically OK with the table format. We would like more clarity on the details of the table structure though. Is the intention that each r_UC is defined in terms of the same set of characteristics:

- r_UC1 has rows for {environment, base station characteristic, topology, spectrum, coexistence, traffic}
- r_UC2 has rows for {environment, base station characteristic, topology, spectrum, coexistence, traffic}
- etc

19 – Nokia Denmark

We agree with the comment from Qualcomm.

20 – ZTE Corporation

We are fine to use Tabular structure to describe each Deployment Scenario.

Moreover, per our observations on the use cases from SA1, we think “with or without CN connection” is another important factor which should be taken into account in the deployment scenario from the beginning of the discussion. So it’s suggested to add a new line “CN connection” in this table.

For the header of last column, we think it’s more suitable to use “description” instead of “value”.

21 – Panasonic Holdings Corporation

OK with the proposed table.

22 – Orange

we are fine

23 – Huawei Tech.(UK) Co.. Ltd

OK for us.

To MediaTek: The basestation characteristic in case there is no basestation could be {none}, or we could add a NOTE: Basestation characteristic applies only to deployments containing basestations. The former option seems more elegant!

CATT: Maybe your comment is in the wrong section. This table does not define use cases, but deployment scenarios, which are RAN’s work in the SID.

Sony: We understood from the moderator’s explanation above the table that in fact the rUC listing would be just once for the whole table in a merged cell, but NWM cannot display merged cells.

24 – TURKCELL

We agree with Qualcomm’s suggestions.

25 – Intel Belgium SA/NV

OK to define representative use case in the tabulated way. We share the views from QC and Lenovo that UE character should also mentioned. One example could be the communication range of A-IoT device which is different from cell coverage assuming the signal of A-IoT device can be relayed by an intermediate node.

<p>26 – Telia Company AB</p> <p>Agree and support Qualcomm proposals.</p>
<p>27 – Ericsson LM</p> <p>We are fine with the overall table structure, but we would like to add a characteristic about ‘Possibility to reuse existing NW deployment’ in the middle column (unless it is made clear that it is included in one of the other characteristics).</p>
<p>28 – KPN N.V.</p> <p>The tabular form is fine, and we agree with Ericsson comments. It is not beneficial to get a new technology that cannot be integrated with existing infrastructure. E.g. not new / separate frequency licenses and separate base stations.</p>
<p>29 – Philips International B.V.</p> <p>We are okay with the table except the “base station characteristic” row, because it could implicitly deprioritize the deployment scenarios via UE, relay, repeater, etc. as stated in SID. We prefer to remove “base station characteristic” row, since it can be covered by connection topology. We also agree with Intel’s input. Furthermore, we agree with Qualcomm to add UE characteristics</p>

4.2 Initial round summary

The tabular format seems agreeable. There are some detailed comments and questions:

- What to do with “basestation characteristic” when there is no basestation (MediaTek, Philips).
 - Moderator response: Suggest adding “if any” to this row.
- If there is an intention to have different tables for e.g. indoor, outdoor, etc. (vivo)
 - Moderator response: See the first FFS under the table. It seems likely to be more convenient to allow multiple values per row in most cases, but it may create some complications in ensuring all value are compatible across rows. Suggest case-by-case is best.
- How to use the grouping approaches for rUCs (Qualcomm)
 - Moderator response: It should be ok to capture more than one set of rUCs in that column, if we agree to more than one grouping method.
- Add row “UE characteristics”, and capture device related aspects later in the deployment scenarios (Qualcomm, Kyocera, Lenovo)
 - Moderator response: Let’s have discussion in the intermediate round on this point. It is not immediately obvious from the SID that a deployment scenario is conditioned on the devices that are present.

- Add with/without CN connection (ZTE)
 - Moderator response: It's possible. Let's have a check in the intermediate round.
- Change "Value" to "description" (ZTE)
 - Moderator response: Seems fine.
- Mapping of rUC to rows (Sony)
 - Moderator response: Just an NWM layout issue. It would be one merged table cell for the rUC list, is the intention.

4.3 Intermediate round

Moderator requests companies input on whether device characteristic should be added to the deployment scenario. According to Qualcomm's comment, it seems we could continue the parallel discussions for the time being, e.g. into RAN#99, and in this meeting have an FFS under this table on if/how to capture devices in deployment scenarios.

Question 3-1: What are your views on including device characteristic in this table, and is it suitable for this meeting to add it as another FFS under the table?

FFS: Whether, and if so how, device characteristic is added to the table.

Feedback Form 8: Question 3-1: What are your views on including device characteristic in this table, and is it suitable for this meeting to add it as another FFS under the table?

<p>1 – Sierra Wireless. S.A.</p> <p>I see no harm in including it or adding FFS.</p>
<p>2 – Beijing Xiaomi Mobile Software</p> <p>From our understanding, device characteristics have impacts on the deployment choice. but currently we have not discussed how device characteristics are captured, so it is OK to just add a FFS under the table</p>
<p>3 – Beijing Xiaomi Mobile Software</p> <p>From our understanding, device characteristics have impacts on the deployment choice. but currently we have not discussed how device characteristics are captured, so it is OK to just add a FFS under the table</p>
<p>4 – Qualcomm Incorporated</p> <p>We think that the potential deployment of e.g., gNB, relay, etc. could depend on the capability of Ambient IoT devices. It would be necessary to have UE characteristics in the table, but how to fill UE characteristics, we need to have further discussion on.</p>

<p>5 – vivo Communication Technology</p> <p>Fine with the FFS</p>
<p>6 – CATT</p> <p>The coverage area of Ambient IoT would depend on the device characteristics.</p>
<p>7 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>OK to have this FFS</p>
<p>8 – Spreadtrum Communications</p> <p>Fine with the FFS</p>
<p>9 – NTT DOCOMO INC.</p> <p>Fine with adding the FFS</p>
<p>10 – Nokia Denmark</p> <p>We support having the UE characteristics in the table. However more discussions/alignment need to enable this.</p>
<p>11 – Apple France</p> <p>We think more discussion would be needed on this and therefore adding the FFS at this point is reasonable</p>
<p>12 – Huawei Tech.(UK) Co.. Ltd</p> <p>It is ok to be FFS. At the moment, we tend to think the FFS may turn out that the effort on devices is best kept in parallel to deployments, but we can see.</p>
<p>13 – Huawei Tech.(UK) Co.. Ltd</p> <p>It is ok to be FFS. At the moment, we tend to think the FFS may turn out that the effort on devices is best kept in parallel to deployments, but we can see.</p>
<p>14 – Kyocera Corporation</p> <p>We support to add the device characteristic in general, while we're fine to leave it to FFS for now since it needs more discussion.</p>
<p>15 – Tejas Networks Ltd.</p> <p>Fine to leave it as FFS.</p>
<p>16 – Panasonic Holdings Corporation</p> <p>For this meeting, we are ok just to add above FFS.</p>

17 – Ericsson LM

We agree that it might be good to add device characteristics to the table, and for now we are fine with the proposed approach to add an FFS on whether/how to do it.

Also, repeating our comment from the initial round, we would like to add a characteristic about ‘Possibility to reuse existing NW deployment’ in the middle column (unless it is made clear that it is included in one of the other characteristics). Perhaps a similar FFS can be added for this aspect.

18 – NOVAMINT

Fine with the FFS for the time being

19 – Samsung Electronics Co.

we are ok for current suggestion

20 – ZTE Corporation

Fine with the FFS on device characteristics.

21 – Intel Belgium SA/NV

We are fine with the proposal. The exact device characteristic can be different in different use cases/deployment scenarios. Therefore, further discussion is helpful

22 – Motorola Mobility España SA

ok, fine to consider the device characteristic, details of the device characteristic depends on the deployment scenario and use cases like Intel suggested

23 – China Telecommunications

Fine with the FFS

24 – MediaTek Inc.

As we have repeatedly stated, this work is driven by the device i.e. adapting the ”system” (where possible) to the device characteristics, not the other way around. So, we do strongly support adding device characteristics.

25 – Sony Europe B.V.

We think device characteristic should be added to the table. One important device characteristic would be whether the device is passive or active. A longer range deployment scenario could be more applicable to active devices whereas shorter range deployment scenarios could be more applicable with passive devices operating with backscattering via a reader.

<p>26 – China Mobile Com. Corporation</p> <p>OK to add FFS</p>
<p>27 – Philips International B.V.</p> <p>Okay with FFS for now.</p>

On including core network, moderator’s notes it is mentioned as potentially included in deployment scenarios in the SID, while not prioritized for RAN effort. Moderator can see two ways to handle this – either as a row in this table, or under “required functionalities” in the third objective

Question 3-2: Where, and if, companies would like to mention with/without CN as a deployment characteristic.

Option 1: As a deployment scenario characteristic

Option 2: As a “required functionality” under the 3rd objective in the SID.

Feedback Form 9: Question 3-2: Where, and if, companies would like to mention with/without CN as a deployment characteristic: option 1 or option2?

<p>1 – Qualcomm Incorporated</p> <p>Option 2 is preferred. The deployment scenario is more about RAN side architecture. With/without CN could be handled separately under the 3rd objective – including the functionality of CN.</p>
<p>2 – vivo Communication Technology</p> <p>Share Qualcomm’s view.</p>
<p>3 – CATT</p> <p>Option 2: The CN needs to be included in the Ambient IoT network architecture discussion.</p>
<p>4 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>We prefer option 2.</p>
<p>5 – LG Electronics Inc.</p> <p>Given the related NOTE in the current SID (i.e., “NOTE: The study shall not prioritize deployment aspects that should be coordinated with SA, e.g. public or private network, with or without CN connection.”), we prefer option 1 or maybe check with SA first before concluding here.</p>

<p>6 – LG Electronics Inc.</p> <p>Given the related NOTE in the current SID (i.e., “NOTE: The study shall not prioritize deployment aspects that should be coordinated with SA, e.g. public or private network, with or without CN connection.”), we prefer option 1 or maybe check with SA first before concluding here.</p>
<p>7 – LG Electronics Inc.</p> <p>Given the related NOTE in the current SID (i.e., “NOTE: The study shall not prioritize deployment aspects that should be coordinated with SA, e.g. public or private network, with or without CN connection.”), we prefer option 1 or maybe check with SA first before concluding here.</p>
<p>8 – Spreadtrum Communications</p> <p>Option1 is preferred.</p>
<p>9 – NTT DOCOMO INC.</p> <p>We share the view with Qualcomm</p>
<p>10 – Nokia Denmark</p> <p>We support option #2</p>
<p>11 – Apple France</p> <p>We support option#2 as well.</p>
<p>12 – VODAFONE Group Plc</p> <p>option 2 is preferred.</p>
<p>13 – VODAFONE Group Plc</p> <p>option 2 is preferred.</p>
<p>14 – VODAFONE Group Plc</p> <p>Option 2 is preferred.</p>
<p>15 – VODAFONE Group Plc</p> <p>Option 2 is preferred.</p>
<p>16 – Huawei Tech.(UK) Co.. Ltd</p> <p>We think it is cleaner to have these tables focus on the RAN side of the question, which we can spend time on in detail. Then the level at which to capture and discuss CN is better taken via Option 2.</p>

<p>17 – Kyocera Corporation</p> <p>We prefer Option 2, and we have similar view as Qualcomm.</p>
<p>18 – Panasonic Holdings Corporation</p> <p>We are ok with either of the options. Small preference toward option 1.</p>
<p>19 – Ericsson LM</p> <p>We prefer Option 2, which is enough for a more general discussion. With Option 1, there would be a case-to-case discussion that seems too detailed given the note in the SID that “The study shall not prioritize deployment aspects that should be coordinated with SA, e.g. public or private network, with or without CN connection”.</p>
<p>20 – NOVAMINT</p> <p>option 2 is preferred</p>
<p>21 – Samsung Electronics Co.</p> <p>option 2 preferred</p>
<p>22 – Intel Belgium SA/NV</p> <p>Option 2 is preferred. The tabulated deployment scenarios can focus on RAN aspects</p>
<p>23 – MediaTek Inc.</p> <p>Option 2 - this study is a RAN study, and ought to focus on RAN aspects. CN aspects (if any) need not be considered.</p>
<p>24 – ZTE Corporation</p> <p>Option 1: We more and more think “with/without CN” is one of the basic aspects which needs to be considered in the deployment scenarios. For example, Topologies discussed in “Feedback Form 16: Question 4-4” may have different assumptions on connection to CN, which may have impacts on the later detailed discussion for all these Topologies.</p>
<p>25 – China Mobile Com. Corporation</p> <p>Prefer option 1.</p> <p>Whether CN is needed or not, depends on the deployment scenario. For example, for a local A-IoT network inside a factory, the CN is not needed, in order to guarantee the data kept within factory.</p>

For information, the table would consequently appear as below, where [...] simply indicate the decisions to be made above.

Table 2: Deployment Scenario X

Applicable representative use cases	Characteristic	Value-Description
	Environment (of device)	
	Basestation characteristic (<i>if any</i>)	
	Connectivity topology	
rUC1, rUC2, ..., ...	Spectrum	
	Coexistence with existing 3GPP technologies	
	Traffic assumption	
	<i>[With or without CN connectivity]</i>	

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)

[FFS: Whether device characteristic is added to the table.]

4.4 Intermediate round summary

3-1: On adding FFS for device characteristics

There is wide support for adding the FFS device characteristics and stabilizing the table. There are some companies much in favor of adding device characteristics directly as a row now, but it seems clear from the replies that we should accept an FFS, and this does not at all prevent the strong proponents achieving their goal next meeting. It is a valid discussion to have, clearly.

Ericsson: Point about possibility to re-use existing NW deployment is precisely the point of discussion in setting the descriptions in Topic 4-3b (i.e., section 5.3). Please refer to that discussion.

3-2 On handling of with/without CN

Approximately 18 companies like option 2, compared to approximately 5 liking option 1 (one of which “slightly”).

Moderator notes an additional advantage for option 2, which may be of interest to those who would include CN in this table, of taking it under “required functionality” potentially allowing a more general listing (at a simple level) of aspects such as security being required, which are mentioned by a couple of companies, whereas if confined to this table it seems not convenient.

Hence, moderator hopes companies can compromise here. In any case, without consensus to add it, we can still discuss it from scratch

4.5 Final round

Based on the summary and explanations, the table is hopefully stable as follows, and the moderator will note that we take CN under the 3rd SID objective, so this is clearly recorded.

Conclusion 3-2: Discussion of CN-related aspects will be under the third objective of the SID.

Proposal 3-1: Agree to capture deployment scenarios as follows:

Table 3: Deployment Scenario <X>

Applicable representative use cases	Characteristic	Description
	Environment (of device)	
	Basestation characteristic (if <u>any</u>)	
	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)

FFS: Whether device characteristic is added to the table.

Feedback Form 10: Is this now stable to agree?

<p>1 – Sierra Wireless. S.A.</p> <p>agree</p>
<p>2 – Qualcomm Incorporated</p> <p>We agree</p>

3 – Spreadtrum Communications Yes, agree.
4 – NTT DOCOMO INC. Agree
5 – vivo Communication Technology OK
6 – Apple France Agree
7 – Samsung Electronics Co. ok
8 – Shenzhen Heytap [OPPO] ok
9 – THALES Agree
10 – Nokia Denmark OK
11 – VODAFONE Group Plc Agree
12 – China Unicom Agree
13 – China Mobile Com. Corporation Agree
14 – Huawei Tech.(UK) Co.. Ltd Yes, we agree.
15 – Intel Belgium SA/NV Agree

16 – ZTE Corporation

We think **Conclusion 3-2** is not so needed.

Honestly to say, the working scope and the expected output of the third objective of the SID is still not crystal clear to us. (But we have no intention to clarify this objective/WID)

We also don't think we can figure out much on the CN functionality. We care much about complete description on the deployment scenarios (with factors as enough as possible) in order to avoid any confusion in later discussion.

So can we also add a FFS on this aspect?

FFS: Whether factor of CN connection (w or w/o) is added to the table.

17 – Panasonic Holdings Corporation

Ok

18 – Kyocera Corporation

We agree.

19 – Ericsson LM

Agree

20 – NOVAMINT

OK

21 – MediaTek Inc.

Apologies for a dumb question: but what exactly is the "3rd objective" in the SID: is this the one? "*Compare and assess the feasibility of meeting the design targets for relevant use case on the basis of the deployment scenario(s) appropriate to it, and identify assumptions on required functionality to be supported.*NOTE: *This is not to require a detailed WG-level analysis*"

22 – Telia Company AB

Ok.

23 – Philips International B.V.

Agree.

4.6 Final round summary

To MediaTek: Yes, that is the 3rd objective of the SID.

To ZTE: Your suggested FFS would go back to Q3-2 in the intermediate round when the outcome was a clear direction as per the conclusion 3-2 (18 companies to 5). I hope you can see we cannot go back at this point, of the extended round. What I can suggest is that if the discussion of CN aspects comes to something that really does need to go in the deployment scenarios table, it'll be possible to point it out, and companies can reach a consensus to add it.

Thus no extended round and moderator will ask the chair to endorse.

Conclusion 3-2: Discussion of CN-related aspects will be under the third objective of the SID.

Proposal 3-1 for agreement: Capture deployment scenarios as follows:

Table 4: Deployment scenario <X>

Applicable representative use cases	Characteristic	Description
	Environment (of device)	
	Basestation characteristic (if any)	
	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)

FFS: Whether device characteristic is added to the table.

5 Topic 4 - Deployment scenario characteristics

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.

5.1 Topic 4-1: Environment

5.1.1 Initial round

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

<p>1 – Samsung Electronics Co.</p> <p>We support both indoor and outdoor based on SA1’s use cases.</p>
<p>2 – VODAFONE Group Plc</p> <p>there are some use cases which is supported in indoor and outdoor scenarios. Hence, not only the indoor or outdoor scenarios but also indoor and outdoor scenarios should be considered.</p>
<p>3 – MediaTek Inc.</p> <p>Indoor and/or outdoor should be possible.</p>
<p>4 – Spark NZ Ltd</p> <p>The use cases should be based on SA1 use cases and include both indoor and outdoor deployments</p>
<p>5 – Huawei Tech.(UK) Co.. Ltd</p> <p>Yes, agreeable. An ambient IoT device could be placed in either indoor or outdoor environment, according to use cases identified in SA1.</p> <p>To Vodafone, et al., on the possibility of a use case existing indoor and outdoor – (i) we understand the suggestion is addressed by the first FFS under the table (and its specific example); or (ii) there could be one deployment scenario table for each of indoor, and outdoor, both of which the rUC is linked.</p> <p>In addition, we would recommend RAN also consider service area size to describe the environment of ambient IoT device. It affects what deployment scenario a representative use case(s) applies to.</p>

6 – Sierra Wireless. S.A. Agreeable
7 – Apple France We agree with both indoor and outdoor environment
8 – Futurewei Technologies Agree to consider both indoor and outdoor environment
9 – vivo Communication Technology OK
10 – NTT DOCOMO INC. Agree
11 – Kyocera Corporation We support both indoor and outdoor deployments.
12 – Spreadtrum Communications Yes, agreeable.
13 – Motorola Mobility España SA [Lenovo] Both indoor and outdoor use cases needs to be supported
14 – CATT Indoor and outdoor includes all scenarios. It is OK but not a good categorization.
15 – Telstra Limited Both indoor and outdoor scenarios need to be included.
16 – China Mobile Com. Corporation Agree indoor and/or outdoor should be considered.
17 – Qualcomm Incorporated We are ok to assume that it could be either indoor or outdoor. To make it clearer, it would be good to explicitly replace “Environment” with “Environment for devices”.

<p>18 – LG Electronics Inc.</p> <p>Yes</p>
<p>19 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>Indoor and/or outdoor shall be considered.</p> <p>But in SA1 use cases, there may be more complicated use cases. For example, use case 15, smart laundry, the device may work within the washing machine.</p> <p>In use cases 5.24, smart manhole cover monitoring, outdoor but may be underground.</p> <p>Such detail shall also be considered since it has significant on the requirement of the system.</p>
<p>20 – Sony Europe B.V.</p> <p>Yes. Device can be either indoor or outdoor. From a deployment perspective, some devices can be indoor and some outdoor within the same deployment.</p>
<p>21 – Nokia Denmark</p> <p>Yes, both needs to be considered.</p>
<p>22 – ZTE Corporation</p> <p>We have sympathy with Vodafone’s comments. We understand the main point to clarify is that we can’t restrict a certain deployment to serve only indoor or only outdoor devices. For example we think the case where an outdoor deployment can also server the indoor devices needs to be considered.</p> <p>For the service area size suggested by Huawei, we think it’s the detail under the indoor or outdoor environment. So it can be discussed later, together with some other relevant factors, e.g., mobility, connection density.</p>
<p>23 – Panasonic Holdings Corporation</p> <p>We support FL view..</p>
<p>24 – NEC Corporation</p> <p>Agreeable. We think Ambient IoT environment should support both from RAN’s perspective based on SA1’s use cases.</p>
<p>25 – Orange</p> <p>There are 3 types of use cases from the device location perspective: full indoor, full outdoor and a mix of indoor and outdoor (for devices in mobility). All 3 cases should be considered.</p>

26 – TURKCELL We support both indoor and outdoor deployments.
27 – Intel Belgium SA/NV We are supportive to the proposal
28 – Telia Company AB Both indoor and outdoor to be considered.
29 – Ericsson LM Agree.
30 – China Telecommunications It is OK.
31 – KPN N.V. Indoor and outdoor deployments are to be considered.
32 – Philips International B.V. We support both indoor and outdoor scenarios: quite a few number of use cases in TR 22.840 cover both indoor and outdoor scenarios. We think that additional details may be added, such as service area as suggested by Huawei or additional characteristics such as underground as suggested by Oppo.

5.1.2 Initial round summary

All companies agree to indoor and outdoor.

- VDF suggests to add the option “indoor and outdoor”. MediaTek, CMCC, OPPO, ZTE, Orange, Sony also mentions as well.
 - Moderator response: This was anticipated the first FFS below deployment scenario table in Topic 3. Seems we can agree, for this row, to have the joint option also. Note that other rows can be discussed separately.
- Huawei recommend to consider service area size in addition. ZTE think it can be discussed as details of indoor and outdoor later. OPPO also mention some specific details such inside a washing machine, or under a manhole cover.
 - Moderator response: Whilst service area size may affect what is a suitable deployment, the moderator wonders whether we can take the finer SA1 details at WG level, by finding a way to express them under ‘design targets’ (e.g. coverage). It seems less desirable to replicate the fine granularity of the SA1 use cases into RAN in full.

- Qualcomm suggest it would be good to explicitly replace ‘Environment’ with ‘Environment for devices’
 - Moderator response: OK.

- ZTE think need to consider the case where an outdoor deployment can also serve the indoor devices
 - Moderator response: This O2I can captured in the existing table by correctly populating the right-hand column.

5.1.3 Intermediate round

According to the initial round summary:

Proposal 4-1: Agree that:

- ‘Environment of device’ can be ‘indoor’, ‘outdoor’, ‘indoor or outdoor’.
 - FFS: Whether to further describe the size of the served area.

Feedback Form 12: Is Proposal 4-1 agreeable?

1 – Sierra Wireless. S.A. Yes
2 – Beijing Xiaomi Mobile Software Yes. and we also think it is good to describe the expected coverage range.
3 – Qualcomm Incorporated We agree
4 – vivo Communication Technology OK
5 – CATT We don't think the need of this discussion.
6 – Shenzhen Heytap [OPPO] Agree

7 – Spreadtrum Communications Yes, agreeable.
8 – NTT DOCOMO INC. Agree
9 – Nokia Denmark Agree
10 – Apple France Agree
11 – VODAFONE Group Plc agree
12 – Huawei Tech.(UK) Co.. Ltd Agree.
13 – Kyocera Corporation We agree.
14 – Tejas Networks Ltd. Agree
15 – Panasonic Holdings Corporation We agree the proposal.
16 – Ericsson LM Agree
17 – NOVAMINT agree
18 – Samsung Electronics Co. ok and agree

<p>19 – ZTE Corporation</p> <p>Fine with the bullet.</p> <p>But for the FFS, we may have different understanding on the size of the served area. We think it may be less important for the RAN design. It's easy to understand that large served area can be covered by multiple gNBs while small served area can be covered by a few gNBs. But the cell coverage/capacity of the gNB can be same.</p> <p>So either way we can add something like cell coverage, mobility and connection density (see below), or we remove the FFS now and leave all the potential detailed aspects to be discussed later.</p> <p>The change suggestion is that: FFS: Whether to further describe <u>other aspects (e.g., the size of the served area, cell coverage, mobility and connection density)</u></p>
<p>20 – Intel Belgium SA/NV</p> <p>Agree</p>
<p>21 – Motorola Mobility España SA</p> <p>ok, for each of the deployment scenario - coverage of the device which also dependent on the device characteristic, coverage range, density of the device etc., may need to be defined otherwise serving area as no meaning.</p>
<p>22 – China Telecommunications</p> <p>Agree</p>
<p>23 – MediaTek Inc.</p> <p>Agree</p>
<p>24 – Sony Europe B.V.</p> <p>OK</p>
<p>25 – China Mobile Com. Corporation</p> <p>Agree</p>
<p>26 – Philips International B.V.</p> <p>Okay.</p>

5.1.4 Intermediate round summary

There is no major disagreement.

To ZTE, Motorola: As already clarified, design targets such as coverage, mobility, connection density, are

under the related 3rd objective, which will get discussed in the next two meetings (and are excluded in this meeting). Discussion of RAN design targets, followed by the feasibility consideration should lead to the question of *whether* a deployment is suitable on the parameters you highlight. I hope that we can deal with your point at high level this time, and you can raise further discussion in future. Thanks.

5.1.5 Final round

The moderator proposes a small update to the FFS in relation to ZTE/Motorola, but as with other areas, we will not have discussions on design targets in this meeting.

Proposal 4-1v2: Agree that:

- ‘Environment of device’ can be ‘indoor’, ‘outdoor’, ‘indoor or outdoor’.
 - FFS: Whether to further describe other aspects, e.g. the size of the served area.

Feedback Form 13: Is this updated proposal agreeable?

1 – Sierra Wireless. S.A. yes
2 – Qualcomm Incorporated We agree
3 – Spreadtrum Communications Yes, agree.
4 – NTT DOCOMO INC. Agree
5 – vivo Communication Technology OK
6 – Apple France Agree
7 – Samsung Electronics Co. ok
8 – Shenzhen Heytap [OPPO] ok

9 – THALES Agree
10 – EURECOM Agree
11 – Nokia Denmark OK
12 – Huawei Tech.(UK) Co.. Ltd Yes, agree
13 – VODAFONE Group Plc Agree
14 – China Unicom Agree
15 – China Mobile Com. Corporation Agree
16 – Intel Belgium SA/NV Yes
17 – ZTE Corporation Ok.
18 – Panasonic Holdings Corporation Ok
19 – Kyocera Corporation We agree.
20 – Ericsson LM Agree
21 – NOVAMINT Agree

22 – MediaTek Inc.

NOTE: We are not quite sure what the "size of the served area" actually refers to. There is already a range target. Anyway, FFS is ok

23 – Telia Company AB

Agree.

24 – Philips International B.V.

Agree.

5.1.6 Final round summary

All companies are OK. Thanks to MediaTek for taking your point under the FFS. Chair will be requested to endorse the proposal. No extended round.

Proposal 4-1v2, for agreement:

- *'Environment of device' can be 'indoor', 'outdoor', 'indoor or outdoor'.*

5.2 Topic 4-2: Basestation characteristic

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 14: 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?

1 – Samsung Electronics Co.

We are ok to include pico and micro considering link budget of ambient IoT, but not sure whether macro cell is really workable for direction connection. We think basestation deployment should be considered together with topology. For example, direction gNB for pico and micro, and relay based for macro.

<p>2 – VODAFONE Group Plc</p> <p>agree on the support of macro-cell, micro-cell and pico-cell deployment scenario</p>
<p>3 – MediaTek Inc.</p> <p>Dependent on topology and max range. We're not convinced macro cell is relevant.</p>
<p>4 – Huawei Tech.(UK) Co.. Ltd</p> <p>Yes, agreeable. We suggest it is too early to rule a particular deployment out, before assessing demand and feasibility, especially since there are a variety of connectivity topologies proposed which could play into the views.</p> <p>These terminologies are in-line with RAN4 specification and can be used as candidate values of 'Basestation characteristic' in our view.</p>
<p>5 – Sierra Wireless. S.A.</p> <p>Agree - and should include macro, at least for now.</p>
<p>6 – Apple France</p> <p>We support both micro-cell and pico-cell based deployment, but not sure if macro-cell based deployment should be included.</p>
<p>7 – Futurewei Technologies</p> <p>We are fine to include all 3 options at the beginning of study. For macro-cell, it is most relevant when FDD spectrum is used. However, the ISD for macro-cell may have to be relatively small in order to connect with Ambient IoT devices.</p>
<p>8 – vivo Communication Technology</p> <p>OK</p>
<p>9 – NTT DOCOMO INC.</p> <p>Agree. All BS characteristics should be included for now. Appropriate one(s) can be discussed together with topology later.</p>
<p>10 – Kyocera Corporation</p> <p>We're fine to include all of macro-cell, micro-cell and pico-cell deployments. We have similar view as Samsung that these base station characteristics are related to the topology options.</p>
<p>11 – Spreadtrum Communications</p> <p>Yes, agreeable. And we also share the observation and potential refinement by Samsung.</p>

<p>12 – Motorola Mobility España SA</p> <p>[Lenovo] Consider basestation characteristic for deployment together with the connectivity topology as Samsung suggested</p>
<p>13 – CATT</p> <p>Macro, micro, and pico base stations are categorized based on Tx power. We should also include the mobile base station with IAB backhaul.</p>
<p>14 – Telstra Limited</p> <p>We agree with Huawei, its too early to rule out particular deployment architectures, therefore agree on the support of macro-cell, micro-cell and pico-cell deployment scenarios</p>
<p>15 – China Mobile Com. Corporation</p> <p>Agree. At this stage, we support to study all these macro-cell, micro-cell and pico-cell deployments.</p>
<p>16 – Qualcomm Incorporated</p> <p>We agree with the given choices of base stations deployments for initial consideration, although once the target device types are narrowed down, some of the base station deployment cases may become irrelevant.</p>
<p>17 – LG Electronics Inc.</p> <p>Yes</p>
<p>18 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>We are ok to include Macro at this early stage, but not sure whether it is feasible.</p> <p>Based on the requirement in SA1, the required maximum communication distance is 250m.</p>
<p>19 – Sony Europe B.V.</p> <p>We first need to agree on the network topology and role definitions of different devices/nodes, before making any decision on the base-station deployment. For example, if a tag talks to a reader (intermediate node) and the reader talk to the basestation, the basestation characteristic might not be that important.</p>
<p>20 – Nokia Denmark</p> <p>Yes, all needs to be considered.</p>
<p>21 – Wiliot Ltd.</p> <p>We support all 3 options including making macro base station connectivity to Ambient IoT possible, as it is needed on some use cases.</p>

<p>22 – ZTE Corporation</p> <p>Agree with Vodafone and some other companies that all macro-cell, micro-cell and pico-cell deployment scenario should be considered.</p> <p>We see many use cases that have requirement on the certain large coverage/mobility for the Ambient IoT devices.</p>
<p>23 – Panasonic Holdings Corporation</p> <p>We support FL view.</p>
<p>24 – NEC Corporation</p> <p>Agree. Macro-cell based deployment needs to be included in the study.</p>
<p>25 – Orange</p> <p>yes all 3 cases (macro, micro & pico) should be considered</p>
<p>26 – TURKCELL</p> <p>We support all three cases.</p>
<p>27 – Intel Belgium SA/NV</p> <p>We support the categorize base station as macro, micro and pico, which can provide additional differentiation to the division of indoor/outdoor</p>
<p>28 – Telia Company AB</p> <p>All 3 cases to be considered.</p>
<p>29 – China Telecommunications</p> <p>Fine with FL view. Macro-cell can be supported at least for this stage</p>
<p>30 – Ericsson LM</p> <p>Yes, all three cases need to be considered.</p>
<p>31 – KPN N.V.</p> <p>All the 3 cell types need to be considered</p>
<p>32 – Philips International B.V.</p> <p>Similar to our answer to Topic 3, we prefer to remove this characteristic and have it covered by 4-4 Connectivity topology. It is more appropriate to discuss base station characteristics in different connectivity topology options.</p>

5.2.1 Initial round summary

The vast majority of companies are OK with the proposal that basestation characteristic can be macro-cell based deployment, micro-cell based deployment, or pico-cell based deployment. Some companies express concerns on macro-cell with feasibility or relationship to topology, etc. Moderator think these can be addressed in later study when discuss topology or feasibility, and can have further conclusion or recommendation in the end of the study.

CATT mention mobile IAB. Moderator is not sure if that is any different than a typical cell size from the proposed list, since an IAB node is a logical entity and relay function.

3 companies ask about a case where there is no basestation involved. The SID tells us to include this characteristic, so the case in question can be represented by having the description “None” for this row.

A few companies suggest to consider BS characteristic together with topology. Since the deployment scenarios table in Topic 3 does that naturally, the moderator assumes that companies will find suitable expressions and restrictions for how to populate the table.

5.2.2 Intermediate round

Based on the summary of the initial round, the moderator thinks we can continue with the existing proposal slightly refined:

Proposal 4-2: Agree that ‘basestation characteristic’ can be: macro-cell based deployment, micro-cell based deployment, pico-cell base deployment, or none.

- *FFS: If/how it is necessary to reflect mobile IAB basestation.*

Feedback Form 15: Is Proposal 4-2 agreeable?

1 – Sierra Wireless. S.A. Yes
2 – Beijing Xiaomi Mobile Software If IAB will be added in FFS, we suggest to add repeater/relay in FFS as well.
3 – Qualcomm Incorporated We agree
4 – vivo Communication Technology OK
5 – CATT Ok

<p>6 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>ok</p>
<p>7 – Spreadtrum Communications</p> <p>Yes, agreeable.</p>
<p>8 – NTT DOCOMO INC.</p> <p>Agree</p>
<p>9 – Nokia Denmark</p> <p>Agree</p>
<p>10 – Nokia Denmark</p> <p>Agree</p>
<p>11 – Apple France</p> <p>Based on the initial round summary from moderator, we can agree with this proposal</p>
<p>12 – Apple France</p> <p>Based on the initial round summary from moderator, we can agree with this proposal</p>
<p>13 – VODAFONE Group Plc</p> <p>Agree</p>
<p>14 – Huawei Tech.(UK) Co.. Ltd</p> <p>This is ok, but we do not see a need to add further to the FFS, since these types of node are themselves macro/micro/etc., and are properly handled as topologies (where they are being already discussed).</p>
<p>15 – Kyocera Corporation</p> <p>We agree.</p>
<p>16 – Tejas Networks Ltd.</p> <p>Agree</p>
<p>17 – Panasonic Holdings Corporation</p> <p>We agree the proposal.</p>

18 – NOVAMINT OK
19 – Ericsson LM Fine to add “none” to capture SL cases. Since an IAB node is largely indistinguishable from a BS for a UE, we think it is not necessary for further complicate this already very wide discussion. Therefore, IAB need not be listed separately but it instead implicit that any BS could be an IAB node.
20 – Samsung Electronics Co. agree
21 – ZTE Corporation We agree with Xiaomi’s suggestion. Also fine with other suggestion to have no FFS on IAB.
22 – Intel Belgium SA/NV Same view as Xiaomi. If IAB is considered special case of BS, we should also mention repeater/relay, since all 3 kinds of nodes are extension of network and transparent to UE.
23 – Motorola Mobility España SA Yes same view as Xiaomi and Intel to include repeaters, relays etc.,
24 – MediaTek Inc. We would like to repeat our concern on ”macro-cell” - this does not fit with the use cases at hand.
25 – China Telecommunications We agree
26 – Sony Europe B.V. OK
27 – China Mobile Com. Corporation Agree.

5.2.3 Intermediate round summary

On the FFS, at least 4 companies raise concerns that a mobile IAB is just one special case of whatever ‘size’ BS is being described. Moderator suggests there is not much value (at RAN plenary level) in itemizing all the different sub-types which are well enough known, just inside an FFS. Based on contributions, it is not explained what impact these sub-types might have, and companies will have a hard time to judge it as a result. Therefore, moderator will replace the FFS by a statement to this effect.

The suggestion from MediaTek to remove ‘macro-cell based’ does not have support. As before, the moderator thinks matters of company priority/preference are going to be handled when it comes to

recommendations/conclusions. Companies not interested in macro-cell deployments can focus their inputs on the other cases, if they wish.

5.2.4 Final round

The replacement for the FFS is as follows, and hopefully this can be an acceptable compromise.

Proposal 4-2: Agree that 'basestation characteristic' can be: macro-cell based deployment, micro-cell based deployment, pico-cell base deployment, or none.

- ***Companies are encouraged to discuss if there are additional necessary details of these descriptions in following meetings.***

Feedback Form 16: Is this proposal agreeable?

1 – Sierra Wireless. S.A. yes
2 – Qualcomm Incorporated We agree
3 – Spreadtrum Communications Yes, agree.
4 – NTT DOCOMO INC. Agree
5 – vivo Communication Technology OK
6 – Apple France Agree
7 – Samsung Electronics Co. ok
8 – Shenzhen Heytap [OPPO] ok

9 – THALES Agree
10 – EURECOM We agree
11 – Nokia Denmark Agree
12 – Huawei Tech.(UK) Co.. Ltd Yes
13 – China Unicom Yes
14 – China Mobile Com. Corporation Agree
15 – Intel Belgium SA/NV Yes
16 – ZTE Corporation Ok.
17 – Panasonic Holdings Corporation Ok
18 – Kyocera Corporation We agree.
19 – Ericsson LM Agree
20 – NOVAMINT OK
21 – MediaTek Inc. Once again we are concerned with the macro-cell target - this is not in line with the current use cases. Of course we don't oppose the above, but at least it might be good to record this (some other comments were made in this direction re: macro cell suitability/lack thereof)

22 – Telia Company AB Agree.
23 – Philips International B.V. Agree.

5.2.5 Final round summary

All companies agree. Chair will be requested to endorse the proposal 4-2. **No extended round for proposal 4-2.**

To MediaTek, thanks again for the flexibility. The moderator understands you'd like the moderator summary to record your concern as to macro cells. Thus we can do it as below, without needing an extended round.

Moderator note: Some companies still have a concern on whether the macro-cell based deployments are in line with current use cases.

Proposal 4-2 for agreement: 'Basestation characteristic' can be: macro-cell based deployment, micro-cell based deployment, pico-cell base deployment, or none.

- ***Companies are encouraged to discuss if there are additional necessary details of these descriptions in following meetings.***

5.3 Topic 4-3: Coexistence with UEs and infrastructure

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 17: 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?

<p>1 – VODAFONE Group Plc</p> <p>agree</p>
<p>2 – MediaTek Inc.</p> <p>These different scenarios likely open the door to a wide range of band support which will inevitably lead to prohibitive complexity for ultra simple devices (which we do see remain the primary target for this work). Global operation and very limited #bands need to be targeted to keep complexity low and potential for economies of scale high. It might be ok to consider deployments as indicated above, so long as there is NO implicit requirement all these options must be supported.</p> <p>In our view the study need to be driven from the constraints of the device itself and what these impose on the system as opposed to try and make the existing system fit into the device.</p>
<p>3 – Spark NZ Ltd</p> <p>we support MediaTek</p>
<p>4 – Huawei Tech.(UK) Co.. Ltd</p> <p>Yes, agree with moderator’s proposal. We don’t see the need to preclude any of the 3 potential ways for the study.</p> <p>On MediaTek’s point, we would suggest returning to the question of inclusion when writing conclusion-s/recommendations in the TR, or in onward SID drafting, etc. Whereas this RAN-stage SI can provide broadly useful input to that process.</p>
<p>5 – Sierra Wireless. S.A.</p> <p>agree with FL’s proposal.</p>
<p>6 – Apple France</p> <p>We are fine with moderator’s proposal</p>
<p>7 – Futurewei Technologies</p> <p>We are ok to include these 3 options at the beginning of study. However, to our understanding, the fundamental technical study of these 3 options is largely common with unique aspects of each that can be dealt with much later</p>
<p>8 – vivo Communication Technology</p> <p>OK</p>

<p>9 – NTT DOCOMO INC.</p> <p>Agree</p>
<p>10 – Kyocera Corporation</p> <p>We're fine with all deployments, i.e., in-band, guard-band and standalone.</p>
<p>11 – Spreadtrum Communications</p> <p>Yes, agreeable.</p>
<p>12 – Motorola Mobility España SA</p> <p>[Lenovo] Agree, in addition consider frequency deployment, UHF band is the popular frequency band for RFID deployment in this license exempt/unlicensed Frequency and C-band for indoor factory</p>
<p>13 – CATT</p> <p>We are OK with the lists of operation frequency. We should prioritize the inband operation.</p>
<p>14 – China Mobile Com. Corporation</p> <p>Agree with moderator's proposal.</p>
<p>15 – Telstra Limited</p> <p>Ok with the moderators proposal, all three deployment modes should be considered at this stage</p>
<p>16 – Qualcomm Incorporated</p> <p>We are open to study these options, although once the device type is narrowed down, some of the options may become irrelevant due to lack of appropriate filtering capability.</p>
<p>17 – LG Electronics Inc.</p> <p>Yes, with clarifying "standalone from NR to standalone band from NR"</p>
<p>18 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>We can consider all these 3 modes but prefer to put high priority to standalone and in-band mode.</p>
<p>19 – Sony Europe B.V.</p> <p>OK</p>
<p>20 – Nokia Denmark</p> <p>We are ok to study all the scenarios, assuming we can narrow down the scope.</p>

<p>21 – Wiliot Ltd.</p> <p>We support in-band or standalone as the best scope.</p>
<p>22 – Panasonic Holdings Corporation</p> <p>We support FL view.</p>
<p>23 – ZTE Corporation</p> <p>As we have no any conclusion on the UE complexity, we are fine with moderator’s proposal and see nothing to be precluded.</p>
<p>24 – NEC Corporation</p> <p>Agree. From coexistence’s perspective, we think all of moderator proposed deployment should not be precluded for the flexibility of operation. On the other hand, we agree with MediaTek that there could be very limited #bands need from operation band’s perspective.</p>
<p>25 – Orange</p> <p>we agree</p>
<p>26 – TURKCELL</p> <p>We agree.</p>
<p>27 – Intel Belgium SA/NV</p> <p>We are fine to the proposal</p>
<p>28 – Ericsson LM</p> <p>It is fine to study all three deployment cases, but we prefer to prioritize in-band deployment.</p>
<p>29 – China Telecommunications</p> <p>We agree</p>
<p>30 – KPN N.V.</p> <p>Our preference is to give priority to the in-band deployment.</p>
<p>31 – Philips International B.V.</p> <p>We agree.</p>

(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.*

Feedback Form 18: Question 4-3b: For basestation deployments, is it agreeable to allow “coexistence with existing 3GPP technologies” to be described as above?

<p>1 – VODAFONE Group Plc agree</p>
<p>2 – Spark NZ Ltd agree</p>
<p>3 – Huawei Tech.(UK) Co.. Ltd Yes.</p>
<p>4 – Samsung Electronics Co. Yes</p>
<p>5 – Apple France Yes, it is agreeable</p>
<p>6 – Futurewei Technologies It is agreeable.</p>
<p>7 – vivo Communication Technology OK</p>
<p>8 – NTT DOCOMO INC. Agree</p>
<p>9 – Kyocera Corporation We’re wondering if the “existing 3GPP deployment” includes the legacy 3GPP system such as LTE. We also wonder if there is any difference between the second bullet “<i>Deployed without an assumption of an existing 3GPP deployment</i>” and the standalone deployment.</p>

10 – Spreadtrum Communications Yes.
11 – Motorola Mobility España SA [Lenovo] Agree
12 – CATT Agree
13 – Telstra Limited Agree
14 – China Mobile Com. Corporation Agree
15 – Qualcomm Incorporated We agree
16 – LG Electronics Inc. Yes
17 – Shenzhen Heytap [OPPO] Agree
18 – Sony Europe B.V. The coexistence issue is presumably about whether ambient IoT devices can operate within the coverage area of an existing 3GPP deployment. Hence, the issue is not about whether deployment can be about deployment of nodes on the same site. We also don't see a coexistence issue if there is no existing 3GPP deployment (what thing would the Ambient IoT device need to coexist with if there were no existing 3GPP deployment?).
19 – Nokia Denmark Yes, we agree
20 – ZTE Corporation Agree.

21 – Panasonic Holdings Corporation We support FL view.
22 – Orange we agree
23 – TURKCELL We agree.
24 – Intel Belgium SA/NV We are fine to the proposal
25 – Ericsson LM Yes, and it would be good to also capture assumptions on whether new NW hardware deployment is required or not.
26 – KPN N.V. Agree. And integrateing with the existing infrastructure is desirable.
27 – Philips International B.V. We agree

5.3.1 Initial round summary

Topic 4-3a: Coexistence with UEs.

The proposal has support from the vast majority of companies, and a few companies mention their preferences for prioritization. Qualcomm and MediaTek raise the point of what the device might, or would, support in practice. For these type of points, the moderator suggests further discussion under e.g. required functionalities and/or when writing recommendations and conclusions for the TR.

Lenovo mention UHF bands, which seems adequately addressed by “standalone from NR”. Details of frequency bands may be more conveniently discussed under “spectrum”.

LG ask to clarify “standalone band from NR” ,which seems fine.

Topic 4-3b: Co-deployment with existing 3GPP deployment

All companies agreed to the first round suggestion, with a couple of additional questions.

- Kyocera: Ask (1) if the “existing 3GPP deployment” includes the legacy 3GPP system such as LTE. And (2) if there is any difference between the second bullet “Deployed without an assumption of an existing 3GPP deployment” and the standalone deployment.
 - Moderator response: It just refers to whether there is existing infrastructure sites, agnostic to what legacy/existing RAT is on those sites, or what bands those existing sites are using.
- Sony: Moderator responds that if there is no existing 3GPP deployment, that is the second bullet of the proposal. It refers to e.g. whether Ambient IoT is convenient to deploy on the same sites as existing network (first bullet), vs. when there is no existing infrastructure (second bullet).

5.3.2 Intermediate round

Topic 4-3a: Coexistence with UEs.

Based on the initial round summary, the moderator thinks we can agree with the existing proposal, and take questions of prioritization at a later stage.

Proposal 4-3a: Agree that the study considers Ambient IoT deployment in-band to NR, in guardband of NR, and standalone band from NR, and FFS: relationship to deployment scenarios.

Note: Prioritization among them can be discussed in later meetings.

Feedback Form 19: Is Proposal 4-3a agreeable?

1 – Sierra Wireless. S.A. Yes
2 – Beijing Xiaomi Mobile Software Yes
3 – Beijing Xiaomi Mobile Software Yes
4 – vivo Communication Technology OK
5 – CATT OK

6 – Shenzhen Heytap [OPPO] OK
7 – Spreadtrum Communications Yes, agreeable.
8 – NTT DOCOMO INC. Agree
9 – Nokia Denmark OK
10 – Apple France Agree
11 – VODAFONE Group Plc Agree
12 – Huawei Tech.(UK) Co.. Ltd Agree.
13 – Kyocera Corporation We agree.
14 – Tejas Networks Ltd. Agree
15 – Panasonic Holdings Corporation We agree the proposal.
16 – NOVAMINT OK
17 – Samsung Electronics Co. ok
18 – Ericsson LM Ok.

19 – ZTE Corporation Agree.
20 – Intel Belgium SA/NV Yes
21 – Motorola Mobility España SA ok
22 – MediaTek Inc. We are ok however we would like to add a NOTE to reflect the point made in the initial round. NOTE: There is no assumption on what option(s) will be supported.
23 – Sony Europe B.V. OK
24 – Philips International B.V. OK

Topic 4-3b: Co-deployment with existing 3GPP deployment

Based on the initial round summary, the moderator thinks we can agree with the existing proposal.

Proposal 4-3b: Agree that for basestation deployments (when present), “Coexistence with existing 3GPP technologies” can be:

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

Feedback Form 20: Is Proposal 4-3b agreeable?

1 – Sierra Wireless. S.A. Yes
2 – Qualcomm Incorporated We agree
3 – vivo Communication Technology OK

<p>4 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>OK</p>
<p>5 – Spreadtrum Communications</p> <p>Yes, agreeable.</p>
<p>6 – NTT DOCOMO INC.</p> <p>Agree</p>
<p>7 – Nokia Denmark</p> <p>We agree</p>
<p>8 – Apple France</p> <p>Agree</p>
<p>9 – VODAFONE Group Plc</p> <p>Agree</p>
<p>10 – Kyocera Corporation</p> <p>We agree.</p>
<p>11 – Panasonic Holdings Corporation</p> <p>We agree the proposal.</p>
<p>12 – NOVAMINT</p> <p>agree</p>
<p>13 – Ericsson LM</p> <p>As we commented in the initial round, it would be good to also capture assumptions on whether new NW hardware deployment is required or not.</p>
<p>14 – Intel Belgium SA/NV</p> <p>Agree</p>
<p>15 – MediaTek Inc.</p> <p>OK</p>

16 – Sony Europe B.V.

We do not understand what the proposal means. Does it mean the following?

Agree that for basestation deployments (when present), “Coexistence with existing 3GPP technologies” refers to:

- *Deployment of AIoT basestations on the **same sites** as existing 3GPP basestations; or*
- *Deployment of AIoT basestations on **different sites** to existing 3GPP basestations*

17 – China Mobile Com. Corporation

agree

5.3.3 Intermediate round summary

Topic 4-3a: In-band/guard-band/standalone band

Companies are all fine. MediaTek want a note “no assumption on supported option(s)”. Moderator points out that there is already a note added in the intermediate round about prioritization (perhaps the formatting did not draw attention), which inevitably allows all kinds of de-prioritization down to removal.

Topic 4-3b: Co-deployment with existing 3GPP deployment

Nearly all companies have agreed.

Moderator reply to Ericsson: it is not so clear if your comment refers to possible software upgrade, instead of hardware deployment. If that is so, it seems orthogonal to the points made in the proposal, and not a matter of deployment since, whether software or hardware, the deployed location is the same. I can try to clarify this. If wanting to delve into software/hardware upgrades, it is not obvious where the SID addresses it - you could come back to this in the next meeting.

Sony: It means what you think, but your change does not seem suitable, since in both bullets you assume there is a 3GPP deployment somewhere. Hope this clarifies, with a small addition as shown in final round.

5.3.4 Final round

Topic 4-3a: In-band/guard-band/standalone band

It is hoped no change is needed, given explanations in the intermediate round summary.

Proposal 4-3a: Agree that the study considers Ambient IoT deployment in-band to NR, in guard-band of NR, and standalone band from NR, and FFS: relationship to deployment scenarios.

1. *Note: Prioritization among them can be discussed in later meetings.*

Feedback Form 21: Is this proposal agreeable?

1 – Qualcomm Incorporated We agree
2 – Spreadtrum Communications Yes, agreeable.
3 – NTT DOCOMO INC. Agree
4 – vivo Communication Technology OK
5 – Apple France Fine
6 – Samsung Electronics Co. ok
7 – Shenzhen Heytap [OPPO] ok
8 – THALES Agree
9 – EURECOM Agree
10 – Nokia Denmark OK
11 – VODAFONE Group Plc ok
12 – Huawei Tech.(UK) Co.. Ltd OK
13 – China Unicom We agree

14 – China Mobile Com. Corporation Agree
15 – Intel Belgium SA/NV OK
16 – ZTE Corporation Ok.
17 – Panasonic Holdings Corporation Ok
18 – Kyocera Corporation We agree.
19 – Ericsson LM Agree
20 – NOVAMINT OK
21 – MediaTek Inc. ok
22 – Telia Company AB OK.
23 – Philips International B.V. Agree.

Topic 4-3b: Co-deployment with existing 3GPP deployment

The revised proposal is:

Proposal 4-3b: Agree that for basestation deployments (when present), “Coexistence with existing 3GPP technologies” can be:

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

NOTE: This does not relate to software or hardware upgrade implications for ambient IoT.

Feedback Form 22: Is this proposal agreeable?

<p>1 – Qualcomm Incorporated</p> <p>We agree</p>
<p>2 – NTT DOCOMO INC.</p> <p>Agree</p>
<p>3 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>ok</p>
<p>4 – THALES</p> <p>Agree</p>
<p>5 – China Mobile Com. Corporation</p> <p>Agree</p>
<p>6 – Intel Belgium SA/NV</p> <p>OK</p>
<p>7 – Panasonic Holdings Corporation</p> <p>Ok</p>
<p>8 – Kyocera Corporation</p> <p>We agree.</p>
<p>9 – Ericsson LM</p> <p>The “on sites” emphasis is a bit unclear, and we propose to change to “on <u>new</u> sites”. We agree that should be of interest first is whether existing sites can be reused and then in a second step whether Ambient-IoT roll-out can be done as a software upgrade. That being said, the case in the second bullet is always possible and it would be good to clarify that this option corresponds to “no coexistence”.</p> <p>Proposed updates:</p> <p><i>Agree that for basestation deployments (when present), “Coexistence with existing 3GPP technologies” can be:</i></p> <ul style="list-style-type: none">- Deployed on the same sites as an existing 3GPP deployment corresponding to the basestation type- Deployed on <u>newsites</u> without an assumption of <u>coexistence with</u> an existing 3GPP deployment

10 – Philips International B.V. Agree.
11 – Huawei Tech.(UK) Co.. Ltd Yes, this is ok.

5.3.5 Final round summary

Topic 4-3a: In-band, guard-band, standalone band

All companies agree. Chair will be requested to endorse proposal 4-3a. No extended round for proposal 4-3a.

Proposal 4-3a for agreement: Agree that the study considers Ambient IoT deployment in-band to NR, in guard-band of NR, and standalone band from NR, and FFS: relationship to deployment scenarios.

- ***Note: Prioritization among them can be discussed in later meetings.***

Topic 4-3b: Co-deployment with existing 3GPP deployment

Almost everything is stable here now.

On Ericsson’s comment, moderator assumes using “**new** sites” is OK to others as it is just an emphasis. But the added words about no coexistence may confuse about bringing in the RF domain when Ambient IoT is in the same locality but not on the same sites. As written, it is just a deployment assumption (for a deployment scenario), rather than an RF-domain assumption. For the extended round, we’ll have to check if “new” is ok.

5.3.6 Extended round

Proposal 4-3b-v2: Agree that for basestation deployments (when present), “Coexistence with existing 3GPP technologies” can be:

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

Feedback Form 23: Is this proposal now agreeable?

1 – Nokia Denmark Agree
2 – NTT DOCOMO INC. Agree
3 – Qualcomm Incorporated We agree
4 – Apple France Agree
5 – ZTE Corporation Agree
6 – Shenzhen Heytap <input type="checkbox"/> OPPO <input type="checkbox"/> ok
7 – Spreadtrum Communications Yes, agreeable.
8 – Kyocera Corporation We agree.
9 – Intel Belgium SA/NV Agree
10 – China Mobile Com. Corporation Agree
11 – Ericsson LM Agree
12 – Huawei Tech.(UK) Co.. Ltd Agree
13 – Philips International B.V. Agree.

5.4 Topic 4-4: Connectivity topology

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

1 – Samsung Electronics Co.

In general, we are ok with current fomulation, one comment is that whether this topology is assumed only one BS for energy transmission and data transmissio and reception. Maybe better to include to have one or multiple BSs or Assiting UEs for transmission energy signal or data TX/RX.

2 – VODAFONE Group Plc

agreed to capture all four topologies. Additionally, it is also possible to have a scenario with combination of 2 topologies (eg. Topology(1) and topology (2)).

3 – MediaTek Inc.

Please clarify topology (4).

Topology (5) that in our view is essential, is missing i.e.: {BS or none} \diamond UE \diamond Ambient IoT device

Note the communication end points will need to be clarified.

We strongly question why the "energy provision" should be considered at all in the study - that and how the Ambient IoT device harvests (if at all) energy is *irrelevant* to the study. See topology 1 note 2, topology 2 note 2, topology 3 note 1 - these notes are inappropriate and go beyond the scope of the study. As per the SID, the energy source and storage are mere device categorization characteristics.

4 – Spark NZ Ltd

all four topologies should be captured

5 – Huawei Tech.(UK) Co.. Ltd

We think it makes sense to summarize the topologies which have been proposed in papers in a generalized way. Our understanding:

(1), for the case ambient IoT device is directly connected to gNB(s).

(2), for the relay case, ambient IoT device is connect to gNB via relay-type node, there is no direct link between gNB and ambient IoT device.

(3), different to relay case, ambient IoT device is connect to gNB via assisting UE where both gNB and assisting UE have direct connection to ambient IoT device.

(4), for the case ambient IoT device is directly connected to UE, possibly with control from gNB.

The above 4 connectivity topologies could cover all possibilities, thus we think it should be agreeable as high-level description of connectivity topologies in our view.

To address points from a few companies (may followup more later):

@Vodafone: That combinational topology is not raised in any paper. It seems to suggest a kind of dual-connectivity for an extremely simple Ambient IoT device. Could you clarify the intention and use for this combined topology? Perhaps it is best to take an FFS on such things, or wait to see if a company motivates such combinations in their next papers?

@Samsung: It seems the optional-plural node(s) covers your case for energy. For data TX, it seems surprising if an ambient IoT node of such minimal complexity is able to perform data combination from multiple TRPs. Is this really intended? We think it might be captured by repeated application of Topology 1 to a given deployment implementation

@MediaTek: Your topology (5) with {BS} is precisely topology (2), according to the NOTE 1 including a UE, and topology (5) with {none} is Topology 4 with {none}.

6 – Samsung Electronics Co.

@Huawei, we do not see the possibility to combine data from mTRP for Ambient IoT device, but MTRP can combine data from Ambient IoT to improve the reliability. In addition, plural node(s) works for us. Thanks.

7 – Sierra Wireless. S.A.

Topology 1 and 2 are clear.

For topology 3 - What is the meaning of a "assisting UE" and how is it different than a Relay? If gNB has a bi-directional direct link to Ambient-IOT device, why does it need an assisting UE? Perhaps you can add a note.

8 – Apple France

Topology 1, 2 and 3 are fine. For topology 4, based on the clarification from Huawei, we would suggest to further separate this into topology 4 and topology 5, where topology 4 can be direct connection of ambient-IoT device to the UE without BS control (UE<->Ambient-IoT Device) and topology 5 can be direct connection of ambient-IoT device to the UE with BS control (UE<->Ambient-IoT Device <-> BS). In our view, this clear distinction do not leave any room for confusion.

9 – Futurewei Technologies

We are ok to be inclusive at the RAN level study. In future WG level work, the aspects related to using UE via sidelink, relay/IAB, or repeater does not provide additional insight in terms of feasible study and fundamental technique study while risks spending a lot of time and distracting the group from the basics. Focusing on base-station only (topology (1)) is a better approach

10 – vivo Communication Technology

For the four topologies, we have the following comments

1, We would like to further distinguish the two types of links as the following, which could make the discussion more easier

- 1) The existing Uu link (enhancement not precluded)

- 2) The new link from/to ambient IoT devices (e.g., gNB/UE/realy <-> Ambient IoT device)

2, According to above 1, the Topology 2) can be expressed as

BS <-(Uu)-> intermediate node <-> Ambient IoT device

3. For topology 3, it seems cover multiple topologies in our understanding. We would prefer to further categorize it for better clarity.

- Topology 3-1: BS<-(Uu)-> assisting UE ->Ambient IoT device ->BS. In this case, BS is used to configure/schedule assisting UE to transmit signal (control command and/or carrier wave) to Ambient-IoT device, based on which the abmbient-IoT device to modulate and transmit signal to the BS, e.g. based on backscattering of the carrier wave from assisting UE.
- Topology 3-2: BS->Ambient IoT device-> assisting UE<-(Uu)->BS. In this case, BS transmit control signaling/carrier wave to Ambient-IoT device, based on which the Ambient-IoT device to modulate and transmit signal to the assisting UE, e.g. based on backscattering of the carrier wave from BS.
- Note that the Uu link in above topologies can be deleted for simplicity, or seperately discussed.

4. For topology 4, we do not quite understand this connection. could moderator or proponents clarify?

11 – NTT DOCOMO INC.

Agree

12 – Kyocera Corporation

We support all the topology options. We assume the arrows include both the data transmission and the energy transmission. We wonder if Topology (3) can only have the “->” direction, and if Topology (3) is a subset of Topology (4).

13 – Spreadtrum Communications

We are fine to capture all the above connectivity topologies

14 – Motorola Mobility España SA

[Lenovo] assisting node in the connectivity topology is low priority. In the RAN level study, the motivation is to define the scope for RAN1 SID. Also it is not necessary as how the device harvest energy should be left to implementation as done in SA1

15 – CATT

We believe that first two topologies are sufficient.

16 – Telstra Limited

We are ok to capture all four topologies but if needed, would prioritise topologies 1 & 2

17 – Qualcomm Incorporated

We are generally ok with having multiple topologies. We have a few comments for selected topologies.

For topology (2), is the “UE” in NOTE1 “assisting UE”? It would be good to clarify the difference of “UE” and “assisting UE”.

For topology (3), we see there are two base stations, one at the starting point and the other one in the end. It is better to clarify if they are the same BS or different BS.

For topology (4), Recommend replacing “{BS or none}” to “{BS or UE or none}” to capture UE<->A-IoT<->UE topology.

18 – LG Electronics Inc.

Topology (1) and (2) should be sufficient and Topology (3) would be acceptable. However, it needs clarification on topology (4). In topology (4), does it mean that the UE does not have any connection with BS? But we think that the UE would have a connection with the BS to be controlled, if so, topology (4) is same as topology (2).

19 – China Mobile Com. Corporation

At this stage, we are open to capture all the topologies for study.

It seems companies are asking for further clarification on the descriptions. So we think capture some figures (may be just for example) would be helpful for the readers to comprehend the whole picture. The figures in our contribution RP-223072 can be a candidate.

For topology 3, I think it refers to topology 2-1&2-2 in RP-223072, to increase the link budget of DL or UL with the help of assisting UE. So the two gNB can be the same.

Regarding to company’s concerns on whether “energy provision” should be considered, we think energy provision need to be captured in the deployment scenario, as the energy provision is one of the key element to analysis the link budget for DL/UL.

20 – Shenzhen Heytap

[OPPO]

1) 1st comment

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

This topology 4 is not clear. If a UE can connect with the device, why there is a need to let also the gNB to connect the device.

Suggest to change Topology 4 as:

UE<->Ambient IoT devie.

2) Generally fine with other 3 topologies.

21 – Nokia Denmark

We are generally fine with the proposed topologies. We would include multiple reading & illumination nodes (UE, BS, etc). What is the difference between UE, assisting UE, and intermediate node?

22 – ZTE Corporation

We cannot clearly understand Mediatek’s comment, why energy is irrelevant to the study? We understand the simplest/typical case is that the battery-less device can make use/backscatter the energy carried by the DL radio transmission to generate the UL radio transmission.

For Vodafone’s comments, we understand the main intention is that a BS needs to support both Topology (1) and Topology (2), we think it generally make sense.

Back to the Topologies, we have the following comments:

1. We have the general understanding that in all the four Topologies, “<->” mainly indicates the communication end points. So we need to make some clarification on energy provision in the Notes (there is already something in some Topologies but also something missed in other Topologies). So firstly, a clarification is needed to Note 2 in Topology 1 and 2 to clarify gNB/intermediate node can also provide energy for the device. Secondly, we think another nodes can also provide energy in Topology 3 and Topology 4.
2. We suggest to add repeater in the Topology 2 as it’s benefit for extending the coverage in this scenario. Please note smart repeater is already specified in RAN and easier to be deployed, e.g., than NW-side relay.
3. We cannot understand why there is “UE” in the Note 1 of Topology (2). If it’s a typo, we suggest to remove it.
4. We cannot understand why we have such restriction that there is no direct link between gNB and ambient IoT device in Topology (2)? We think similar as Topology (3), it’s also possible to have the “asymmetric links” in Topology (2), e.g., ambient IoT device is connect to gNB via intermediate node where both gNB and intermediate node have direct connection to ambient IoT device. So we suggest to add “” in the end of Topology (2)
5. For Topology (4), if the control is from gNB, we think possibility is same as that in Topology (3). So in order to avoid overlapping between Topologies, we suggest to remove “<-> {BS or none}” from Topology (4)

Based on the above comments, we give the following suggestions:

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 BS(s) or another node(s)

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

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

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

NOTE 3: The Ambient IoT device may be provided with energy from another node(s)

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

NOTE 1: The links may be bidirectional or unidirectional operation

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

23 – Sony Europe B.V.

We are open to study different topologies. The 4 examples provided in the text of topic 4-4 could form the basis (and we can refine these) but we are open to study more topologies if found necessary.

24 – Panasonic Holdings Corporation

We support FL view.

25 – NEC Corporation

We think the motivation of Topology (3) BS <-> assisting UE <-> Ambient IoT device <-> BS is to extend the coverage. The assisting UE should be a ambient IoT aware UE. However, we think assisting UE can be applied as a relay node to communication with Ambient IoT device and relay the information to BS. So the motivation for the link Ambient IoT device <-> BS in Topology (3) is not strong compared with other three Topologies. We think Topology (3) could be FFS and others are agreeable.

26 – Orange

we support all 4 topologies and think these capture all the cases to be covered

27 – TURKCELL

We support all topology options.

28 – Intel Belgium SA/NV

Our understanding on the proposal is to identify the possible topologies for A-IoT. On the other hand, it is preferred to prioritize certain typical topologies.

- For Topology (1) note 1, we are not convinced for ‘BS Rx and BS Tx in different BSs’ since it is not supported in the existing NR operations.
- For Topology (2), prefer to add ‘repeater’ in Note 2.
- For Topology (3), does it mean the uplink or downlink transmission of A-IoT device are to/from different nodes (UE or BS)?
- For Topology (4), what is the assumption for uplink, downlink and energy source?

29 – Intel Belgium SA/NV

Some further comments

- To clarify our question to Topology (3), the dual arrow is confusing. Does it limited to following two flows, or more interpretations are allowed?

Topology (3-1) BS -> assisting UE -> Ambient IoT device -> BS

Topology (3-2) BS <- assisting UE <- Ambient IoT device <- BS

- Note 2 in topology 1/2 is not included in Topology 3/4. Does it mean energy source must be one of listed UE or BS doing Tx/Rx transmission to/from the A-IoT device? If not, better to capture Note 2 in Topology 3/4 too.

30 – Ericsson LM

It would be good to clarify the meaning of the arrows and consider distinguishing between unidirectional and bidirectional arrows if needed. If larger changes can be considered, we think that the following topologies would be clearer.

Topology (1) BS <-> Ambient IoT device

NOTE 1: Bidirectional case, i.e., BS Rx and BS Tx in the same BS.

NOTE 2: Applicable both to active Tx/Rx and passive Tx/Rx.

NOTE 3: BS can possibly be an IAB node or NW-based relay.

Topology (2) BS -> Ambient IoT device -> BS

NOTE 1: BS Rx and BS Tx in different BSs.

NOTE 2: Applicable only to passive Tx/Rx.

NOTE 3: BS can possibly be any NW node, e.g., IAB node, NW-based relay, separate charge carrier wave transmitter, or separate reader.

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

NOTE 1: UE Tx (charge carrier wave) and BS Rx reader.

NOTE 2: Applicable only to passive Tx/Rx.

NOTE 3: UE can possibly be a UE, assistance UE, or UE-based relay.

NOTE 4: BS can possibly be any NW node, e.g., IAB node, NW-based relay, or separate reader.

Topology (4) BS -> Ambient IoT device -> UE

NOTE 1: BS Tx (charge carrier wave) and UE Rx reader.

NOTE 2: Applicable only to passive Tx/Rx.

NOTE 3: UE can possibly be a UE, assistance UE, or UE-based relay.

NOTE 4: BS can possibly be any NW node, e.g., IAB node, NW-based relay, or separate charge carrier wave transmitter.

Topology (5) UE <-> Ambient IoT device

NOTE 1: Bidirectional case, i.e., UE Rx and UE Tx in the same UE.

NOTE 2: Applicable both to active Tx/Rx and passive Tx/Rx.

NOTE 3: UE can possibly be a UE, assistance UE, or UE-based relay.

31 – Huawei Tech.(UK) Co.. Ltd

Couple of follow-ups:

@Qualcomm: On the topology of your suggested UE<->Ambient IoT<->UE. What is the difference to UE<->Ambient IoT, and what is the second UE used for? Does it mean the ambient IoT device needs to maintain dual -connectivity to multiple UEs? We cannot see this topology in a submitted paper.

@Samsung: Thanks for the reply.

@Sierra: At least in our understanding, UE assistant case is different to relay case. For relay case, the relay node is usually used for coverage extension of a base station, ambient IoT device is connected to relay node and relay node forwarding data between BS and ambient IoT device. For UE assistant case, ambient IoT device is connected to BS, the assisting UE works to improve the link budget of the weaker one between ‘ambient IoT device receiving from BS’ and ‘ambient IoT device transmitting to BS’. Perhaps some refinement of these topologies can be considered.

32 – KPN N.V.

We support all the 4 topologies.

33 – Philips International B.V.

In addition to the four topologies above, we propose to study the following topologies:

- the topology as discussed in Qualcomm’s paper RP-222918 Figure 3 (e.g. BS <-> Ambient IoT device <-> UE). It is not clear if this is covered by these four topologies above.
- Similarly, an Ambient IoT device could be in direct coverage of the BS to receive information, but then use an intermediate node to communicate back to the BS, e.g. BS -> Ambient IoT device -> intermediate node -> BS.

5.4.1 Initial round summary

Based on the inputs, moderator understands most of companies could live with all of the 4 connectivity topologies for the study at least as a starting point. Some companies give detail comments on these topologies in general or specific to each. Moderator gives response as follows:

Comments in general:

- There are some comments to clarify including the multiple BSs or assisting UE in these topologies from Samsung and Nokia. And Samsung further clarifies in the reply they do not see the possibility to combine data from mTRP for Ambient IoT device, but mTRP can combine data from Ambient IoT to improve the reliability. Moderator think it is possible but seems up to basestation implementation. For the multiple illumination nodes moderator also think it seems up to implementation.
- Some comments to discuss whether need to consider energy provision in topology. MediaTek believe it should be discussed in device categorization. Lenovo think it is up to implementation. CMCC and ZTE explicitly support to discuss associated with topology. The reason moderator wrote energy providing in NOTE under topology candidates is just from contributions where companies propose it in their topology. ZTE also comment to add more energy providing node on top of existing wording.
 - In general, the situation is that energy may provided either by a node which is not the ambient IoT device, or may be from storage in the device. Moderator suggests making this a general note to all the topologies and removing it from the per-topology level.

- Vivo suggest to distinguish Uu link and Ambient IoT link with different arrows. <- Uu -> and <- ->
 - Moderator: It seems that this could be usefully discussed as a next-level detail once we have the high level topologies settled, so I leave the change for now, whilst not precluding clarification.
- MediaTek and ZTE mentions whether need to claim communication end points for each topology. Moderator's understanding for (1), (2), (3) the end point is BS, and (4) is either UE or BS depend on the direction of the link from Qualcomm's paper.
- CMCC suggest to add figure for each topology.
 - Moderator may ask the rapporteur or TR editor to help with this once they are stable!
- Combination of topology can be FFS as Huawei replied to VDF.
- Some companies ask about a difference between topology 2 and 3 when the intermediate node is a UE. This is mentioned by at least Samsung, and Intel. Moderator offers the explanation that a relay node is typically for coverage extension of a BS, with the ambient IoT device connected to the relay, and (due to coverage) not connected to the BS. Whereas with an assisting UE node, it works to improve the link budget of the weaker between 'ambient IoT device receiving from BS' and 'ambient IoT device transmitting to BS' (see e.g. CMCC's reply). Thus, moderator retains 'UE' in NOTE 1 of topology 2 at this time.

Comments specific to Topology (1):

- (No specific comments).

Specific to Topology (2):

- ZTE suggest to add 'repeater'. Moderator notes the "etc", but can explicitly add it, though scope does not change. If ZTE consider there is link between gNB and ambient IoT UE, it would be in topology 3.
- Some companies ask why UE could be the intermediate node in topology 2. And what is the difference to assisting UE in topology 3. Moderator wrote it by reading contributions from Samsung and Intel. Moderator suggest interested companies to further discuss and clarify on this issue.

Specific to Topology (3):

- Vivo suggest to split (3) to 3-1 and 3-2, moderator suggests this should be next step after agree the high-level type, if companies raise this point.

Specific to Topology (4):

- There are some comments on the meaning of {BS or none}, and Qualcomm suggest to make it {BS or UE or none}, and another suggestion is to remove the whole "{BS or none}". Moderator notes that adding UE at each end is not a topology raised in any paper, and that these suggestions partially overlap.

- Moderator will clarify this topology by splitting the version with a third node (either BS or UE) into a new topology 5, and making topology 4 only UE<->device.

5.4.2 Intermediate round

Based on the initial round summary, the topologies are revised as follows.

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, repeater, 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

FFS: If the two BS can be different, or are always the same BS

Topology (4) UE <-> Ambient IoT device <-> {BS or UE}

NOTE 1: The links may be bidirectional or unidirectional operation

Topology (5) UE <-> Ambient IoT device <-> {BS or UE}

NOTE 1: The links may be bidirectional or unidirectional operation

NOTE for all topologies: The Ambient IoT device may be provided with energy from another node(s) either inside or outside the topology

FFS: Whether to consider combination of different topologies in the study.

FFS: BS, UE, or assisting UE could be multiple BSs, UEs or assisting UEs, respectively.

Feedback Form 25: Question 4-4: Can we agree to the above list of topologies?

1 – Sierra Wireless. S.A.

Good discussion here which is helpful but I still do not find the text very clear. I do think diagrams would make it clearer.

What can the "<->" be? DL wave for backscattering, UL Backscattered wave, DL data (e.g. trigger) But not Radio wave for energy harvesting.

Is it correct that a Intermediate Node will always have bidirectional the user plane data to/from the A-IOT device going through it? Where an "assisting UE" never has user plan data of the A-IOT going through it?

2 – Qualcomm Incorporated

We agree with the revised topology options.

3 – Beijing Xiaomi Mobile Software

Generally fine, but for **Topology (5) UE <-> Ambient IoT device <-> {BS or UE}**, if the link is bidirectional, the UE in the brace should be deleted, cause it has been included in Topology (4)

4 – vivo Communication Technology

We are fine with updated topology (1),(2),(4)

On topology (3), we have concern on involving two different BS at this stage, we think the same BS case should be the easier one to start with. Suggest to keep FFS only for the case when two BSs are different.

On topology (5), if the intention is that an Ambient IoT device can be controlled by a UE and another BS/UE simultaneously, it is not clear what is the motivation for such topology. But it can be viewed as a combination of topology (1) and (4). Since we have a general FFS on the combination of different topologies in the end, we prefer to delete topology (5) for now.

5 – CATT

We are fine with Topologies (1) - (4). We don't see the need of Topology (5) since it is covered by Topologies (1) and (4).

<p>6 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>Suggest to revise Topology 5 as <u>UE <-> Ambient IoT device <-> UE.</u></p> <p>Since we don't see the need to connect the device to both UE and gNB.</p>
<p>7 – Spreadtrum Communications</p> <p>Yes</p>
<p>8 – NTT DOCOMO INC.</p> <p>Agree</p>
<p>9 – Nokia Denmark</p> <p>Yes, this is ok</p>
<p>10 – Apple France</p> <p>Agree with the updated topologies to separate topology 5 from topology 4.</p>
<p>11 – VODAFONE Group Plc</p> <p>Agree with vivo comment that topology 5 could be realized as a combination of topology 1 and 4.</p>
<p>12 – Kyocera Corporation</p> <p>We're fine with the update topology options, except for Topology (5). We share Vivo's view on Topology (5) that it's a combination of Topologies (1) and (4), and such combinations are FFS for now.</p>
<p>13 – Panasonic Holdings Corporation</p> <p>We agree the the above list of topologies.</p>
<p>14 – Huawei Tech.(UK) Co.. Ltd</p> <ol style="list-style-type: none">1. We also could be OK to add some clarification as in Sierra's reply, although we think these could also be next-step level topology discussion.2. Topology (5) is unclear to us on some points. For the case 'UE <-> Ambient IoT device <-> BS', if there is no link between UE and BS, we don't understand how it works from system point view. If there is link between UE and BS implied, then it seems belonging to Topology (3) in our view. Another interpretation is that from Vodafone, where we take it under FFS for combination of topologies (1)+(4). For the case 'UE <-> Ambient IoT device <-> UE', we are sceptical to include it without an explanation of its purpose, as it was not input from a paper.3. In the NOTE for all topologies, a clarification is needed that

- The Ambient IoT device may be provided with energy or a carrier wave from another node(s) {...}

the difference being that a carrier wave is for modulated signal generation at its given frequency, whereas 'energy' does not need to have that feature and might be used for e.g. generally powering the device.

15 – Samsung Electronics Co.

we are fine in general but maybe better to have some figures for better understanding of arrows or wording. Seems not easy to add arrows in TR.

16 – NOVAMINT

Tend to agree with Vivo's comment on Topology (5) - either we update it or we see it as combination of (1) and (4)

17 – Intel Belgium SA/NV

The dual arrow <-> in Topology (3) is confusing. Does it include the following case? i.e., the assisting UE provide both UL and DL connection to the A-IoT device, while the BS in the right may not exist at all?

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

If such configuration is not allowed by Topology (3), we prefer to make it clear, e.g., split (3) to 3-1 and 3-2 as commented by vivo and Intel in first round.

18 – Ericsson LM

We still think the alternatives are unclear:

- Bistatic backscattering cases should not have bidirectional arrows (“<->”), otherwise it cannot be understood which node is the transmitter and which is the reader.
- It is unclear why the 4th node is needed in Topology (3). Why must the 1st BS be included?
- In Topology (2), if the intermediate node is a UE, what is the difference to Topology (4) and (5)? If the intermediate node is an IAB node, what is practical difference for the device compared to Topology (1)?
- What is the point with the {}-parenthesis in Topology (5), and isn't it always the same as either from Topology (4) or Topology (3)? (Only 'UE -> Ambient-IoT Device -> UE' is different, but then that should be listed only).

We think the following topologies remove these problems and are clearer:

Topology (1) BS <-> Ambient IoT device

NOTE 1: Bidirectional case, i.e., BS Rx and BS Tx in the same BS.

NOTE 2: Applicable both to active Tx/Rx and passive Tx/Rx.

NOTE 3: BS can possibly be an IAB node or NW-based relay.

Topology (2) BS -> Ambient IoT device -> BS

NOTE 1: BS Rx and BS Tx in different BSs.

NOTE 2: Applicable only to passive Tx/Rx.

NOTE 3: BS can possibly be any NW node, e.g., IAB node, NW-based relay, separate charge carrier wave transmitter, or separate reader.

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

NOTE 1: UE Tx (charge carrier wave) and BS Rx reader.

NOTE 2: Applicable only to passive Tx/Rx.

NOTE 3: UE can possibly be a UE, assistance UE, or UE-based relay.

NOTE 4: BS can possibly be any NW node, e.g., IAB node, NW-based relay, or separate reader.

Topology (4) BS -> Ambient IoT device -> UE

NOTE 1: BS Tx (charge carrier wave) and UE Rx reader.

NOTE 2: Applicable only to passive Tx/Rx.

NOTE 3: UE can possibly be a UE, assistance UE, or UE-based relay.

NOTE 4: BS can possibly be any NW node, e.g., IAB node, NW-based relay, or separate charge carrier wave transmitter.

Topology (5) UE <-> Ambient IoT device

NOTE 1: Bidirectional case, i.e., UE Rx and UE Tx in the same UE.

NOTE 2: Applicable both to active Tx/Rx and passive Tx/Rx.

NOTE 3: UE can possibly be a UE, assistance UE, or UE-based relay.

Topology (6) UE -> Ambient IoT device -> UE

NOTE 1: Bistatic case, 1st UE Tx (charge carrier wave) and 2nd UE Rx reader.

NOTE 2: Applicable only to passive Tx/Rx.

NOTE 3: UE can possibly be a UE, assistance UE, or UE-based relay.

19 – ZTE Corporation

The current proposals are much better and clearer, thanks.

Our further comments are as below:

Thanks to Moderator's explanation to our comment "adding "<-> BS" in Topology (2)". Now we understand:

- the main intention of Topology (2) is a symmetrical link between BS and ambient IoT device,
- the main intention of Topology (3) is an asymmetric link between BS and ambient IoT device.

Based on this understanding, we think we'd better to have the following changes for Topology (3):

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

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

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

FFS: If the two BS can be different, or are always the same BS

Please note, even the two BSs in Topology (3) are same, it's still different from that in Topology (2) as one link is "BS <-> Intermediate node <-> Ambient IoT device" while the other link is "Ambient IoT device <-> BS".

We also echo Xiaomi's comments on Topology (5), e.g, it partially overlap with Topology (4).

Our suggestion is as below:

Topology (4) UE <-> Ambient IoT device <-> UE

NOTE 1: The links may be bidirectional or unidirectional operation

FFS: If the two UE can be different, or are always the same UE

Topology (5) UE <-> Ambient IoT device <-> {BS-~~or~~ UE}

NOTE 1: The links may be bidirectional or unidirectional operation

20 – Motorola Mobility España SA

agree with the topology, but the note on the energy is not clear. Are we suggesting RF energy needs to be provided by some nodes incl. assistance UE. In the SA1, energy harvesting is out of scope. Similarly we can mention that the energy harvested by Ambient device is out of scope or by implementation. We dont need to mention to related energy and topology in notes

21 – Sony Europe B.V.

OK

22 – MediaTek Inc.

We are concerned with this NOTE:

NOTE for all topologies: The Ambient IoT device may be provided with energy from another node(s) either inside or outside the topology

This is irrelevant to the disussion and we do not expect the study to look into such matters.

As per the SID:

In terms of energy storage, the study will consider the following device characteristics:

- *Pure batteryless devices with no energy storage capability at all, and completely dependent on the availability of an external source of energy*
- *Devices with limited energy storage capability that do not need to be replaced or recharged manually.*

Device categorization based on corresponding characteristics (e.g. energy source, energy storage capability, passive/active transmission, etc.) may be discussed during the study, in relation with the relevant use cases. The device's peak power consumption shall be limited by its practical form factor for the intended use cases, and shall consider its energy source.

23 – China Mobile Com. Corporation

We agree with all the revised topologies

5.4.3 Intermediate round summary

Although there are questions and comments, in general the direction is converging around these topologies, in least a first meeting high-level way.

Moderator responds on general points:

- Sierra ask for further clarification what can the " $\leftarrow\rightarrow$ " be of DL wave for backscattering, UL Backscattered wave, DL data (e.g. trigger) But not Radio wave for energy harvesting. And further ask the difference between intermediate node and assisting UE in terms of use plane data of ambient IoT. Huawei think the suggestion from Sierra would be either clarified now or later in further detail discussion on topology.
 - Moderator think these question are useful but would prefer to take them in next-step level discussion in detail, while now the proposal does not preclude any of the 3 things Sierra mentions. Please see below on energy/carrier wave change that your comment in part inspired.
 - Figures to follow. Text is convenient for companies to copy/edit.
- Huawei raise a point that energy may different to carrier wave, and suggest mentioning both in the related NOTE.
 - Moderator thinks it could be added to make the concept clear. It can address some of Sierra's question as well as some of Ericsson's (hopefully).
- Ericsson:
 - Bistatic backscattering cases should not have bidirectional arrows (" $\leftarrow\rightarrow$ "), otherwise cannot know Tx and Rx
 - Moderator: Bidirectional arrows mean it can be either direction, to reduce the number of topologies. Thus the Tx and Rx are inferred from the direction chosen.
 - Why the 4th node is needed in Topology (3). Why must the 1st BS be included?
 - Moderator: This was proposed by several companies. It appears to mean that e.g. a triggering BS is not necessarily the same BS as receives the device's transmission.
 - In Topology (2), if the intermediate node is a UE, what is the difference to Topology (4) and (5)? What difference from device perspective?
 - What is the point with the {}-parenthesis in Topology (5), and isn't it always the same as either from Topology (4) or Topology (3)
 - Moderator to both of these: there may indeed some cases which have a different topology but the same air interface from the device's point of view. They might not be the same in all higher-layer aspects, even so. Moderator understand that companies are identifying the topologies to allow RAN to look into those questions, in order to reach that conclusion (if it is a correct conclusion). Not identifying the topologies at all, seems suboptimal in that sense.\

- Having studied the expansion of the topologies from Ericsson, the moderator thinks they are all included within the current proposal, but are a kind of down-selection within. This may happen in the SI, and is a discussion suggested to take in the next meeting.
- It also seems Ericsson's proposal does not have the link between BS and UE where moderator's proposal (by reading papers) does consider cases where Uu interface as be the part of topology (probably in the same vein as the replies just above)

MediaTek raise the point about energy sources again, considering it "irrelevant". The moderator has to observe, respectfully, that other companies do not think it is irrelevant. However, a technical resolution to this might be the difference between a **carrier wave** for a passive device to reflect, and an **arbitrary energy source**. We can try replacing "may be provided with energy" by "...may be provided with a carrier wave". This might anyway be the real intent of papers such as CMCC's and others.

On each topology:

Comments to topology (1): Ericsson propose more NOTES for topology (1)

- See replies above.

Comments to topology (2): None

Comments to topology (3): vivo, Intel, ZTE

- Vivo think BS should be same BS at this stage, and suggest to keep FFS only for the case the two BSs are different.
 - Moderator sees nobody has a concern on the same BS part, and hence will leave only the different BS part as FFS.
- Intel think the dual arrow is confusing, asking whether it includes the case Topology (3) BS <-> assisting UE <-> Ambient IoT device <-> BS
 - Moderator thinks the answer is no. The Ambient IoT device does have link with BS in topology 3 which means the arrow does not mean no link.
- ZTE would like to change the assisting UE to intermediate node.
- The difference of Topology (3) and (2) has been clarified by companies during the discussion, and moderator hopes this is now ok.

Comments to topology(4): None (see topology 5, in part)

Comments to topology (5): Xiaomi, vivo, CATT, OPPO, VDF, Kyocera., ZTE

- Xiaomi and OPPO suggest to remove UE case in the bracket and only keep BS.

- Vivo, CATT, Vodafone, Kyocera, NOVAMINT, ZTE think the motivation is not clear and it can be viewed as combination of topology (1) and (4), prefer to delete topology (5). Huawei also have some concern on the relationship of topology (5) with other topology in BS case and unclear for the UE case.
 - Moderator think ZTE's update is actually same as what (5) is now.
- The moderator asks Qualcomm for a compromise here – and suggests that we can capture the topology (5) as written, but label it as FFS to be decided in the next meeting, and specifically state that with a (temporary) note

5.4.4 Final round

The updated proposals as follows. The changes in summary from the replies above:

- For the FFS of topology (3), only the case of different BSs is left FFS, per response to vivo et al.
- Changed "...may be provided with energy" to "may be provided with a carrier wave", as per response to MediaTek.
- Retained topology 5 in an FFS state with a NOTE stating we will discuss again next meeting.

Proposal: Define the following topologies as starting points for the next meeting:

- Topology (1): BS <-> Ambient IoT device
 - NOTE 1: Includes the possibility of BS Rx and BS Tx in different BSs
- Topology (2): BS <-> intermediate node <-> Ambient IoT device
 - NOTE 1: Intermediate node can be relay, IAB, UE, repeater, etc. which is capable of ambient IoT
- Topology (3): BS <-> assisting UE <-> Ambient IoT device <-> BS
 - NOTE 2: Assisting UE can be either bidirectional or unidirectional operation to others
 - **FFS: If the two BS can be different, or are always the same BS**
- Topology (4): UE <-> Ambient IoT device
 - NOTE 1: The links may be bidirectional or unidirectional operation
- **FFS: Topology (5) UE <-> Ambient IoT device <-> {BS or UE}**
 - **NOTE 1: The links may be bidirectional or unidirectional operation**

NOTE: For potential topology (5), discuss its relation with other topologies, its necessity, etc. in RAN#99.

NOTE for all topologies: The Ambient IoT device may be provided with **energy/carrier wave** from another node(s) either inside or outside the topology

FFS: Whether to consider combination of different topologies in the study.

FFS: BS, UE, or assisting UE could be multiple BSs, UEs or assisting UEs, respectively.

Feedback Form 26: Can companies take these topologies as a starting point for the next meeting?

1 – Sierra Wireless. S.A. Yes - a good start
2 – Qualcomm Incorporated We agree
3 – Spreadtrum Communications Yes, agree
4 – NTT DOCOMO INC. Agree
5 – LG Electronics France If I understand the discussion correctly, we think it is better to clarify "carrier wave" as "carrier wave as energy source" in the Note below since meaning of "provided with carrier wave" looks ambiguous. NOTE for all topologies: The Ambient IoT device may be provided with energy/carrier wave as energy source from another node(s) either inside or outside the topology
6 – vivo Communication Technology OK
7 – Apple France Support
8 – Samsung Electronics Co. ok

<p>9 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>ok</p>
<p>10 – THALES</p> <p>Agree</p>
<p>11 – EURECOM</p> <p>Agree</p>
<p>12 – Nokia Denmark</p> <p>Agree</p>
<p>13 – VODAFONE Group Plc</p> <p>Agree as the starting point.</p>
<p>14 – ZTE Corporation</p> <p>No adoption of our suggestion for Topology (3), we think the following scenario cannot be covered in any Topology:</p> <p>BS1 -> Intermediate node -> Ambient IoT device -> BS1 (BS2)</p> <p>Please note Topology (2) can only cover the following cases, they are different:</p> <p>BS1 -> intermediate node -> Ambient IoT device -> intermediate node->BS1 (BS2)</p> <p>No adoption of our suggestion for Topology (5), we think the following scenario could be covered by both Topology (4) and Topology (5) (overlapping):</p> <p>UE1 -> Ambient IoT device -> UE1(UE2)</p> <p>But if no enough time to discuss in details, we are ok to take the current achievement as start point for further discussion.</p>
<p>15 – China Mobile Com. Corporation</p> <p>Agree</p>
<p>16 – Panasonic Holdings Corporation</p> <p>Ok</p>
<p>17 – Kyocera Corporation</p> <p>We agree.</p>

18 – Intel Belgium SA/NV

The proposal is generally fine.

On Topology (4)/(5) in which the UE has no link to BS, does it mean the UE has no connection to BS, or the BS and the ambient IoT are transparent to each other?

It seems the following notes actually applies to <-> in all 5 topologies. So we suggest to make it a general note.

NOTE 1: The links may be bidirectional or unidirectional operation

Further, we prefer to add a note for Sierra’s comment and moderator’s replies on <->, e.g.

Note: <-> can be of DL wave for backscattering, UL Backscattered wave, DL data (e.g. trigger) But not Radio wave for energy harvesting

Note: <-> mean it can be of either link direction, but does not mean no link.

19 – NOVAMINT

OK for this as starting point

20 – MediaTek Inc.

OK as a result of this meeting

21 – Telia Company AB

ok

22 – Huawei Tech.(UK) Co.. Ltd

Moderator rapid response to ZTE: Sorry if I omitted a specific response in the intermediate round summary, but thanks for being OK with the current status. For your point on topology (3), it appears one way to see it is a combination of (1) and (2), and raise it under the FFS on combinations, at least. On the overlapping comment of topology (4) and (5), other companies also raise the question, and that’s one of the reasons Topology (5) is FFS as a whole, so you can raise it in that discussion.

23 – Philips International B.V.

Agree.

24 – Ericsson LM

We think it would be good to sort out the comments and questions from LG and Intel.

Perhaps the “FFS: If the two BS can be different” is redundant since there is an overall “FFS: BS, UE, or assisting UE could be multiple BSs, UEs or assisting UEs, respectively”. Perhaps this addresses some of ZTE’s concerns as well.

5.4.5 Final round summary

A few more comments we can finalize in an extended round.

To ZTE (copying response as during the final round):

- Sorry if I omitted a specific response in the intermediate round summary, but thanks for being OK with the current status.
- For your point on topology (3), it appears one way to see it is a combination of (1) and (2), and raise it under the FFS on combinations, at least. On the overlapping comment of topology (4) and (5), other companies also raise the question, and that's one of the reasons Topology (5) is FFS as a whole, so you can raise it in that discussion.

LG: Whether 'carrier wave' can be changed to 'carrier wave as energy source'?

- Moderator: Please refer to the intermediate round response to MediaTek. In short, this change from energy source to carrier wave was due to the difference between a carrier wave for a passive device to reflect, and an arbitrary energy source. Of course, such a carrier wave might also be an energy source, but it depends on how the device is constructed. This is actually captured in the listing of harvestable energy sources in NWM Proposal 5-1b-v2. Thus, moderator believes the overall balance of proposals/agreements addresses your point.

Intel. Thanks for being generally fine with the proposal. On your points:

- In topology (4)/(5), whether no presence of a BS means in fact no BS, or that the ambient IoT device and BS are mutually transparent?
 - From the proponent papers, it seems to mean there is in fact no BS, but other companies have questioned whether there is a BS and the topology is equivalent to another. These questions are good material for the next meeting, please feel free to raise it there.
 - On whether NOTE 1 (bidirectional/unidirectional) of topology 4 & 5 should apply to all topologies. It seems correct, and this got a bit out of sync across the rounds of discussion, because moderator was initially keeping the topologies self-contained. Will adjust to make applicable to all.
 - On your mention of many uses of a link, the moderator addressed this in the previous round, and does not propose to re-address it - see intermediate round comments to e.g. Sierra Wireless.
 - On if <-> can mean no link, moderator does not see a need to preclude impossible things or illogical things. Where you see a link, there is a link, subject to the notes.

To Ericsson:

- On the overall FFS relating to multiple BS, etc. The general multiple-BS FFS could (in principle) be applied to each of the BSs in topology 3, but this still does not answer whether (all) the BSs at the two ends have to be the same or can be different, which is addressed by the topology-3-specific FFS. The moderator refers to next meeting for whether to downselect some of those options! The most complicated would surely have a high bar to cross for relevance.

5.4.6 Extended round

Proposal 5-4: Define the following topologies as starting points for the next meeting:

- Topology (1):BS <-> Ambient IoT device
 - NOTE 1: Includes the possibility of BS Rx and BS Tx in different BSs
- Topology (2): BS <-> intermediate node <-> Ambient IoT device
 - NOTE 1: Intermediate node can be relay, IAB, UE, repeater, etc. which is capable of ambient IoT
- Topology (3): BS <-> assisting UE <-> Ambient IoT device <-> BS
 - ~~NOTE 2: Assisting UE can be either bidirectional or unidirectional operation to others~~
 - FFS: If the two BS can be different
- Topology (4):UE <-> Ambient IoT device
 - ~~NOTE 1: The links may be bidirectional or unidirectional operation~~
- FFS: Topology (5) UE <-> Ambient IoT device <-> {BS or UE}
 - ~~NOTE 1: The links may be bidirectional or unidirectional operation~~

NOTE: For potential topology (5), discuss its relation with other topologies, its necessity, etc. in RAN#99.

NOTE for all topologies: The Ambient IoT device may be provided with carrier wave from another node(s) either inside or outside the topology

NOTE for all topologies: The links in each topology may be bidirectional or unidirectional

FFS: Whether to consider combination of different topologies in the study.

FFS: BS, UE, or assisting UE could be multiple BSs, UEs or assisting UEs, respectively.

Feedback Form 27: Any remaining comments before agreeing?

1 – Nokia Denmark Agree
2 – NTT DOCOMO INC. Agree
3 – Qualcomm Incorporated We are ok with agreeing on the current proposal at this meeting with the understanding that the topic,

including all the FFS parts, will be further discussed during the next meeting.

Our understanding is that the current agreement is about high level topologies – which need further details such as on direction of link, type of link, existence of link, type of node, combinations, difference of 'assisting UE' vs. 'UE', etc., as captured in the NOTE.

4 – Apple France

Agree

5 – ZTE Corporation

Thank you for Moderator's further response. But we are not so convinced by Moderator's response that the missed case from Topology (2) or Topology (3) can be covered by combination of (1) and (2). If this is the case, can we say the current Topology (3) can also be achieved with combination of (1) + (4) or (2) + (4) or even (1) + (2) + (4)? We think it's possible, then it may be enough to have only (1), (2) and (4). Since now we already have had a separate Topology (3), we'd better to clarify its main characteristic/difference. Per our understanding, the main difference of Topology (3) is not "assistance UE", but "an asymmetric link between BS and ambient IoT device."

So for one of the two links in Topology (3), we think it's more suitable to insert Intermediate node to cover both NW node and (assistance) UE. Please note another link is a direct link from ambient IoT device to BS.

Even we are fine to take the current things as start point, we also agree with Qualcomm that in next meeting we need to further clarify the details such as on direction of link, type of link, existence of link, type of node, combinations, difference of 'assisting UE' vs. 'UE', etc.

6 – Spreadtrum Communications

Agree.

7 – Kyocera Corporation

We agree.

8 – Intel Belgium SA/NV

We are OK with the proposal.

Regarding ZTE's comments on Topology (3) with intermediate node, we think such topology should be studied. We also share the moderator's view that it can be achieved by combination, e.g., Topology (2) + (3). However, different companies may have different understandings on combining method.

9 – China Mobile Com. Corporation

Agree

10 – Ericsson LM

We would like to make the possibility for an Ambient IoT device to communicate via intermediate assistance NW node in one direction but directly with BS in the other direction more explicit. This case can

be covered, e.g., by generalizing “assisting UE” to “assistance node” in Topology (3) and adding a similar note for Topology (3) as for Topology (2).

Furthermore, we agree with MediaTek and ZTE that it would be good to indicate the end points for the communications, e.g., by underlining the end points.

11 – VODAFONE Group Plc

We can agree with the current proposal at this meeting and all the FFS parts to be further discussed in the next meeting.

12 – Philips International B.V.

We are supportive of the proposal as a starting point with details including the FFSs to be discussed further.

13 – Huawei Tech.(UK) Co.. Ltd

Agree.

While we think the further detail of topology 2&3 raised by Ericsson (and ZTE) is a valid thing to discuss, we see enough room to do so under the current formulation, of ”starting point”, and ”FFS whether combinations”. However, we could accept Ericsson’s change to assisting node. Other details we look forward to next meeting’s discussion.

5.5 Topic 4-5: Spectrum

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 28: Question 4-5: Is it agreeable that ‘Spectrum’ in a deployment scenario is: licensed FDD, licensed TDD, or unlicensed?

1 – Samsung Electronics Co.

We think interference management is one of the reasons why the ambient IoT is operated in the 3GPP ecosystem. Considering the difference between interference management in licensed and unlicensed spec-

<p>trums, it is difficult to consider both from a work load perspective. We propose to proceed with SID in preference to licensed spectrum first. Regarding FDD and TDD, it is ok to include both as the deployment scenarios.</p>
<p>2 – Wiliot Ltd.</p> <p>It is possible to include unlicensed spectrum in the study in interference insensitive usages such as energy signals.</p>
<p>3 – VODAFONE Group Plc</p> <p>all three scenarios ; licensed FDD, licensed TDD and unlicensed can be considered</p>
<p>4 – MediaTek Inc.</p> <p>All three.</p>
<p>5 – Spark NZ Ltd</p> <p>interference management will be easier with licensed bands and we could prioritize to start with this.</p>
<p>6 – Sierra Wireless. S.A.</p> <p>All three with equal priority.</p>
<p>7 – Apple France</p> <p>We agree with all three</p>
<p>8 – Futurewei Technologies</p> <p>It is ok to be more inclusive during RAN level study. For future WG level work, though unlicensed spectrum for ambient IoT has its additional aspects, those are secondary and can be addressed later. In addition, the transmission power of the unlicensed spectrum is quite limited which could further reduce the range of ambient IoT. Focusing on licensed spectrum is preferred.</p>
<p>9 – vivo Communication Technology</p> <p>OK</p>
<p>10 – NTT DOCOMO INC.</p> <p>Agree</p>
<p>11 – Kyocera Corporation</p> <p>We support all spectrum options, i.e., licensed FDD/TDD and unlicensed spectrums. Though, we assume the prioritization among these spectrums will be discussed in the future, if needed, e.g., when the follow-up SID/WID is formed.</p>
<p>12 – Spreadtrum Communications</p> <p>We are fine to consider these three deployment scenarios</p>

<p>13 – Motorola Mobility España SA</p> <p>[Lenovo] consider All</p>
<p>14 – CATT</p> <p>Ok on all.</p>
<p>15 – Telstra Limited</p> <p>Only need to capture licensed spectrum for both FDD and TDD</p>
<p>16 – Qualcomm Incorporated</p> <p>All three cases could be considered.</p>
<p>17 – LG Electronics Inc.</p> <p>Yes</p>
<p>18 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>All 3 cases can be considered. Licensed band will be usually the 1st step in 3GPP</p>
<p>19 – Huawei Tech.(UK) Co.. Ltd</p> <p>We can agree with the proposal.</p> <p>For unlicensed, like others, we also think interference is the primary limitation, and this is only likely to be sufficiently suppressed indoors. Although the tabular structure would be able to capture that restriction implicitly TR purposes, we are open to further discussion on how/if to include unlicensed for indoors.</p>
<p>20 – China Mobile Com. Corporation</p> <p>We support only licensed FDD and licensed TDD. But, we have serious problem with unlicensed.</p> <p>Because the unlicensed spectrum has the limitation of transmission power, more serious intra-freq interference, which impact on the transmission range of ambient IoT. And the restriction of LBT will make the design more complex, since it is difficult to support LBT on the battery-less tag.</p> <p>So we don't support to capture unlicensed.</p>
<p>21 – Sony Europe B.V.</p> <p>OK</p>

22 – Nokia Denmark Yes, we would like to include all spectrum scenarios in the RAN study with potential down selection.
23 – ZTE Corporation We also think licensed FDD, licensed TDD and unlicensed (e.g., to also consider the bands used by legacy RFID) can be considered in all the deployment scenarios.
24 – Panasonic Holdings Corporation We support FL view.
25 – NEC Corporation Yes, it is agreeable.
26 – Orange Licensed FDD and TDD should be the priority scenarios
27 – TURKCELL We support all three options.
28 – Intel Belgium SA/NV We are fine to the proposal
29 – Ericsson LM Yes, and if there is a need to prioritize, we prefer to prioritize licensed bands. Here, it could also be clarified whether the bands are assumed (in the study) to be the same as the ones currently specified for NR.
30 – KPN N.V. Licensed FDD and TDD are our preference

5.5.1 Initial round summary

Companies views appear to be:

- Yes to all: VDF, MediaTek, Sierra, Apple, Futurewei, vivo, DCM, Kyocera, Spreadtrum, Lenovo, CATT, Qualcomm, LG, OPPO, Huawei/HiSilicon, Sony, Nokia, ZTE, Panasonic, NEC, TURKCELL, Intel, Ericsson,
- Concerns with unlicensed: Samsung, Huawei/HiSilicon (outdoor), Spark, Telstra, CMCC, Orange, KPN
- Support unlicensed: Wiliot

5.5.2 Intermediate round

Clearly licensed FDD and licensed TDD are agreeable. The concerns on unlicensed raise again the question of prioritization. However, a large number of companies specifically indicate they can accept all 3 at this stage. Moderator’s general view is to take that later, when we write recommendations and conclusions, and work for now on the general understanding that down-selection / prioritization may occur in general across the SI. Given that additional to prioritization, companies also raise particular concerns on unlicensed, e.g. transmit power limitation, interference outdoors, the moderator can suggest to having a note about further discussions.

Proposal 4-5: Agree that spectrum in a deployment scenario is: licensed FDD, licensed TDD, unlicensed.

- Note: Further discuss if the study should apply any limitations to the cases for which unlicensed spectrum is studied.

Feedback Form 29: Is Proposal 4-5 agreeable?

<p>1 – Sierra Wireless. S.A.</p> <p>Yes but our view is unlicensed should be treat with similar priority.</p>
<p>2 – Qualcomm Incorporated</p> <p>We agree</p>
<p>3 – Beijing Xiaomi Mobile Software</p> <p>Yes</p>
<p>4 – vivo Communication Technology</p> <p>OK</p>
<p>5 – CATT</p> <p>Ok</p>
<p>6 – CATT</p> <p>Ok</p>
<p>7 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>OK</p>

8 – Spreadtrum Communications Yes, agreeable.
9 – NTT DOCOMO INC. Agree
10 – Nokia Denmark Agree
11 – Apple France Agree
12 – Huawei Tech.(UK) Co.. Ltd Yes, and we think further checking on when/what limitations apply needs to be made for unlicensed spectrum.
13 – VODAFONE Group Plc Agree
14 – Kyocera Corporation We agree.
15 – Panasonic Holdings Corporation We agree the proposal.
16 – Tejas Networks Ltd. Agree. Does the study for unlicensed involve remote powering of ambient IOT device to be done using licensed spectrum? (It is actually a hybrid scenario).
17 – Samsung Electronics Co. ok
18 – NOVAMINT agree on the proposal and agree with the comment made by SW - unlicensed should be treated with same priority than licensed
19 – Intel Belgium SA/NV OK

20 – ZTE Corporation Agree
21 – Ericsson LM Yes, and if there is a need to prioritize, we prefer to prioritize licensed bands. Here, it could also be clarified whether the bands are assumed (in the study) to be the same as the ones currently specified for NR.
22 – Motorola Mobility España SA agree
23 – Sony Europe B.V. OK
24 – MediaTek Inc. OK
25 – China Mobile Com. Corporation We still only support licensed band communication, and unlicensed band can only be used for energy harvesting. At least licensed band should be prioritized since unlicensed band have significantly higher interference and lower transmitter power in UL.

5.5.3 Intermediate round summary

There seems to be agreement to the proposal.

Note on CMCC's comment, that the moderator is understanding this agrees to include unlicensed as proposed, but that CMCC have a particular view of what it can be used for. This seems fair enough to raise in the future meetings e.g. when making deployment scenario tables, and functionalities, etc. To Tejas, the same reply.

On prioritization statements, the moderator assumes all companies are taking due note of these views, and does not intend to capture them at this level of proposal since it makes no statement (not even of equality) relating to prioritization.

5.5.4 Final round

It appears the following can be endorsed by the Chair.

Proposal 4-5: Spectrum in a deployment scenario is: licensed FDD, licensed TDD, unlicensed.

- *Note: Further discuss if the study should apply any limitations to the cases for which unlicensed*

spectrum is studied.

Feedback Form 30: Indicate if concern for the Chair to endorse this

1 – Qualcomm Incorporated We agree
2 – Spreadtrum Communications Agree to endorse this
3 – NTT DOCOMO INC. No concern
4 – vivo Communication Technology OK
5 – Apple France Agree
6 – Samsung Electronics Co. ok
7 – Shenzhen Heytap [OPPO] OK
8 – THALES Agree
9 – EURECOM Agree
10 – Nokia Denmark OK
11 – Huawei Tech.(UK) Co.. Ltd No concern.
12 – China Mobile Com. Corporation We can accept to endorse this proposal.

13 – ZTE Corporation Ok.
14 – Panasonic Holdings Corporation Ok
15 – Kyocera Corporation We agree.
16 – Ericsson LM Agree
17 – NOVAMINT OK
18 – MediaTek Inc. OK
19 – Telia Company AB Agree

5.5.5 Final round summary

This was already stable in the intermediate round, thanks to all for the confirmation. Hence no extended round.

Proposal 4-5 for agreement: Spectrum in a deployment scenario is: licensed FDD, licensed TDD, unlicensed.

- ***Note: Further discuss if the study should apply any limitations to the cases for which unlicensed spectrum is studied.***

5.6 Topic 4-6: Traffic assumption

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 31: 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?

1 – VODAFONE Group Plc

agree to have device-terminated command and device-terminated reporting trigger.

2 – MediaTek Inc.

We’re not sure the distinction is needed at this stage. However we do agree that ”device-terminated communication trigger” is a primary characteristic - whatever the communication that will next be made by the device.

3 – Huawei Tech.(UK) Co.. Ltd

It seems useful to have this clarification to help the TR set out the differences within the single terminology. There is a further case we’d like to capture:

- *Device-originated autonomous report (for which the TR can state e.g. of wireless sensor for environment monitoring, etc.)*

4 – Sierra Wireless. S.A.

We do not understand why we need this MT command vs Reporting Trigger distinction.

<p>5 – Apple France</p> <p>We would be fine to have the distinction of device-terminated command and device-terminated reporting trigger</p>
<p>6 – Futurewei Technologies</p> <p>We are fine with the proposal</p>
<p>7 – vivo Communication Technology</p> <p>Fine in general.</p> <p>However, we would like to ask a question for clarification. If sensor report is considered as "device-terminated report trigger", what would then be the representative use case for "device-originated" traffic? would be good to hear companies understanding on this.</p>
<p>8 – NTT DOCOMO INC.</p> <p>We are open to differentiate these traffic types for clarification</p>
<p>9 – Kyocera Corporation</p> <p>We're ok to include these assumptions.</p>
<p>10 – Spreadtrum Communications</p> <p>We understand that both device-Terminated command and Device-Terminated reporting trigger are belong to the category details, so they can be included in the traffic category of device terminated.</p> <p>In addition, device originated traffic can be transferred to device terminated traffic according to SA1 study, for example, sensor service can be categorized as device terminated traffic.</p>
<p>11 – Motorola Mobility España SA</p> <p>[Lenovo] device originated for wireless sensor network and device terminated for inventory tracking for logistics</p>
<p>12 – CATT</p> <p>Both active and passive devices could support device terminated. However, only active devices could support device originated. We need to define the device type and use cases first before defining device originated/terminated.</p>
<p>13 – Qualcomm Incorporated</p> <p>We want to clarify that the traffic characterization such as "device-originated", "device-terminated-command" or "device-terminated-reporting-trigger" are all <u>application layer</u> characterization. Note that they may not necessarily be in line with physical layer signaling flow. For example, it is still possible that (semi)-passive device can send "device-originated" application message based on lower layer trigger signal from gNB. The lower layer trigger signal could be occasional polling signal to trigger/allow Ambient IoT devices to</p>

transmit its own message. The “device-originated” traffic could be also, of course, used to refer the traffic generated by active device (w/o trigger signal).

We think the traffic characterization should not implicate certain device type (i.e. passive or active).

14 – LG Electronics Inc.

Considering that Device-Terminated command can trigger Device-Terminated reporting, we are not sure to differentiate between Device-Terminated command and Device-Terminated reporting trigger.

15 – Shenzhen Heytap

[OPPO]

Not sure whether we need to have such detailed type.

And it may not be able to have an accurate categorization. For example, for a function, it may include only one or include both.

16 – Sony Europe B.V.

Do not support. “Device terminated” is general terminology and includes the two extra bullets.

17 – China Mobile Com. Corporation

It’s too early to go into details. For now, we can simply use MO/MT for general.

18 – Nokia Denmark

We support the comment from Qualcomm.

19 – ZTE Corporation

We are generally fine with the following types suggested by the Rapp:

- *Device-originated autonomous report (for which the TR can state e.g. of wireless sensor for environment monitoring, etc.)*
- *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.)*

Why we remove the positioning is that we are uncertain whether positioning belongs to Device-terminated command type since we are not clear yet how to perform positioning for such Ambient-IoT devices.

And we think one difference between Device-terminated command and Device-terminated reporting trigger is that UL application traffic may be not expected in Device-terminated command.

20 – Panasonic Holdings Corporation

We support FL view.

21 – TURKCELL

We support Qualcomm’s view.

22 – Intel Belgium SA/NV

We prefer to first clarify if it is the case that a DT device always need to acknowledge the received DT indication. The acknowledge may be a physical layer signal or a high layer message

If it is supported that there is no acknowledge in either PHY or high layer, the categorization of device-terminated command or device-terminated reporting would be fine. However, positioning may not be a proper example for device-terminated command since A-IoT device may transmit/backscatter a signal after receiving an indication for positioning.

23 – Ericsson LM

We would prefer to see the more generic ‘DT data’ and ‘DO data’ (cf. NR Small Data Transmission), since according to several SA1 use cases, transmission of DL data payload must be supported.

5.6.1 Initial round summary

Based on the inputs, moderator understands a lot companies are fine to have Device-Terminated command and Device-Terminated reporting trigger as additional descriptions of DT traffic assumption. While some companies don’t think it is necessary to discuss such detail at this stage and would keep only DT and DO at high level. A few companies think DO can be implemented as DT (by polling) or has certain relation to DT trigger, one company ask to clarify the relation between DO and the DT triggered sensor report. Two companies ask to remove positioning in moderator’s example. 2 companies think the application layer concept DT command, DT reporting trigger and DO may not necessarily be in-line with physical layer signaling flow which means application layer concept may be different to physical concept.

Moderator thinks it seems premature to discuss detail of DT at this moment, thus to propose remains DT and DO for now, and encourage companies to further look in next meeting.

5.6.2 Intermediate round

The SID at least tells us at DT and DO are valid within the SI. Given the divergent views on the basis of the discussion, moderator suggests taking an FFS for the next meeting. Moderator includes some level of detail as a reminder to companies of the discussion.

Conclusion 4-6: The moderator records the following for this meeting:

- FFS whether the TR will describe different types of device-terminated traffic, e.g. Device-Terminated command and Device-Terminated reporting trigger, and whether to describe relationships between device-originated and device-terminated traffic, etc.

Feedback Form 32: Is conclusion 4-6 agreeable?

<p>1 – Sierra Wireless. S.A.</p> <p>Yes</p>
<p>2 – Qualcomm Incorporated</p> <p>We think that when we talk about DT and DO, we need to be clear whether it is application layer or lower layer. We propose the following modified text: ”FFS whether the TR will describe different types of device-terminated traffic, e.g. Device-Terminated command and Device-Terminated reporting trigger, and whether to describe relationships between device-originated and device-terminated traffic, etc., <u>with consideration of the application layer and PHY/-MAC layer.</u></p>
<p>3 – Beijing Xiaomi Mobile Software</p> <p>Yes</p>
<p>4 – vivo Communication Technology</p> <p>Fine with the moderator proposal. Qualcomm’s clarification seems also useful.</p>
<p>5 – CATT</p> <p>OK</p>
<p>6 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>Agree with this proposal with Qualcomm’s clarification.</p>
<p>7 – Spreadtrum Communications</p> <p>Yes, agreeable.</p>
<p>8 – NTT DOCOMO INC.</p> <p>Agree. Also fine with Qualcomm’s modification</p>
<p>9 – Nokia Denmark</p> <p>Agree, also fine with Qualcomm’s modification</p>
<p>10 – Huawei Tech.(UK) Co.. Ltd</p> <p>OK</p>

<p>11 – VODAFONE Group Plc</p> <p>Agree, also fine with Qualcomm’s addition</p>
<p>12 – Kyocera Corporation</p> <p>We agree with the moderator’s proposal, with Qualcomm’s clarification.</p>
<p>13 – Panasonic Holdings Corporation</p> <p>We are OK with above.</p>
<p>14 – Tejas Networks Ltd.</p> <p>Agree with Qualcomm suggestion</p>
<p>15 – NOVAMINT</p> <p>Agree with Qualcomm’s proposal</p>
<p>16 – Intel Belgium SA/NV</p> <p>Fine with revision by Qualcomm</p>
<p>17 – ZTE Corporation</p> <p>Fine with the moderator proposal.</p> <p>Qualcomm’s clarification seems not so needed and can be left to WG discussion.</p>
<p>18 – Ericsson LM</p> <p>Fine with the moderator proposal, not sure that Qualcomm’s addition is needed</p>
<p>19 – Motorola Mobility España SA</p> <p>Fine, Qualcomm’s addition is not needed.</p>
<p>20 – Sony Europe B.V.</p> <p>OK</p>
<p>21 – MediaTek Inc.</p> <p>OK with FFS</p>
<p>22 – China Mobile Com. Corporation</p> <p>OK with FFS</p>

5.6.3 Intermediate round

No objection to the text proposed so far is observed from the replies.

Qualcomm suggest additional text on whether the concept of DT and DO is application layer or lower layer, and suggest clarification about that. OPPO, Tejas, NOVAMINT, Intel and Kyocera also think this addition is useful. Vivo, DCM, VDF, Nokia could be either fine with original proposal or Qualcomm 's update. Motorola, Ericsson, and ZTE do not support the addition (one reason is to leave it to potential WG-level discussion).

Since it is only an FFS text, the items listed as marked as only examples, and it also includes "etc" already, moderator suggests that there is already room enough to raise the point in RAN, and see if companies wish to make agreements relating to it, without exploring the controversy of trying to update the wording of FFS.

5.6.4 Final round

Noting the summary and explanation, the moderator asks to agree to the same text as the intermediate round:

Conclusion 4-6: The moderator records the following for this meeting:

- *FFS: whether the TR will describe different types of device-terminated traffic, e.g. Device-Terminated command and Device-Terminated reporting trigger, and whether to describe relationships between device-originated and device-terminated traffic, etc.*

Feedback Form 33: Is this OK to take as a conclusion?

1 – Qualcomm Incorporated We agree
2 – Spreadtrum Communications OK
3 – NTT DOCOMO INC. Agree
4 – vivo Communication Technology OK
5 – Apple France Ok

6 – Samsung Electronics Co. ok
7 – Shenzhen Heytap [OPPO] ok
8 – THALES OK
9 – Nokia Denmark OK
10 – VODAFONE Group Plc agree
11 – Huawei Tech.(UK) Co.. Ltd Yes
12 – China Mobile Com. Corporation Agree
13 – ZTE Corporation Ok.
14 – Panasonic Holdings Corporation Ok
15 – Kyocera Corporation We agree.
16 – Intel Belgium SA/NV OK
17 – Ericsson LM Agree
18 – MediaTek Inc. OK

19 – Telia Company AB

Ok

5.6.5 Final round summary

Everyone is OK to have this as a conclusion for this meeting. Chair will be asked to endorse it. No extended round.

Conclusion 4-6 for endorsement:

- ***FFS: whether the TR will describe different types of device-terminated traffic, e.g. Device-Terminated command and Device-Terminated reporting trigger, and whether to describe relationships between device-originated and device-terminated traffic, etc.***

5.7 Topic 4-7: With or without core network

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 Topic 5-1 - Characteristics

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

<p>1 – VODAFONE Group Plc</p> <p>agree to consider all three device characteristics</p>
<p>2 – MediaTek Inc.</p> <p>So long as energy provision is NOT considered, the above is ok and in line with the SID.</p>
<p>3 – Spark NZ Ltd</p> <p>we should capture all device characteristics</p>
<p>4 – Huawei Tech.(UK) Co.. Ltd</p> <p>First two are OK, but we not sure about the “Tx only, Rx&Tx”. Seems it is from RP-222929, could the proponent clarify how the “Tx only” device is supposed to work? For example, how can the device understand when to conduct uplink signal reflection/transmission without Rx capability in the device? It seems to lead to the loss raised by Vodafone:</p> <ul style="list-style-type: none">- <i>“The radio system should support the ability to address individual tags”</i>- <i>“Rather than “reflecting” every received radio signal, tags should be able to only react (reflect/transmit) when they receive something addressed to them (or their group).”</i> <p>We also are not sure there is any SA1 use case calling for this operation. We would suggest to delete “Device function”.</p>
<p>5 – Apple France</p> <p>We agree with categorization based on energy storage capability. For generation of RF signal for transmission, we are also fine. However, for Tx only, we have similar question as Huawei</p>
<p>6 – Futurewei Technologies</p> <p>We are fine with the first 2 bullets. On the third one, we have the same concern as Apple and Huawei.</p>
<p>7 – Qualcomm Incorporated</p> <p>We agree to consider all three characteristics. Of course, some down-selection is expected and some of the sub-types, or combination of sub-types, are not expected to be pursued.</p>
<p>8 – vivo Communication Technology</p> <p>Agree with these characteristics should be studied.</p> <p>other characteristics can also be considered. for example, the energy source for energy storage can be different, e.g., RF energy vs Non-RF energy. typically, the latter has higher energy conversion efficiency, and can sustain higher device power consumption/design targets.</p>

9 – NTT DOCOMO INC.

We are not sure whether "Device function" is necessary or not since it is unclear what is the difference from "Generation of RF signal for transmission". If it is included, clarification is necessary on which combinations are feasible.

10 – Kyocera Corporation

We're fine with the three characteristics as the moderator suggested. We just wonder what is intended in "Rx" in the third bullet, i.e., it only means the data reception or also includes the energy reception.

11 – Spreadtrum Communications

We are fine with the first two characteristics.

For the last characteristic, we share the similar views as HW, and prefer to delete it.

In addition, we suggest to add a new bullet:

- Inherent characteristics, e.g., device size, form factor, buffer, etc. (Note: To reflect the possible impacts to the complexity of A-IoT)

12 – Motorola Mobility España SA

[Lenovo] – agree

however, how to energize the ambient IoT device using RF is out of scope

13 – CATT

We are OK to study all type of devices. However, we need to define the target maximum power consumption for different categories of devices.

14 – Telstra Limited

We are ok to study all three device characteristics at this early stage

15 – LG Electronics Inc.

Ok with these characteristics for now.

16 – Shenzhen Heytap

[OPPO]

OK.

For the 3rd bullet, in SA1 there is use cases may need Tx only device, e.g., Use case on pressure powered switch or Use case on smart bridge health monitoring using Ambient IoT

We need to evaluate whether we can support this type of device in future RAN study.

<p>17 – Sony Europe B.V.</p> <p>OK. These characteristics, however, need to be taken into account when defining device categorization in 5.2</p>
<p>18 – China Mobile Com. Corporation</p> <p>Agree to capture first two bullets, i.e., energy storage and generation of RF signal.</p> <p>However, we have concerns on the device or communication function. From our perspective, it can be concluded from SA1’s requirements that all Ambient IoT devices should be capable of both RX and TX.</p> <p>The requirement of introducing A TX only device should be clarified, is it like a beacon?</p>
<p>19 – Nokia Denmark</p> <p>We are ok with the proposed three scenarios.</p>
<p>20 – ZTE Corporation</p> <p>We are also generally fine with the first two bullets. But we think “RF” is too specific and can be removed from the second bullet.</p> <p>Same comments for the third bullet as Huawei.</p>
<p>21 – Panasonic Holdings Corporation</p> <p>We support FL view.</p>
<p>22 – TURKCELL</p> <p>We agree with the categorization. We share the concern of other companies with Tx only.</p>
<p>23 – Orange</p> <p>We support all 3 cases. For devices, Rx + Tx cases but also Tx only should be considered, with backscattering triggered without a specific receiver.</p>
<p>24 – Intel Belgium SA/NV</p> <p>We are OK to study on the three characteristics</p>
<p>25 – Telia Company AB</p> <p>We are fine with the proposal.</p>
<p>26 – Ericsson LM</p> <p>Agree.</p>
<p>27 – China Telecommunications</p> <p>Agree.</p>

28 – KPN N.V.

We want AmbientIoT with power harvesting and we are not a fan of passive IoT with backscatter technology.

6.1.1 Initial round summary

All companies agreed to capture the first two bullet (energy storage, Generation of RF signal for transmission), while 8 companies asked for clarification or suggest to delete the third bullet (device function: Tx only, Rx&Tx). In addition, some other aspects were mentioned during the discussion, they are:

- On energy source for energy storage: there are different opinions of RF energy only, RF&non-RF energy, and out of scope.
- Add a new bullet: inherent characteristics, e.g. device size, form factor etc.
- Define target maximum power consumption for different categories of devices.

6.1.2 Intermediate round

Since all companies agree to (a) energy storage and (b) generation of RF signal for transmission, we can use those in Topic 5-2, and include them in the TR. Other can be added later, if agreed to.

On device function, it seems more controversial, and appropriately captured by the FFS in the categorization methods discussed next.

On maximum power consumption target (CATT), this might be a design requirement rather than a device characteristic (i.e. whatever is the device, it must not exceed a given power). However, we can add an FFS to the device categorizations below.

On “inherent characteristics” (Spreadtrum), the moderator sees that this is being discussed a lot in SA1 (e.g. what size device does a cattle farmer need, to be worn by the animals), and the general nature of that discussion seems non-radio, and hence better left out of RAN and in SA1.

Topic 5-1b: Energy harvesting sources

On whether to have RF only, RF & non-RF, or consider it as out of scope to the SI, moderator thinks it is not immediate from the SID that it is entirely out of scope, since the justification section discusses such sources, and the device categorization text refers to “energy sources”. On the other hand, clearly RAN should not start its own investigations into how to harvest energy. Is it sufficient to satisfy all companies if we just have a listing of all the sources reported by companies from literature, without any attempt to evaluate them or look at implementations, etc?

Question 5-1b: Can we agree to capture the following statements in an Annex of the TR.

- “Companies have reported the following energy sources for energy harvesting in literature: RF, solar/light, piezoelectric (kinetic/vibration), electromagnetic, electrostatic, heat/thermal, thermoelectric, magnetic, wind/water, acoustic”

Feedback Form 35: Question 5-1b: Can we agree to capture the above statements in an Annex of the TR?

1 – Sierra Wireless. S.A. yes
2 – Sierra Wireless. S.A. yes
3 – Qualcomm Incorporated We agree
4 – Beijing Xiaomi Mobile Software Yes
5 – vivo Communication Technology OK
6 – CATT OK
7 – Shenzhen Heytap [OPPO] OK.
8 – Spreadtrum Communications We agree to capture the above statements in an Annex of the TR. We appreciate the moderator’s feedback for “inherent characteristics”, and we also understand that this is being discussed a lot in SA1. However, we think this should be also discussed in RAN, since the inherent characteristics may have RAN impacts, for example, smaller size may lead to limited implementations (smaller Rx number, similar to XR 2Rx issue), then impact the RF performance(RAN4’s work) and RAN procedures/specifications. We understand that the most important perspectives for A-IoT are energy and complexity, RAN should study them very carefully and completely. Therefore, we should not preclude any RAN impacted characteristics at this early stage. For progress, we suggest to add “inherent characteristics” as a FFS bullet , companies can provide their views on this part, if any. If we cannot make any consensus on this part at the end of SI, we can remove it from RAN TR finally.

9 – NTT DOCOMO INC. Agree
10 – Nokia Denmark OK
11 – Huawei Tech.(UK) Co.. Ltd OK. Not sure it needs to be an Annex. Let's see later.
12 – Kyocera Corporation We agree.
13 – China Mobile Com. Corporation Agree
14 – Panasonic Holdings Corporation We are OK with above.
15 – Tejas Networks Ltd. Agree
16 – Apple France Agree
17 – NOVAMINT OK for us
18 – Intel Belgium SA/NV We are OK with the proposal. RAN will not work on how to harvest the energy. On the other hand, the speed and amount for energy harvesting may impact the RAN operation of A-IoT. We expect such impact on A-IoT device operation can be further discussed
19 – ZTE Corporation Agree.
20 – Ericsson LM Agree

21 – Motorola Mobility España SA agree
22 – Sony Europe B.V. OK
23 – China Telecommunications Agree
24 – MediaTek Inc. No such annex is needed.

6.1.3 Intermediate round summary

Apart from MediaTek, the other ~23 companies are fine with the proposal. The moderator thus refers it to the TR editor for capturing in TR 38.848, and suggests to MediaTek that they can bring some additional caveating text to the next meeting to reflect the controlled scope or knowledge level you'd like the TR to indicate. Can add one bullet to point that out.

On whether it should be an annex, there is only 1 company raising a query on that, so the moderator will retain it in annex form. (If this turns out to be an awkward representation, we can decide to move the text somewhere else under the editor's guidance later, perhaps).

6.1.4 Final round

Based on the summary, the proposal is:

Proposal 5-1b-v2:

- *Capture the following in an Annex:*

“Companies have reported the following energy sources for energy harvesting in literature: RF, solar/light, piezoelectric (kinetic/vibration), electromagnetic, electrostatic, heat/thermal, thermoelectric, magnetic, wind/water, acoustic”

- *Note that further explanatory text can still be considered in future meetings of the SI.*

Feedback Form 36: Any final comments before agreement?

1 – Qualcomm Incorporated We agree to include the text. But we need to further discuss where to capture it. It could be in an Annex or in another place/section in TR. We propose to discuss where to put it in the next meeting.

<p>2 – Spreadtrum Communications</p> <p>We have no further comments on Proposal 5-1b-v2, but we would like to mention that our reply and suggestions for “inherent characteristics” in the Intermediate round is not treated in the summary part (6.1.3). As explained in the Intermediate round, we suggest to add “inherent characteristics” as a FFS bullet in section 4.3 device categorization. We are also willing to hear moderator’s views on this suggestions. Thanks.</p>
<p>3 – NTT DOCOMO INC.</p> <p>Agree</p>
<p>4 – vivo Communication Technology</p> <p>OK</p>
<p>5 – Apple France</p> <p>We share similar view as Qualcomm</p>
<p>6 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>OK</p>
<p>7 – EURECOM</p> <p>Agree, we support Qcom’s comment.</p>
<p>8 – Nokia Denmark</p> <p>Agree with the comment from Qualcomm</p>
<p>9 – Huawei Tech.(UK) Co.. Ltd</p> <p>We agree, and we do not mind whether it is an Annex or other location. This agreement, or a TR editor decision is fine.</p>
<p>10 – China Mobile Com. Corporation</p> <p>Agree</p>
<p>11 – ZTE Corporation</p> <p>Ok.</p>
<p>12 – Panasonic Holdings Corporation</p> <p>Ok</p>

13 – Kyocera Corporation We agree.
14 – Intel Belgium SA/NV Agree
15 – Ericsson LM Fine with Qualcomm’s suggestion
16 – NOVAMINT OK with Qualcomm’s suggestion
17 – MediaTek Inc. Please add ”etc.” at the end of the list.

6.1.5 Final round summary

Thank you for the flexibility, MediaTek, adding ‘etc’ should be ok, so will do it.

To Spreadtrum, first, thanks for accepting the proposal 5-1b-v2. Second, the moderator’s response on “inherent characteristic” was after the initial round, and it must be noted that no other company has indicated support for the proposal. From the moderator’s point of view the phrasing “inherent characteristic”, together with what it covers in RAN vs SA1, etc. would need too much work to become precise enough for companies to agree in the extended round. I hope to ask you for this flexibility, and feel free to raise a precise proposal in the next meeting. The door is not closed.

On Qualcomm et al. comments on whether an Annex or not, this seems to go back by at least one round of discussion, where in the intermediate round these companies all had indicated agreement to being an Annex. Moderator has to think it does seem reasonable to ask companies who had that expectation and are already compromising a long way, to now reverse their expectation in the extended round.

The baseline situation is that everyone has kindly indicated agreement to the text, and we run the extended round on that underlying assumption.

6.1.6 Extended round

- The baseline situation is that everyone can accept (or live with) the text, that much is clear.
- Furthermore every company has agreed either in the intermediate round or the final round to have it as an annex.

Therefore, the moderator will ask if anyone has an objection to deciding later where precisely in the TR to put

the text; and if any objection to that, then we stand by the use of an annex.

Proposal 5-1a-extended:

- The following text is included in TR 38.848, with precise location up to later decision, unless there is an objection to letting the precise location be decided later, in which case the text is included in an Annex of the TR.
 - *“Companies have reported the following energy sources for energy harvesting in literature: RF, solar/light, piezoelectric (kinetic/vibration), electromagnetic, electrostatic, heat/thermal, thermoelectric, magnetic, wind/water, acoustic, etc.”*
- Chair is respectfully requested to make the appropriate agreement accordingly after the extended round.

Feedback Form 37: Please indicate as needed

1 – Nokia Denmark Agree
2 – NTT DOCOMO INC. Agree
3 – Qualcomm Incorporated We thank the Moderator for reflecting our comment. We agree with the current proposal.
4 – Apple France Agree
5 – ZTE Corporation Agree
6 – Spreadtrum Communications Agree. In addition, thanks David for your detailed feedback for “inherent characteristic” and we accept your suggestion on the potential late procedures.
7 – China Mobile Com. Corporation We are fine to capture it in the annex. No strong view to capture it in annex or formal text.

8 – Kyocera Corporation We agree.
9 – Intel Belgium SA/NV OK
10 – Ericsson LM Agree
11 – Shenzhen Heytap [OPPO] Agree
12 – VODAFONE Group Plc OK
13 – Huawei Tech.(UK) Co.. Ltd Agree (and either way is OK for us)
14 – China Telecommunications Agree
15 – Philips International B.V. OK

6.2 Topic 5-2 - Categorization

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.

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 38: 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.

<p>1 – Samsung Electronics Co.</p> <p>We support method 3, whether to have energy storage for backscatter type is up to implementation and unclear in some implementations. Since transmission schemes might be impact on protocol design, device function can be considered a given method 3.</p>
<p>2 – VODAFONE Group Plc</p> <p>we support method 1 for device categorization</p>
<p>3 – MediaTek Inc.</p> <p>Method 3.</p>
<p>4 – MediaTek Inc.</p> <p>As explained earlier - that a device harvests energy is fine (when "plugged" to a power source, it harvests the energy of said source... which in itself is nothing new) but is not relevant to the discussion. Energy storage could be considered, but we should make abstraction of the energy source. Some storage capacity, power consumption targets should be defined, against which traffic models can be tested.</p>
<p>5 – Spark NZ Ltd</p> <p>support method 1</p>

6 – Huawei Tech.(UK) Co.. Ltd

As in RP-223400, we categorized the devices by method 1: Combination of energy storage and device transmission method.

- Device Category #1A corresponding to devices with only passive RF components, and without energy storage capability
- Device Category #1B corresponding to devices with only passive RF components, and with energy storage capability
- Device Category #2 corresponding to devices including active RF components, and with energy storage capability

This is because we think passive RF or RF active components for transmission and reception is the main factor which will make difference. We prefer to categorize the device by transmission method in the first place, then introduce sub-category by energy storage when needed. In this sense, both Method 1 and 3 are fine to us.

7 – Apple France

We support method 1

8 – Futurewei Technologies

We support method 1. As of energy source for harvesting, RAN should only consider RF signal.

9 – vivo Communication Technology

Method 1 seems close to our understanding.

For passive device B in method 1, it may be further categorized in to sub-types, e.g.,

- energy source only relies on RF energy from reader
- energy source from ambient(e.g., solar, vibra)

different energy source may sustain different device power consumption, and leading to different design KPIs.

10 – NTT DOCOMO INC.

At least categorization by device transmission method is necessary since it would have much impact on the air interface and coverage. In that sense, we are fine with either Method 1 or 3

11 – Kyocera Corporation

We think Method 1 is a reasonable categorization. We think it's obvious that the backscattering transmission can be done by both no energy storage and limited energy storage devices, while the active transmission can be done only by energy storage-capable devices. So, these should be depicted in the device categorization.

12 – Spreadtrum Communications

Method 1 is preferred.

13 – Motorola Mobility España SA

[Lenovo] method 1 is preferred
please rewrite as passive, semi-passive and active

14 – CATT

Method 1

15 – Telstra Limited

We support Method 1

16 – Qualcomm Incorporated

As a first step, we think that the two fundamental characteristics: signal generation method and energy storage should be treated as two independent dimensions, and we should develop good understanding of them and agree on a common terminology. Then as a second step, we could have a 'matrix' where we decide which combination of per dimension sub-types are supported or not supported.

For example, for signal generation, we could have:

- S1 (passive) has no independent signal generation or signal amplification capability
- S2 (semi-passive) has no independent signal generation capability but has active components with which to amplify reflected signals
- S3 (active) has independent signal generation capability, including producing oscillator frequency

And for energy storage, we could have

- P1 (no storage) has no energy storage
- P2 (very limited energy storage) expressed in a range of capacitance or range of mAh (or mA x ms) with agreed reference voltage
- P3 (medium energy storage) a higher range of capacitance or range of mAh
- ...

We could also have, as another dimension, Tx-only and Rx+Tx device types, as was discussed before.

As mentioned, it should be discussed as a second step (but as soon as possible) which Sx-Py combinations should be pursued and which shouldn't be.

17 – LG Electronics Inc.

Method 1 is preferred.

18 – Shenzhen Heytap

[OPPO]

Method 1 is most close to our preference.

But we think it is too premature at current stage to preclude other possibility thus it need an FFS: other device type is not precluded.

19 – Sony Europe B.V.

Do not support.

The categorisation only consider whether energy storage is required for transmission and does not include the case where energy storage is required to power a device that includes a low-power low-complexity receiver that requires an energy storage device.

Method 1 should split active device into “active device A” and “active device B”:

- active device A: Energy storage from harvesting ambient sources, active RF components for transmission
- active device B: Energy storage from harvesting ambient sources, active RF components for reception and transmission

Method 2:

- device B1: presumably the energy storage is also used to maintain device state (memory) between a command phase (reception) and a transmit phase (backscattering communication)
- device B2: active RF components can also be used for reception

Method 3: We think that this does not give the full picture as the method of reception is also significant

20 – China Mobile Com. Corporation

We prefer Method 1. It looks clear.

21 – Nokia Denmark

Method 1 seems to cover nicely.

22 – ZTE Corporation

We support Method 1 for device categorization.

<p>23 – Intel Belgium SA/NV</p> <p>We are OK with either Method 1 or 2. For backscatter transmission, it is helpful to use separate categories since the operation with or without energy storage may be quite different</p>
<p>24 – Panasonic Holdings Corporation</p> <p>We are fine either of method 1 or method 3. To distinguish backscattering or not is one important factor.</p>
<p>25 – NEC Corporation</p> <p>Method 3 firstly. If much difference of backscattering transmission between no energy storage and energy storage device can be observed, then method 1 could be considered.</p>
<p>26 – TURKCELL</p> <p>We prefer Method 1.</p>
<p>27 – Ericsson LM</p> <p>Method 1 or 2 is fine. Regarding the FFS on device function, it seems reasonable to include whether the device supports downlink reception (of data or commands) or not, which to our understanding is not feasible for a device without any form of energy storage.</p>
<p>28 – China Telecommunications</p> <p>We prefer Method 1.</p>
<p>29 – KPN N.V.</p> <p>method 1</p>

6.2.1 Initial round summary

23 companies supported method 1. 6 companies supported method 3. 2 company supported method 2. And there are some other suggestions raised during the discussion, including “to consider different methods for reception”, “further discussion on different types of signal generation and energy storage”, “energy source for harvesting, only RF signal or RF+Ambient”, “rewrite as passive, semi-passive and active”, “other device type is not precluded” and “including whether the device supports downlink reception or not”. Qualcomm suggest different levels of energy storage, and the creation of energy-storage vs. signal-generation pairs. Sony suggest sub-dividing active devices according to whether active for Tx only (and presumably passive for Rx), or active for Tx and Rx.

6.2.2 Intermediate round

Topic 5-2a: Energy storage characteristic

On the Qualcomm suggestion for energy storage capacity, we can have discussion in this round on what/if to

capture in this regard, although it seems clear we should have a closed-ended list. If we capture a few levels/capacities as Qualcomm suggests, this may be a useful way to highlight what the proponents of Method 2 are prioritizing.

Question 5-2a: Can we agree to categorize energy storage capacities as follows:

- *Storage 1: No storage at all.*
- *Storage 2: Up to that of an ordinary capacitor*
- *Storage 3: Up to that of a supercapacitor*

FFS: In RAN#99 if and what approximate maximum values to indicate for storage 2 and storage 3.

Feedback Form 39: Can we agree to categorize energy storage capacities as in Question 5-2a?

<p>1 – Sierra Wireless. S.A.</p> <p>Will this text just bring up the question of mAH for #2 and #3. Perhaps we should go right to defined mAH ranges.</p>
<p>2 – Qualcomm Incorporated</p> <p>We agree in principle to the categorization for energy storage. This is the first dimension of device categorization.</p> <p>However, the terms "ordinary capacitor" and "supercapacitor" may not have commonly accepted value range associated with them. We suggest to use ranges X and Y for Storage 2 and Storage 3, respectively, instead of using "ordinary capacitor" and "supercapacitor". The value range could be in Farad or mAh (with a reference voltage for the latter).</p>
<p>3 – vivo Communication Technology</p> <p>The difference between #2 and 3# are unclear. We suggest to agree on two capabilities for now (with and without energy storage), the one with energy storage capability can be further spit in future meetings based on the discussion.</p>
<p>4 – CATT</p> <p>Can we use quantitative descriptions of energy storage 2 and 3?</p>
<p>5 – Shenzhen Heytap</p> <p>[OPPO]</p> <p>We can agree on two Cat: with and without energy storage.</p> <p>But as the comments above, it is not clear what is an <i>ordinary capacitor</i> or <i>supercapacitor</i>, and it is also <i>difficult to use quantitative description for now</i>.</p> <p>in addition, some other kinds of storage element can also be considered, such as solid state battery.</p> <p>So, we suggest to have two categories: 1) No energy storage 2) with limited energy storage.</p>

6 – Beijing Xiaomi Mobile Software

Suggest to merge storage 2 and 3 as one category. We are not clear about the intention of having the differentiation of storage 2 and storage 3. and it would be hard for companies to converge on a single threshold value to decide between storage 2 and storage 3. If it is for evaluation purpose, we think it would be better to let companies report energy storage capabilities they assumed.

7 – Beijing Xiaomi Mobile Software

Suggest to merge storage 2 and 3 as one category. We are not clear about the intention of having the differentiation of storage 2 and storage 3. and it would be hard for companies to converge on a single threshold value to decide between storage 2 and storage 3. If it is for evaluation purpose, we think it would be better to let companies report energy storage capabilities they assumed.

8 – Spreadtrum Communications

Yes agree

9 – NTT DOCOMO INC.

We share the view with vivo

10 – Nokia Denmark

We agree in principle, however a definition of *ordinary* and *super-capacitor* is required.

11 – Apple France

In principle, we support categorization based on energy. However, we need to clarify what exactly ordinary and super-capacitor. Considering this, we would be fine with just 2 categories, i.e., without energy storage and with energy storage. There can be FFS under energy storage type for further categorization.

12 – VODAFONE Group Plc

agree in principle. agree with Nokia that a clear definition of ordinary and super-capacitor is required.

13 – Huawei Tech.(UK) Co., Ltd

We can agree with the proposal, and we would expect e.g. literature efforts to provide ranges for the storage 2 and storage 3 relatively easily in the next meeting. If storage 2 and 3 are merged, it seems likely that the sub-detail will be captured somehow anyway.

14 – Kyocera Corporation

We agree with the moderator's proposal in general, and we're fine to define the category with e.g., mAh, although we assume the energy storage category will be up to implementation.

15 – Panasonic Holdings Corporation

Instead of ordinary capacitor and supercapacitor, Qualcomm suggested wording would be better in our view as it does not limit how to implement them.

P2 (very limited energy storage) expressed in a range of capacitance or range of mAh (or mA x ms) with agreed reference voltage

P3 (medium energy storage) a higher range of capacitance or range of mAh

16 – Tejas Networks Ltd.

Agree in principle. Please specify the mAh capacity in bracket for P2 and P3.

17 – Intel Belgium SA/NV

The differentiation between storage 2/3 is not clear. We also prefer to merge them into one capability for now, e.g.,

- *Storage 2: with a capacitor*

18 – ZTE Corporation

We think without the technical discussion in WGs, e.g., RAN1 and RAN4, we may not be able to clarify the detailed requirements on UE energy storage, even in next RAN plenary meeting.

So we think we don't need any proposal on this question and can directly go for the output of Feedback Form 26: Question.

19 – NOVAMINT

Agree with Qualcomm's suggestion (we would need to indicate a corresponding mAh capacity or ranges rather than use terms such as ordinary or super capacitor - the super capacitor of today will become soon an ordinary capacitor)

20 – Orange

we agree that clear definitions of capacitors & super capacitors are needed

21 – Ericsson LM

We prefer that further categorization of limited energy storage capacities is FFS (not just the maximum values for storage 2 and storage 3).

22 – Motorola Mobility España SA

agree

23 – Sony Europe B.V.

We think it is too early to agree on this. Despite the note, there could be very divergent views on what an "ordinary capacitor" is and what a "supercapacitor" is. Does "no storage at all" mean that the logical state of the A-IoT device is lost (memory is erased) if there is a momentary lapse in the incident ambient energy source??

24 – MediaTek Inc.

We should simply quantify the energy storage capacity

25 – China Mobile Com. Corporation

We wonder if RAN can study the volume of capacitor or battery, since we didn't do that before for NB-IoT/eMTC. For the tag, we can study and classify the tag based on the power, e.g., 1uW tag and 100uW tag.

Topic 5-2b: Device categorization

Based on initial round inputs, and the addition of energy storage capacity above, Moderator proposes to agree to Method 1 for categorization, wherein the angle of Method 2 is captured separately by the proposal 5-2a above. An FFS is added on potentially including target maximum power consumption per category of device, as suggested by CATT under the characteristics discussion.

On re-naming of device types, moderator suggests we should choose basically neutral names and use the long-form words to characterize. Thus, no change is proposed.

Proposal 1: The following devices are considered in the SI:

- *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.*

FFS: Whether to include device function

FFS: Whether to include a target maximum power consumption for each device

Feedback Form 40: Question: Can we agree to the above proposal on devices?

1 – Sierra Wireless. S.A.

Yes

2 – Qualcomm Incorporated

Second dimension - waveform generation methods – can be agreed first and then study the different combinations of device characteristics.

We don't agree with the moderator's proposal. We would prefer the approach similarly to that proposed

earlier by vivo for this categorization:

- **Passive** signal generation: has no independent signal generation or signal amplification capability
- **Semi-passive** signal generation: has no independent signal generation capability but has active components with which to amplify reflected signals
- **Active** signal generation: has independent signal generation capability, including producing oscillator frequency

3 – vivo Communication Technology

Comparing the moderator proposal and Qualcomm’s proposal above, our understanding is:

- 1) For Passive device A&B: ”Backscattering transmission” is the same as ”passive signal generation”
- 2) It would be good to also mention that Passive device B may have the optional capability to amplify the signal, while Passive device A cannot.
- 3) For active device, our understanding is that ”*active RF components for transmission*” and ”active signal generation” are talking about the same thing

4 – Shenzhen Heytap

[OPPO]

We understand there 3 types are the basic types.

But other type is still possible, e.g. Combination of *backscattering transmission and active transmission*.
The device can choose which kinds of transmission depending different cases.

So, we need one Note: Device support both *backscattering transmission and active transmission can also be considered*.

5 – Spreadtrum Communications

Yes agree

6 – NTT DOCOMO INC.

Agree. Also fine with Qualcomm’s proposal

7 – Nokia Denmark

We agree with Qualcomm’s proposal

8 – Apple France

We are also fine with Qualcomm’s proposal

9 – VODAFONE Group Plc

Agree

10 – Kyocera Corporation

We agree with the rapporteur’s proposal.

11 – Panasonic Holdings Corporation

Instead of passive device A and B, we support to name passive and semi-passive as proposed by Qualcomm. On the difference between 1st passive (passive device A or passive) and 2nd passive (passive device B or semi-passive), we support to moderator's direction of energy storage but amplifying aspect is also mentioned as example usage of stored energy.

12 – Huawei Tech.(UK) Co.. Ltd

Yes.

It seems that Qualcomm's structure is equivalent to the moderator's, and since all companies in the first round were OK to include energy storage as a device characteristic, the proposal seems consistent with that.

13 – Intel Belgium SA/NV

We are OK with the proposal.

For the harvested energy in Passive device B, it may have two usage, i.e., for DL reception and/or for amplifying the backscatter transmission. In this sense, the current wording in moderator's proposal is a superset of proposal from QC on '**Semi-passive** signal generation'. Therefore, the proposal from moderator is slightly preferred.

14 – Orange

we agree

15 – ZTE Corporation

Agree.

We have sympathy that the intention of the rapporteur's proposal and Qualcomm's suggestion are almost same.

But at least now in this meeting, we think the rapporteur's proposal is better as it's general. The Qualcomm's suggestion seems too specific.

16 – Ericsson LM

We are fine with the moderator proposal except that the FFS on maximum power consumption is unclear. First, why should the maximum power consumption be limited? Second, is this referring to instantaneous transmission power, or to harvesting power being larger than consumed power? We prefer to remove that FFS.

17 – NOVAMINT

We believe we should have a different terms for device A and device B - if we focus on including the energy storage as device characteristics we propose the following naming:

Passive device: No energy storage, backscattering transmission

***Power-assisted Passive Device:** Energy storage from harvesting ambient sources, backscattering transmission*

Active Device: Energy storage from harvesting ambient sources, active RF components for transmission

We believe it should be more comprehensible outside of 3GPP as well

18 – Sony Europe B.V.

As raised in the initial round, the “reception” capability has not been included for any of the device categorisations. IF these devices need to also receive, it is not very clear how for instance Passive device A is going to function.

The categorisation does not describe what the point of the energy storage is.

For passive device B, is it used to store device state when there is no ambient energy? Is it used to drive an active receiver? Is it used to amplify reflected signals (Qualcomm’s S2 semi-passive device).

For active B, is it used to store device state when there is no ambient energy? Is it used to drive an active receiver?

It would be OK to agree with the three device types if we added an FFS:

FFS: what the stored energy is used for.

19 – MediaTek Inc.

”From harvesting ambient sources” is irrelevant and shall be removed. We should only refer to the energy storage capacity.

20 – China Mobile Com. Corporation

Agree

6.2.3 Intermediate round summary

Topic 5-2a: Energy storage characteristic

Approximately 12 companies support the proposal. In addition, some suggest that clear definition/ranges need to be defined for storage 2 and storage 3.

Approximately 6 companies suggest to combine storage 2 and storage 3, leaving two categories (without and with energy storage). It is mentioned that further split of ‘with storage’ in can be considered in future meeting.

Several comments want to avoid technology expressions such as (super)capacitor, e.g. due to relative technology evolution over time (Nordic), and in some cases would prefer to just provide quantitative boundaries (e.g. MediaTek). Several also suggest leaving a parameter for the capacity in scope for future meeting determination, or want to avoid naming, e.g. Qualcomm (and others) suggest to use terms “range X and Y” to replace ordinary capacitor and supercapacitor.

The moderator will propose an updated framework for the next round’s discussion.

Topic 5-2b: Device categorization

The main debate is relating to Qualcomm’s suggestion. In the moderator’s understanding, this is actually

almost the same as the intermediate round proposal, with the addition of specifically mentioning (no) independent signal generation/amplification capability. Noting Sony’s comment about general questions on usage of stored energy, and Intel’s remark about receiving, the moderator suggests a joint way forward of adding an FFS on use of stored energy, and incorporating signal generation/amplification into the descriptions now. The FFS can be used to refine the descriptions next time.

On the naming, moderator will pick completely neutral names at this stage, as naming discussions can be time consuming (and are already diverging), when the real focus should be on the technical content. This does not preclude companies from raising naming in their future papers.

Ericsson’s comment: CATT requested in the initial round the FFS you ask to delete. Would prefer not to ping-pong an FFS. You can simply answer “no” to its question at the appropriate times.

OPPO suggest a ‘hybrid’ of passive and active. We can have an FFS for that.

6.2.4 Final round

Topic 5-2a: Energy storage characteristic

The moderator suggests generalizing the framework somewhat, and ask companies to consider the storage capacities (f_1, f_2) they think are presently relevant for RAN to consider, and also allow the chance to not subdivide storage 2 and storage 3. This should give a framework for settling in the next meeting.

Question 5-2a: Can we agree this framework to categorize energy storage capacities:

- *Storage 1: No storage at all.*
- *Storage 2: Up to f_1 Farad*
- *Storage 3: Up to f_2 Farad*

FFS: In RAN#99 value(s) of f_1, f_2 and it is possible that $f_1=f_2$, in which case we have only two storage categories.

Feedback Form 41: Is the proposed framework to categorize energy storage capacities agreeable?

1 – NTT DOCOMO INC. Agree
2 – Nokia Denmark Agree
3 – ZTE Corporation We are not clear the exact meaning of f_1, f_2 Farad, it seems not a regular terminology in 3GPP. Hope try to avoid adopting unclear thing.

4 – Intel Belgium SA/NV

We can accept the proposal. Is it necessary to further define typical value(s) within 0 – f1 Farad or within f1 – f2 Farad for the storage 2 or 3?

5 – Ericsson LM

No, we think the categorization of energy storage characteristic should be FFS.

6 – Kyocera Corporation

We're not sure if "Farad" is suitable for this categorization. So, we wonder if the unit is left to FFS for now.

7 – Sony Europe B.V.

We are OK with the general approach taken. However, we are talking about energy storage and should hence use Joules, rather than Farads. We see several benefits of talking about Joules:

- It is a unit of energy
- It is not dependent on voltage
- It doesn't make assumptions on energy storage technology (capacitors vs batteries etc).

Hence, we would propose:

categorize energy storage capacities:

- *Storage 1: No storage at all.*
- *Storage 2: Up to E1 Joules*
- *Storage 3: Up to E2 Joules*

FFS: In RAN#99 value(s) of E 1, E 2 and it is possible that E 1=E2, in which case we have only two storage categories.

8 – Shenzhen Heytap

[OPPO]

Not sure why we have to discuss 2 storage level (storage2/3) here, because it will up to implementation.

In addition, using Farad will restrict the implementation only to use capacitor, but actually, other kind of storage element can also be considered, such as small solid state battery (to store the energy).

Therefore, propose the following:

- *Storage 1: No storage at all.*
- *Storage 2: limited storage.*

9 – MediaTek Inc.

We do have some sympathy for the comment from Sony!

10 – NOVAMINT

same comment as others about the term "Farad".

Topic 5-2b: Device categorization

The moderator's proposal incorporating the described updates is as follows. Companies can also note that we will continue to discuss devices in the subsequent meetings where more detail can be raised.

Proposal 5-3b: The following set of Ambient IoT devices are considered in the SI:

- *Device A: No energy storage, no independent signal generation/amplification, i.e. backscattering transmission*
- *Device B: Energy storage from harvesting ambient sources, no independent signal generation, i.e. backscattering transmission. Use of stored energy can include amplification for reflected signals.*
- *Device C: Energy storage from harvesting ambient sources, has independent signal generation, i.e. active RF components for transmission.*

FFS: Whether to include device function

FFS: Whether to include a target maximum power consumption for each device

FFS: Whether/how to describe what stored energy is used for (in addition to the statement for Device (B))

FFS: If combinations of these devices will be considered.

Feedback Form 42: Is this set of device descriptions agreeable?

1 – Qualcomm Incorporated We agree
2 – Spreadtrum Communications Yes, agreeable.
3 – NTT DOCOMO INC. Agree
4 – vivo Communication Technology OK
5 – Apple France Agree

<p>6 – Samsung Electronics Co.</p> <p>ok</p>
<p>7 – Shenzhen Heytap</p> <p>[OPPO]</p> <p><i>Fine with Proposal 5-3b</i></p> <p>For <i>Question 5-2a</i>, not sure why we have to discuss 2 storage here, because it will up to implementation.</p> <p>in addition, using Farad will restrict the implemnetation only to use capacitor, but acturally, other kind of storage element can also be considered, such as small solid state battery (to store the energy)</p>
<p>8 – THALES</p> <p>Agree</p>
<p>9 – Nokia Denmark</p> <p>Agree</p>
<p>10 – Huawei Tech.(UK) Co.. Ltd</p> <p>We support the proposal. With this further clarification and added notes, it seems aligned between the comments in the previous round, now.</p>
<p>11 – China Mobile Com. Corporation</p> <p>Agree</p>
<p>12 – Panasonic Holdings Corporation</p> <p>Ok</p>
<p>13 – ZTE Corporation</p> <p>Agreeable.</p>
<p>14 – Intel Belgium SA/NV</p> <p>The proposal is generally OK.</p> <p>As commented in the intermediate round, we prefer to capture using stored energy for DL reception in the definition of device B which seems even more straightforward than the use for amplifying backscatter transmission</p>
<p>15 – Kyocera Corporation</p> <p>We agree.</p>
<p>16 – Ericsson LM</p> <p>Agree</p>

17 – Sony Europe B.V.

OK.

Our understanding of the term “ambient sources” is that one of the nodes can purposefully provide energy to the AIoT device. For example, a reader could provide RF energy in the direction of the tag to be read.

18 – MediaTek Inc.

We do remain concerned with the vocabulary “from harvesting ambient sources”. The Device categories should refer directly to the energy storage categories in the previous section instead.

19 – NOVAMINT

ok though we could have removed “*from harvesting ambient sources*” as suggested by MediaTek in previous round

6.2.5 Final round summary

Topic 5-2a: Energy storage

There are some further questions from companies:

OPPO are not sure why we have 2 storages, and think it would be up to implementation

- Moderator response: If $f1 = f2$, there are not two storages, see the note underneath. We can add a further possibility of having only a description in this case.

ZTE: Ask to be clear on the exact meaning of $f1$, $f2$ Farad

- Moderator response: Farad the unit of capacitance, $f1$ the quantity of the unit (eg, $f1 = 100$ mFarad). In any case, see below.

Intel ask is it necessary to further define typical values within $0-f1$ Farad or within $f1-f2$ Farad for the storage 2 or 3

- Moderator response: This would come under the first proposed FFS. Thanks for accepting the proposal nonetheless.

Kyocera, Sony, et al.: Think the unit of Farad may not be suitable.

- Moderator response: Perhaps so. We could try Sony’s suggestion.

Ericsson: See if you can live with the working assumption proposal the moderator now makes, instead. One possible outcome of that is the cancelation of the WA, quite apart from the details of energy unit, etc.T

Topic 5-2b: Device categorization

There is a remaining concern from MediaTek (and a preference from Novamint) about the energy harvesting words in Device B and Device C. Perhaps it is neutral to remove those words, and rely on the energy storage framework of topic 5-2a, by implication. Hopefully this can be agreeable in the extended round.

6.2.6 Extended round

Topic 5-2a: Energy storage

It seems the Sony proposal is a good way forward for being neutral on voltage and technology. On the other hand, we might need to check if joules is ok as the unit. It seems like a good candidate to be a working assumption.

Proposal 5-2a-extended: Make a working assumption for this framework to categorize energy storage capacities:

Storage 1: no storage at all

Storage 2: Up to E1 joules~~Farad~~

Storage 3: Up to E2 joules~~Farad~~

FFS: In RAN#99 value(s) of E1, E2 and it is possible that E1=E2, in which case we have only two storage categories. Note in this case that storage 2 and 3 could be replaced by a single description such as "limited energy storage", instead.

Feedback Form 43: Can we take this framework as a working assumption?

1 – Nokia Denmark Agree
2 – NTT DOCOMO INC. Agree
3 – Qualcomm Incorporated We agree
4 – Apple France Agree

5 – ZTE Corporation We feel too little inputs on how to describe the energy storage. But taking into account the FFS, the current <i>Proposal 5-2a-extended</i> is acceptable to us.
6 – Spreadtrum Communications Yes, agree.
7 – China Mobile Com. Corporation Agree
8 – Kyocera Corporation We agree.
9 – Intel Belgium SA/NV Fine
10 – Ericsson LM Agree
11 – Shenzhen Heytap [OPPO] ok
12 – Huawei Tech.(UK) Co.. Ltd OK
13 – China Telecommunications Agree
14 – MediaTek Inc. Agree!
15 – Philips International B.V. OK

Topic 5-2b: Device categorization

As per the view from MediaTek, moderator propose a small change for the extended round to be neutral over where the energy is stored from, and we'll rely on the framework of 5-2a to understand what it means:

Proposal 5-3b-v2: the following set of Ambient Iot devices are considered in the SI:

- Device A: No energy storage, ~~no harvesting ambient sources~~, no independent signal generation, i.e. backscattering transmission
- Device B: **Has** energy storage ~~from harvesting ambient sources~~, no independent signal generation, i.e. backscattering transmission. Use of stored energy can include amplification for reflected signals
- Device C: **Has** energy storage ~~from harvesting ambient sources~~, has independent signal generation, i.e. active RF component for transmission

FFS: Whether to include device function

FFS: Whether to include a target maximum power consumption for each device

FFS: Whether/how to describe what stored energy is used for (in addition to the statement for Device B)

FFS: if combination of these devices will be considered.

Feedback Form 44: Is this now agreeable?

1 – NTT DOCOMO INC. Agree
2 – Qualcomm Incorporated We agree
3 – ZTE Corporation Agree
4 – Kyocera Corporation We agree.
5 – Intel Belgium SA/NV We are fine with the proposal
6 – Shenzhen Heytap [OPPO] ok
7 – VODAFONE Group Plc Agree

8 – Huawei Tech.(UK) Co.. Ltd

Yes, agree

9 – MediaTek Inc.

Thank you! We agree

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.

8 Status Report

The rapporteur's draft status report is in

https://www.3gpp.org/ftp/tsg_ran/TSG_RAN/TSGR_98e/Inbox/Drafts/%5B98e-11-Ambient-IoT%5D/SR/draft_RP-223395_FS_Ambient_IoT_RAN_SR.docx.

Please respond if you have any comments on the SR, and the SI rapporteur please update as appropriate.

Feedback Form 45: Any comments?

1 – Huawei Tech.(UK) Co.. Ltd

{Matthew, as SI rapporteur}.

We also need to approve the SID revision in RP-223396. Maybe to save a timezone, I can make this a rapporteur's proposal.

Proposal 8 (from SI rapporteur): Approve the revised SID in RP-223396.

2 – NTT DOCOMO INC.

We are fine with both SR and revised SID

3 – Apple France

We are okay with SR and revised SID

4 – Kyocera Corporation

We're fine with both SR and revised SID.

5 – Intel Belgium SA/NV

we are OK with SR and revised SID

6 – Ericsson LM

We are fine with SR and SID revision

7 – MediaTek Inc.

OK!