**3GPP TSG-WG SA2 Meeting #170 *S2-2507808***

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**Source: Huawei, HiSilicon, CAICT**

**Title: KI#2, #5, New Sol: Authorization and exposure to the sensing service consumer**

**Document for: Approval**

**Agenda Item: 20.2.1**

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*Abstract: This pCR describes a solution for which an Application Function (AF) requests a sensing service whereby the consumer of the Sensing Result can be the AF. Authorization for use of the service and revocation of the service is also presented based on the requester and consumer.*

# 1. Introduction/Discussion

This document addresses KI#2 and KI#5.

# 2. Text Proposal

It is proposed to capture the following changes vs. TR 23.700-14.

\* \* \* \* First change \* \* \* \*

# 2 References

The following documents contain provisions which, through reference in this text, constitute provisions of the present document.

- References are either specific (identified by date of publication, edition number, version number, etc.) or non‑specific.

- For a specific reference, subsequent revisions do not apply.

- For a non-specific reference, the latest version applies. In the case of a reference to a 3GPP document (including a GSM document), a non-specific reference implicitly refers to the latest version of that document *in the same Release as the present document*.

[1] 3GPP TR 21.905: "Vocabulary for 3GPP Specifications".

[2] 3GPP TS 22.137: "Service requirements for Integrated Sensing and Communication; Stage 1".

[3] 3GPP TS 23.501: "System Architecture for the 5G System; Stage 2".

[4] 3GPP TS 23.273: "5G System (5GS) Location Services (LCS); Stage 2".

[5] 3GPP TS 37.355: "LTE Positioning Protocol (LPP)".

[6] 3GPP TS 38.455: "NG-RAN; NR Positioning Protocol A (NRPPa)".

[7] 3GPP TR 22.837: "Feasibility Study on Integrated Sensing and Communication".

[8] 3GPP TS 23.288: "Architecture enhancements for 5G System (5GS) to support network data analytics services".

[9] 3GPP TS 33.501: " Security architecture and procedures for 5G system".

[10] 3GPP TS 23.502: "Procedures for the 5G System; Stage 2".

[X] 3GPP TS 23.032: "Universal Geographical Area Description (GAD)".

\* \* \* \* Second change \* \* \* \*

## 6.0 Mapping of Solutions to Key Issues

Table 6.0-1: Mapping of Solutions to Key Issues

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | Key Issues | | | | | |
| Solutions | #1 | #2 | #3 | #4 | #5 | #6 |
| #1 | X |  | X | X | X |  |
| #2 |  | X |  |  | X |  |
| #3 | X | X | X | X | X | X |
| #4 | X |  |  |  |  |  |
| #5 | X |  |  | X |  |  |
| #6 | X | X | X |  |  |  |
| #7 | X |  |  |  |  |  |
| #8 |  | X |  |  |  |  |
| #9 |  | X |  |  |  |  |
| #10 |  | X |  |  |  |  |
| #11 |  | X |  |  |  |  |
| #12 |  | X |  |  |  |  |
| #13 |  |  | X |  |  |  |
| #14 |  |  | X |  |  |  |
| #15 |  |  | X |  |  | X |
| #16 |  |  | X |  |  |  |
| #17 |  |  | X |  |  |  |
| #18 |  |  |  | X |  |  |
| #19 | X | X |  |  | X |  |
| #20 |  |  |  |  |  | X |
| #W |  | X |  |  | X |  |

\* \* \* \* Third change \* \* \* \*

## 6.W Support of Sensing authorization and exposure

### 6.W.0 High-level solution Principles

The solution addresses KI#2 and KI#5 and is based on the following general principles to support sensing service:

- The AF can be a sensing service requester;

- When the AF is the sensing service consumer:

- the NEF performs the authorization of the AF as requester and consumer;

- the exposure of Sensing Result to Sensing Service Consumer is performed by NEF;

- result exposure can be based on a request for one-time, periodic, or event subscription request;

- the AF may submit a follow-up request referring to previous request(s) based on previous Sensing Result;

- the Sensing Control Function checks authorization information based on service parameters e.g., allowed Sensing Service Area, allowed Sensing Service type, etc., to determine if a sensing service is allowed.

- Revocation of the sensing service as follows:

- When the AF is the consumer, the sensing service for an AF can be revoked by either the NEF or the Sensing Control Function;

NOTE: The revocation can be used for any kinds of reporting for Sensing service, i.e., one time, periodic or triggered events.

- The use cases defined in TS 23.137 [2] are classified to the sensing service type, namely Object Detection, Border Crossing Detection, Path Monitoring and Path Tracking.

- The Target Sensing Service Area can be provided based on geographical information defined in TS 23.032 [X] (e.g. a polygon).

### 6.W.1 Description

#### 6.W.1.1 Terms used within this solution

For the purposes of the present solution the following definitions apply:

**Sensing Service type:** indicating the Sensing scenarios, it includes Object Detection within a Target Sensing Service Area, Border Crossing Detection, Path Monitoring and Path Tracking.

**Sensing Control** **Function**: Indicating the logical function which is involved to support Sensing Service and responsible for selecting the Sensing Entities and for providing the related configuration information.

**Sensing Processing Function**: responsible for receiving the 3GPP Sensing Data and for performing the elaboration for determining the Sensing Result.

**Sensing Context**: data maintained by the Sensing Control Function containing information relative to a sensing operation (e.g., Sensing Service Consumer, requested Sensing Service type).

**Sensing Service Requester**: the entity which request the sensing service e.g., the AF.

**Sensing Service Consumer**: the entity which consumes the sensing service i.e., the AF.

**Object Identifier**: an identifier that the Sensing Control Function allocates to a detected object and that can be used by the Application Function as input to subsequent sensing service requests

**Result Identifier:** an identifier of the results of the sensing provided to the requesting AF. It can be used by the AF and Sensing Control Function to perform additional requests.

#### 6.W.1.2 Solution Description

This solution addresses the use case whereby the sensing service result consumer is not necessarily the entity which always requests the sensing service. However, the consumer may also be the entity which submits the sensing request.

Two solution options are presented as follows: the case when the AF is both the sensing service requester and consumer, and the case when the AF is the sensing service requester.

The solution also addresses the revocation of the sensing service.

**AF as sensing service requester and consumer**

For this case, the Sensing Service authorization consists of two steps: authorisation of the AF performed by the NEF and authorisation of the specific sensing service request performed by the Sensing Control Function.

It is assumed that the general framework used by the NEF to authorise an AF is applied without modification.

If the AF is authorised to request sensing service, the NEF forwards the request to the Sensing Control Function which determines whether the sensing service request can be authorised based on the AF identity and request parameters.

Also considered is the case where the AF may need to perform a first Sensing Service request over a Sensing Target Area to identify objects of interest. The sensing results will return a result ID and an enumeration of the objects detected that the AF can use as inputs in follow-up requests.

**Sensing Service Revocation**

The revocation of the AF to use the sensing service may occur as follows:

- The NEF may at any time revoke the AF authorisation - the general framework used by the NEF to revoke AF authorisation is applied without modifications.

- The Sensing Control Function may at any time revoke the authorisation granted to an AF to receive Sensing Result. The Sensing Control Function notifies the AF that the authorisation has been revoked and cancels all relevant sensing procedures related to the sensing service request whose authorisation has been revoked.

#### 6.W.1.3 Sensing Service types

The Sensing Control Function and Sensing Processing Function can support the following sensing service types:

- Object Detection within a Target Sensing Service Area: the detection of the objects within the Target Sensing Service Area

- Border Crossing Detection: the detection of the object that crosses the border of the Target Sensing Service Area, for example to detect objects that enter or exit a predetermined area

- Path Monitoring: the detection and monitoring of object(s) present in a path, for example to monitor the status of a road, the object(s) present on a road, etc...

- Path Tracking: the tracking of detected object(s), for example to report position, heading and speed of object(s) in a Target Sensing Service Area.

Editor's Note: Which of these Sensing Service types can be supported is based on the information that can be provided by RAN node and is dependent on RAN WG outcome and is FFS.

The input, output and type of request information for the above sensing service types are:

- Object Detection within a Target Sensing Service Area:

- Input: The AF provides the Target Sensing Service Area where to detect objects. The AF may also provide a list of the object(s) for which a further sensing operation is required within the Target Sensing Service Area. Some filtering criteria for the objects to be detected may also be provided.

- Output: Sensing Control Function provides the Sensing Result including the list of detected objects with associated sensing information (e.g., object identifiers and result ID) within the Target Sensing Service Area that match the filter criteria (if provided).

- Type of request: one time or periodical.

NOTE 1: the AF may issue a follow up request based on the Sensing Results e.g. to obtain additional information on a detected object.

- Border Crossing Detection:

- Input: The AF provides the Target Sensing Service Area (the Border is the boundary of the target service area) requesting the Sensing Control Function to provide an alert when it detects an object(s) crossing the border. The AF can specify whether the alert is provided only when an object crosses the border in a specific direction (e.g. in/out or out/in) or in both directions.

- Output: when the Sensing Control Function detects a border crossing matching the direction requested from the AF, it provides the Sensing Result including the indication whether the object is moving in or out of the Target Sensing Service Area and its location.

- Type of request: subscription to event.

- Path Monitoring:

- Input: The AF provides the Target Sensing Service Area (which in this case corresponds to the path to be monitored) requesting that the Sensing Result provide a list of the object(s) in the monitored path.

- Output: Sensing Control Function provides the Sensing Result including list of object(s) with associated sensing information matching the criteria, if any. Other Sensing Contextual Information may be also provided.

- Type of request: subscription to event or periodical.

NOTE 2: The path monitoring service type is a superset of the Border crossing detection service type where the border corresponds to the boundary of the path.

- Path Tracking:

- Input: The AF provides the Target Sensing Service Area requesting the Sensing Result to track the object(s) within the Target Sensing Service Area (i.e., position, heading, speed).

- Output: Sensing Control Function provides the Sensing Result including for each sensed object a vector with position, heading and speed with associated sensing information matching the criteria, if any. Other Sensing Contextual Information may be also provided. The Sensing Result may include a result ID and an object identifier for each object discovered. The result ID and object identifier may be used by the AF for follow up request(s) to indicate to the Sensing Control Function which objects are to be tracked.

- Type of request: subscription to event or periodical.

### 6.W.2 Procedures

#### 6.W.2.1 Procedure for Sensing Service authorization and Sensing Result exposure

##### 6.W.2.1.1 Procedure for Sensing Service authorization and Sensing Result exposure for AF as the Consumer



Figure 6.W.2.1.1-1: Sensing Service authorization procedure for AF as requester and consumer.

NOTE 1: This sub-clause provides the details of Sensing Service authorization and invocation procedure, and corresponds to step 1- 2 and step 4 - 7 of the high-level procedure and architecture (in Solution #3).

1. The AF sends Nnef\_SensingService\_Subscribe Request message to the NEF. The request contains the Sensing Service requirement(s) (e.g. Target Sensing Service Area, accuracy, resolution, refresh rate, Sensing Service time duration, one-time report/periodical report/event-triggered, etc), Sensing Service type and corresponding information to obtain required Sensing Result from network, optionally, and if previously provided in Nnef\_SensingService\_Notify message, the Result ID and Object ID(s) which is defined in clause 6.W.1.1.

2. The NEF authorizes the AF for using the Sensing Service based on AF ID. If the authorization is not granted, the rest of the procedure (steps 3- 6) is skipped and the NEF responds to the AF indicating the failure of the Sensing Service authorization in step 8.

3. The NEF may discover and select the candidate Sensing Control Function(s). This step is outside the scope of this solution and it is addressed by solutions to KI#3.

4. If the authorization succeeds, then the NEF sends the Nscf\_SensingServiceExposure\_Subscribe Request message to the Sensing Control Function. The request message contains the Sensing Service type and associated parameters.

5. The Sensing Control Function creates the Sensing Context containing information relative to a sensing operation (e.g., Sensing Service Consumer, requested Sensing Service type).

6. The Sensing Control Function retrieves the sensing authorization information. The sensing authorization information contains either allowed Sensing Service Area, allowed Sensing Service type, allowed Sensing service time duration, or forbidden Sensing Service Area, forbidden Sensing Service type, forbidden Sensing service time duration. Upon receiving request from NEF, the Sensing Control Function performs authorization based on the received parameters from NEF (e.g., AF ID, Target Sensing Service Area, Sensing Service Type, Sensing service time duration) and sensing authorization information to determine whether the Sensing Service requirement is authorized or not.

If only part of the Target Service Area is authorized by the Sensing Control Function (e.g., the Target Service Area is partially within the Allowed Sensing Service Area), the subsequent steps continue only with this authorized Target Sensing Service Area.

7. If the Sensing Control Function does not grant the authorization to perform the sensing service request in step 6, steps 9 to step 15 of the overall Sensing procedure (see Solution #3) are skipped and Sensing Control Function reports the authorization failure in the Nscf\_SensingServiceExposure\_Subscribe response. If the authorization in step 6 succeeds, the procedure continues with step 9.

8. The NEF sends Sensing Service subscription response message to the AF, the response message indicates whether the Nnef\_SensingService\_Subscribe response is successful or not.

NOTE 2: For example, the Sensing Control Function determines whether the sensing can be performed in the requested Target Sensing Service area and/or Sensing Service type.9. The discovery and selection of gNB(s) is then performed based on solutions to KI#3. If the request contained a result ID and Object ID(s), the Sensing Control Function takes them into consideration for the discovery and selection of the Sensing Entity and may pass the relevant object ID to the Sensing Processing Functions involved in the sensing operation.

10. The configuration of gNB is performed based on solution to KI#6

11. Once the Sensing Processing Function(s) has obtained 3GPP Sensing data from Sensing Receiver(s), the Sensing Control Function initiates the sensing data processing task on Sensing Processing Function. For details of how the 3GPP Sensing data are obtained, refer to KI#4 and KI#6 solutions.

12. The Sensing Processing Function determines the Sensing Result.

13. The Sensing Processing Function reports the sensing result to Sensing Control Function.

14. The result ID and Object ID(s) to each the detected object and includes this information in the Sensing Result which is provided to NEF using Nscf\_SensingServiceExposure\_Notify.

NOTE 3: Possible use of the object IDs includes narrowing down the Target Sensing Area, indicate to the Sensing Control Function which specific object(s) to track, subscribe to event of a specific object crossing a boundary and so on.

15. The NEF then provides the Sensing Result to the AF using Nnef\_SensingService\_Notify which the NEF forwards transparently. The corresponding output of each Sensing Service type are defined in clause 6.W.1.3. The AF may use the result ID and Object ID(s) in follow up Sensing Service requests.

Steps 9- 15 may be repeated in case of periodical reporting.

#### 6.W.2.2 Procedure for Sensing Service revocation

##### 6.W.2.2.2 NEF Revocation of the Sensing Service for an AF



Figure 6.W.2.2.2-1: Procedure of NEF revoking the Sensing Service for an AF

1. The NEF may decide to revoke the capability of the AF to invoke Sensing Services (e.g., the subscription of AF is not authorized any more) as described in TS 23.501 [3] or the NEF may receive the Nnef\_SensingService\_Unsubscribe Request of the AF to revoke the Sensing Service.

2. The NEF sends the Nsf\_SensingService\_Unsubscribe request message to the Sensing Control Function to cancel subsequent reporting of the Sensing Result of the requester.

3. The Sensing Control Function enforces the revocation of the sensing procedure, and cancels the reporting of related Sensing Result according to Nnef\_SensingService\_Unsubscribe request. The Sensing Control Function determines whether the sensing request towards the gNB needs to be updated or the Sensing Control Function determines the cancellation of the Sensing procedure of the downstream nodes based on the AF corresponding Sensing Service requirement.

NOTE: For example, if the Target Sensing area of the cancelled Sensing Service overlaps with the Target Sensing area of the on-going service which has been not cancelled, in that case, the Sensing procedure regarding that area might be maintained. If the removal of Target Sensing area does not have any overlaps, the Sensing Control Function may interact with the gNB to update the Sensing procedure.

4. The Sensing Control Function also removes the Sensing Context associated to the Sensing requests from AF.

5. The Sensing Control Function sends a Sensing Task Update Request to Sensing Processing Function if it determines to update the task to stop processing data related to the sensing request whose authorisation was revoked, or the Sensing Control Function sends a Sensing Task Release Request to the Sensing Processing Function to cancel the sensing task if it determines to cancel the Sensing Service.

6. The Sensing Control Function sends Nscf\_SensingService\_Unsubscribe response message to the NEF to indicate that the Sensing Service has been cancelled.

7. The NEF sends Nnef\_SensingService\_Notify message to the AF to indicate that the Sensing Service has been cancelled.

##### 6.W.2.2.3 Sensing Control Function Revocation of the Sensing Service



Figure 6.W.2.2.3-1: Procedure of Sensing Control Function revoking authorisation for an AF to use Sensing Service.

1. The Sensing Control Function retrieves the sensing authorization information. The sensing authorization information contains either allowed Sensing Service Area, allowed Sensing Service type, allowed Sensing service time duration, or forbidden Sensing Service Area, forbidden Sensing Service type, forbidden Sensing service time duration. Then the Sensing Control Function determines whether the sensing request towards the gNB needs to be maintained updated or to revoke the Sensing procedure according to SLA change, received sensing authorization information sensing information or the requested Sensing Service is no longer allowed.

2. The Sensing Control Function also removes the Sensing Context regarding the Sensing requests from AF.

3. The Sensing Control Function determines whether any of the existing Sensing task needs to be updated or release, for example if the Target Sensing area of the cancelled Sensing Service overlaps with the Target Sensing area of the on-going service which has been not cancelled, in that case, the Sensing procedure regarding that area might be maintained. If the removal of Target Sensing area does not have any overlaps, the Sensing Control Function may interact with the gNB to update the Sensing procedure., If needed, the Sensing Control Function send a Sensing Task Update Request to Sensing Processing Function if it determines to update the task or the Sensing Control Function sends a Sensing Task Release Request to the Sensing Processing Function to cancel the sensing task if it determines to cancel the Sensing Service.

4. The Sensing Control Function determines whether there is the need to the configuration of the gNB which are providing the Sensing measure related to Request revoked, for example if the removal of Target Sensing area does not have any overlaps, the Sensing Control Function may interact with the gNB to update the Sensing procedure per KI#6 solutions.

5. The Sensing Control Function sends Nscf\_SensingServiceExposure\_Notify message to the NEF to indicate that the Sensing Service has been cancelled.

6. The NEF sends Nnef\_SensingService\_Notify message to the AF to indicate that the Sensing Service has been revoked.

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

AF:

- Support Sensing Service requirement, Sensing Service type and corresponding information provisioning, and Sensing Result acquisition.

NEF:

- Support Sensing Service authorization and revocation

- Support Sensing Result and other related information provisioning.

Sensing Control Function and Sensing Processing Function:

- Support Sensing Service authorization and revocation

- Support the determination of the Sensing Result by processing the 3GPP Sensing Data.

- Support Sensing Result and other related information provisioning

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