**[SA1#99e, FS_Sensing_definitions] Sensing Definitions - Version 0.0.1**

**SA1**

# 3 Definitions of terms, symbols and abbreviations

## 3.1 Terms

For the purposes of the present document, the terms given in 3GPP TR 21.905 [1] and the following apply. A term defined in the present document takes precedence over the definition of the same term, if any, in 3GPP TR 21.905 [1].

### Sensing measurement

**[agreed -TR 22.837] sensing measurement**: obtaining sensing measurement data about a target object.

**[proposal, Apple -** S1-222237] **sensing ~~measurement~~ data**: ~~obtaining sensing measurement data about~~ reflected RF signals from a target object.

**Feedback Form 1: Comments/Questions regarding Sensing Data proposal**

**1 – Motorola Mobility Germany GmbH**

It is suggested to consider that the RF signal may not become data prior to reception/measurement by a receiver. Also, the term ”sensing data” maybe confused with the ”sensing result data”, considering the definition of sensing result. Hence, the previous term ”sensing measurement” is preferred.

An updated definition would be as following:

**Sensing Measurement:** Measurement of the received RF signals impacted (e.g., reflected, refracted, diffracted) by an object of interest for sensing.

**2 – Apple France**

Thanks Seyedomid for your comments.

I’m fine to keep the original term ’sensing measurement’. For the updated definition, perhaps we could avoid to use ’measurement’ again. I also understood that we are not exclusively sensing objects and a number of use cases talk about environmental sensing, so how about something like this:

**sensing measurement:** *samples* of received RF signals impacted (e.g., reflected, refracted, diffracted) by an object *or environment* of interest for sensing *purposes*.

**3 – Motorola Mobility Germany GmbH**

Dear Mona, thanks, I agree with the updated definition.

**4 – Huawei Technologies France**

Dear Mona,

Thanks for the proposal. Sensing Measurement should be a given action to obtain measurement information about the target object. In your proposal, ”samples of received RF signals impact by...” seems like a solution, and could be quite restrictive for the purpose of ”sensing measurement” definition.

Therefore, I would say definition originally agreed seems to be both clear and general enough.

Thanks,

Best regards,

Shuang

**5 – Apple France**

Dear Omid, thanks for the feedback :-)

Dear Shuang,

Thanks for your comment! I think this is an excellent point, and this is what triggered my contribution - since it’s not so clear to me if we are talking about the *process of collecting the measurements* or the *RF signals* themselves.

Is ’sensing measurement’:

1) the process of collecting the RF signals, or

2) the RF signals themselves?

I’m open to both, but it would be great that we can be clear on the intent. I can make updates based on what we would like to define.

Thanks and looking forward to your thoughts.

**6 – Huawei Technologies France**

Dear Mona,

Thanks for the quick reply :) We find ”RF signals” to be a little bit too restrictive. Any chance to reword it into the action to collect ”measurement data about the target object” ?

Thanks!

Best regards,

Shuang

**7 – Apple France**

Dear Shuang,

Thanks for the feedback! That's an interesting point...

On your suggestion (if I understand it correctly):

**sensing measurement**: collect measurement data about a target object.

My comment is that it's a bit hard to define the term 'measurement' by using the same term 'measurement' in the definition...

Is your concern about 'RF' in 'RF signals'? Does it help if we remove 'RF' and replace it with 'radio interface'? For example:

**sensing measurement**: *collection of* ~~**RF**~~ signals **on the radio interface** impacted (e.g., reflected, refracted, diffracted) by an object *or environment* of interest for sensing *purposes*.

Thank you

**8 – QUALCOMM Europe Inc. - Italy**

Thanks, Mona and all.

Qualcomm prefers sensing measurements for reasons mentioned by others on this thread. Also, it is great to see that "environment of interest" is also included along aside "object." On whether to use RF signals signal or not, we will propose to replace RF signal with "radio/wireless" signal. Radio interface is quite confusing.

**9 – Nokia Corporation**

Thank you, Mona for your proposal.

Nokia prefers the latest proposal with Qualcomm suggestion, that is;

**sensing measurement**: *collection of radio/wireless* signals impacted (e.g., reflected, refracted, diffracted) by an object *or environment* of interest for sensing *purposes*.

That is sufficient and any additional definition, i.e. sensing measurement data is not necessary.

**10 – Apple France**

Thanks Lola and Hideaki for your comments and proposals.

I like your suggestions, and I'm happy to make this update in r1:

**sensing measurement**: *collection of radio/wireless* signals impacted (e.g., reflected, refracted, diffracted) by an object *or environment* of interest for sensing *purposes*.

**11 – Philips International B.V.**

The latest suggested definition is a bit ambiguous: the word ”collection” can be interpreted as a verb denoting the act of collecting/gathering or as a noun indicating a set. In both interpretations it is not clear how this relates to measurement data. Suggest to rephrase e.g. as follows:

**sensing measurement**: *data collected about radio/wireless* signals impacted (e.g., reflected, refracted, diffracted) by an object *or environment* of interest for sensing *purposes*.

**12 – Apple France**

Thanks Walter for the suggestion, you have a good point there.

Could we avoid using the term ’data’? Going in your direction, would this alternative work instead:

**sensing measurement**: *samples of radio/wireless* signals impacted (e.g., reflected, refracted, diffracted) by an object *or environment* of interest for sensing *purposes*.

**13 – Huawei Technologies France**

Dear Mona, all,

Thanks for the discussion. I’d like to propose to use ”information collection” instead of ”samples of”, to make it clear that the sensing measurement is an action that collects information of target object/environment. We are ok to keep the wording ”radio/wireless signals impacted...”

**sensing measurement**: *information collection of radio/wireless* signals impacted (e.g., reflected, refracted, diffracted) by an object *or environment* of interest for sensing *purposes*.

Thanks,

Best regards,

Shuang

**14 – vivo Japan KK**

Dear all,

I notice there is blur understanding on sensing measurement and sensing measurement information. I believe we are giving definitions for the data, not the process of the data. So I suggest to substitute ”sensing measurement” to ”sensing measurement information” to be consistent with ”sensing result”, which is also the data, not the process itself, small improvement is as follows:

**Sensing measurement *information*:***information collection of radio/wireless* signals impacted (e.g., reflected, refracted, diffracted) by an object *or environment* of interest for sensing *purposes*.

Sensing Result

**[agreed -TR 22.837] sensing result**: the information about a target object after processing, such as being present and object dimension, which is related to a particular sensing service.

**[proposal, Apple -**S1-222237**]sensing result**: the information about a target object derived after processing of sensing data.~~, such as~~Examples of sensing result are a target object being present and target object dimension~~, which is related to a particular sensing service~~.

**Feedback Form 2: Comments/Questions regarding Sensing Result proposal**

**1 – ZTE Corporation**

It is suggested to include the environment around a target object.

**sensing result**: the information about a target object **or environment around a target object** derived after processing of sensing data.~~, such as~~Examples of sensing result are a target object being present and target object dimension,**the size of obstacles around, and other moving objects nearby**, etc.~~, which is related to a particular sensing service~~.

**2 – Apple France**

Thank you, Ling, for your comments!

I think that is a good point, to include environment - I have also made a proposed change for the term 'sensing measurements' above, please check if this is good for you.

For sensing result, maybe we can put both target object and environment in the example?

So how about this (I am re-using the original 'sensing measurements' term, based on comments from Motorola):

**sensing result**: the information ~~**about a target object**~~derived after processing of sensing ***measurements***.~~, such as~~Examples of sensing result are **certain environmental conditions,** a target object being present, target object dimension, **the dimension of obstacles around a target object, and other moving objects in the vicinity of a target object**~~, which is related to a particular sensing service~~.

**3 – ZTE Corporation**

Thank you, Mona, I am fine with the revision.

**4 – vivo Japan KK**

Dear Mona and ZTE colleague, thank you for providing the revisions. It is much easier to be understand now, especially the relationship between sensing measurement and sensing result. However, I want to highlight the point that the sensing results has highly dependency on the use case, so I suggest to keep the last sentence, i.e. which is related to a particular sensing service.

Besides, I have a question on "the dimension of obstacles around a target object, and other moving objects in the vicinity of a target object", what is the purpose on this? In which kind of sensing service we need to detect the obstacles, and also what is the moving objects near the target object, can you make an example?

Thank you, Br, -Amy

**5 – Apple France**

Dear Amy,

Thanks for the suggestions! For the last part of the text ”i.e. which is related to a particular sensing service”, may I ask for an example? I think I am not understanding the scenario correctly.

For the other part of the question, I hope Ling can help to clarify.

**6 – TNO**

May I suggest to keep the definition as simple as possible and place the second sentence ”Examples of... ” in a NOTE? Would that be acceptable?

**7 – QUALCOMM Europe Inc. - Italy**

Hi All, Based on the discussion above and our understanding, I will like to propose this version:

**sensing result**: the information derived from processing sensing ***measurements***.

Note: Examples of sensing results include **environmental conditions, detection of the presence of an** object, target object dimension, etc. The type of information derived is dependent **on the particular sensing service** .

Hope this version works for everyone.

**8 – Nokia Corporation**

Hi all,

Qualcomm proposal looks better in shape. On the other hand, we’re not sure if examples are needed here. As already commented, different use cases have different sensing results. So, it would be questioned how these are selected... So, on top of Qualcomm proposal, we’d like to simplify and generalize it as shown below.

**sensing result**: the information derived from processing sensing ***measurements***.

Note: Examples of sensing results **are environmental conditions, characteristics of an** object, etc. The type of information derived is dependent **on the particular sensing service** .

**9 – Apple France**

Thank you, José, Lola and Hideaki, for your comments and suggestions.

The latest suggestion is fine for me, I’ll update the term in r1 as follows:

**sensing result**: the information derived from processing sensing ***measurements***.

Note: Examples of sensing results **are environmental conditions, characteristics of an** object, etc. The type of information derived is dependent **on the particular sensing service** .

Wireless Sensing

**[proposal, Xiaomi -** S1-222110**]** **Wireless Sensing**: aims to acquire information about remote object(s) characteristics (e.g. shape, size, speed, location, distances or relative motion between objects, etc.) using Radio Frequency signals.

**[proposal, DT -**S1-222226**]****Wireless sensing**: 5GS feature providing capabilities to get information about characteristics of the environment and objects within the environment (e.g. shape, size, speed, location, distances or relative motion between objects, etc.)

NOTE: Certain use cases (e.g. detection of UE's significant location change) might make use of information already available in EPC and E-UTRA. This study will not lead to impacts on EPC and E-UTRA.

**Feedback Form 3: Comments/Questions regarding Wireless Sensing proposals**

**1 – Motorola Mobility Germany GmbH**

Considering the defined terms "sensing result" and "sensing measurement" above, I suggest to use them for more clarity. One suggestion would be to modify any of the above definitions to ".. to acquire sensing measurements and/or result using RF signals", regarding the first proposal, and ".. to get sensing measurement and/or result." regarding the DT proposal.

**2 – Huawei Tech.(UK) Co.. Ltd**

We believe that, based on the SID, we should not tend towards a generalised definition of "Wireless Sensing" but should instead be quite clear about what we are defining requirements for. SA1 say, in the SID, that work will be focusing on NR-based sensing and that KPIs are only going to be defined for NR-based sensing. For this reason, and to be consistent that this study will not lead to impacts on EPC and E-UTRA, we propose the following:

**NR Wireless sensing**: 5GS feature providing capabilities to get information about characteristics of the environment and objects within the environment (e.g. shape, size, speed, location, distances or relative motion between objects, etc.)using NR RF signals.

NOTE: Certain use cases (e.g. detection of UE's significant location change) might make use of information already available in EPC and E-UTRA. This study will not lead to impacts on EPC and E-UTRA.

**3 – Huawei Tech.(UK) Co.. Ltd**

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**NR Wireless sensing**: 5GS feature providing capabilities to get information about characteristics of the environment and objects within the environment (e.g. shape, size, speed, location, distances or relative motion between objects, etc.)using NR RF signals.

NOTE: Certain use cases (e.g. detection of UE's significant location change) might make use of information already available in EPC and E-UTRA. This study will not lead to impacts on EPC and E-UTRA.

**4 – Huawei Tech.(UK) Co.. Ltd**

I would also like to point out that the majority of the wording in this HW proposed definition is taken from the output of the conference calls between SA1#98e and now. The name of the definition is as per a strongly supported proposal on the CC (which confusingly was not part of the final output).

**5 – vivo Japan KK**

Dear Shuang, Vasil and Chunhui,

I propose to delete the "e.g." the proposed definitions, as it has appeared here and there for several times, and for the definition, it is better to keep is clear and simple.

Besides, I want to mention here that we also have the scope in S2-222222, which already captures the "NOTE" and adds explanations very well.

"Certain use cases (e.g. detection of UE's significant location change) might make use of information already available in EPC and E-UTRA. This study will not lead to impacts on EPC and E-UTRA."

So I suggest:

**NR Wireless sensing**: 5GS feature providing capabilities to get information about characteristics of the environment and objects within the environment using NR RF signals.

**6 – vivo Japan KK**

Sorry, to correct the above proposed reference, it is S1-222222, where Vasil has proposed the scope to include the content in "NOTE"

Br, -Amy

**7 – Deutsche Telekom AG**

Just to clarify, what is proposed in the S1-222226 is slightly different from the written above. There is:

***Wireless sensing***: *5GS feature providing capabilities to get information about characteristics of the environment and objects within the environment (~~e.g.~~ shape, size, speed, location, distances or relative motion between objects, etc.)*

*NOTE: Certain use cases (e.g. detection of UE's significant location change) might make use of information already available in EPC and E-UTRA. This study will not lead to impacts on EPC and E-UTRA.*

We are removing also the e.g. - based on the Vivo proposal.

When looking to the alternative proposals we think the most important point is to exclude the NR in the definition, as this already points out to a solution. We do not understand why automatically passive E-UTRA based sensing should be excluded. It is also quite clearly seen from the alternative proposed note - E-UTRA can be used, as it is. As pointed out in S1-222226: 3GPP SA1 should be focused on defining requirements rather than pointing out to specific solutions directly in the definitions. why we should point out only NR sensing shall be used?

**8 – Nokia Corporation**

As far as I understand, the controversy is stemmed from the objectives of the SI that the term ”NR based sensing” is found there. Given the situation observed in this thread, we start to wonder if the definition of ”wireless sensing” is essential that has to be specified right now. While I searched that term in v0.1.0 of the TR, I didn’t find it at all. Maybe, we will revisit later and see how the TR is updated and decide the need of ”wireless sensing”?

5G based wireless sensing service

**[proposal, Xiaomi -** S1-222110**] 5G based wireless sensing service:** aims to enable 5G system to provide wireless sensing performed by RAN and UE.

NOTE: Certain use cases (e.g. detection of UE’s significant location change) might alternatively be satisfied using information already available in EPC and E-UTRA. In such cases, the available information can be used. This study will not lead to impacts on EPC and E-UTRA.

**Feedback Form 4: Comments/Questions regarding 5G Based Wireless Sensing Service proposal**

**1 – Deutsche Telekom AG**

We are not sure why definition of 5G based wireless sensing service would be needed. When looking to TS22.261 there is lack of definition of different 5G capabilities as services - there is lack of positioning service, 5G LAN service, etc. TS22.261 is using ”capabilities”. In regard to common topics similar between the studies - e.g. metaverse, not sure how to differentiate sensing in this context - is sensing part of metaverse service or is different service. Our suggestion is not to have definition of sensing service.

**2 – Nokia Corporation**

Agree with DT