3GPP SA WG1 Meeting #97e S1-220144r3

Electronic Meeting, 14 Feb –24 Feb 2022 (revision of S1-21xxxx)

**Source: China Mobile,Xiaomi,Qualcomm**

**Title: New SID on Integrated Sensing and Communication**

**Document for: Approval**

**Agenda Item: 4**

3GPP™ Work Item Description

Information on Work Items can be found at <http://www.3gpp.org/Work-Items>
See also the [3GPP Working Procedures](http://www.3gpp.org/specifications-groups/working-procedures), article 39 and the TSG Working Methods in [3GPP TR 21.900](http://www.3gpp.org/ftp/Specs/html-info/21900.htm)

Title: Study on Integrated Sensing and Communication

Document for: Approval

Acronym: FS\_Sensing

Unique identifier:

Potential target Release: Rel-19

# 1 Impacts

{For Normative work, identify the anticipated impacts. For a Study, identify the scope of the study}

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Affects: | UICC apps | ME | AN | CN | Others (specify) |
| Yes |  | X | X | X |  |
| No |  |  |  |  |  |
| Don't know | X |  |  |  | X |

# 2 Classification of the Work Item and linked work items

## 2.1 Primary classification

### This work item is a …

|  |  |
| --- | --- |
|  | Feature |
|  | Building Block |
|  | *Work Task* |
| X | Study Item |

## 2.2 Parent Work Item

|  |
| --- |
| Parent Work / Study Items  |
| Acronym | Working Group | Unique ID | Title (as in 3GPP Work Plan) |
|  |  |  |  |

### 2.3 Other related Work Items and dependencies

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| --- |
| Other related Work /Study Items (if any) |
| Unique ID | Title | Nature of relationship |
|  |  |  |
|  |  |  |

# 3 Justification

Wireless sensing technologies aim at acquiring information about a remote object and its characteristics without physically contacting it. The perception data of the object and its surrounding can be utilized for analysis, so that meaningful information about the object and its characteristics can be obtained.

Radar (radio detection and ranging) is a widely used wireless sensing technology that uses radio waves to determine the distance (range), angle, or instantaneous linear velocity of objects. There are other sensing technologies including non-RF sensors, which have been used in other areas, e.g., time-of-flight (ToF) cameras, accelerometers, gyroscopes and Lidar.

Integrated Sensing and Communication in a 3GPP 5G system means the sensing capabilities are provided by the same 5G NR wireless communication system and infrastructure as used for communication, and the sensing information could be derived from RF-based and/or non-RF based sensors. In general, it could involve scenarios of communication assisted sensing, e.g., where 5G communication system provides sensing services, or sensing assisted communication , e.g., when sensing information related tothe communication channel or environment is used to improve the communication service of the 5G system itself e.g, the sensing information can be used to assist radio resource management, interference mitigation, beam management, mobility, etc.

There are multiple market segments and verticals where 5G-based sensing services can be beneficial for intelligent transportation, aviation, enterprise, smart city, smart home, factories, consumer applications, XR, and public sector.

Mobile operators can play an important role in providing 5GS-based Integrated Sensing and Communication to customers, including e.g., the management and control of 5G-based sensing service. A recently published 5G-Automotive Association (5GAA) technical report ([5GAA\_White-Paper\_C-V2X-Use-Cases-Volume-II.pdf](https://5gaa.org/wp-content/uploads/2020/10/5GAA_White-Paper_C-V2X-Use-Cases-Volume-II.pdf)), illustrates some example of the roles operators can play to enhance V2X type of services, specifically for Infrastructure Assisted Environment Perception, Infrastructure-Based Tele-Operated Driving, High-Definition Map Collecting and Sharing and Tele-Operated Driving Support.

Other example use cases to study of 5GS to provide communication assisted sensing services are:

* Environment Real-time monitoring: Using wireless signals to reconstruct the environment map to further improve positioning accuracy and enable environment related applications, such as realizing an array of real-time monitoring related applications including dynamic 3D map for driving assistance, pedestrian flow statistics, intrusion detection, traffic detection and etc.
* Autonomous vehicles/UAV: Autonomous vehicles/UAV applications have some common functional requirements. For example, Autonomous vehicles/UAV shall support Detect and Avoid (DAA) to avoid obstacles. Meanwhile, Autonomous vehicles/UAV shall have the capability to monitor path information, like selecting routes, complying with traffic regulations.
* or air pollution monitoring: The quality of the received wireless signal displays different attenuation characteristics with changes in air humidity, air particulate matter (PM) concentration, carrier frequency and etc, which can be used for weather or air quality detection.

Indoor Health Care and Intrusion Detection. Respiration rate estimation, breathing depth estimation, apnoea detection, elders’ vital sign monitoring and indoor intrusion detection can be realized

Sensing of wireless communication channels and environment could further improve the performance of communication systems. Some examples of sensing assisted communication scenarios are:

* Sensing UE’s location and channel environment to narrow the beam sweeping range and shorten the beam training time.
* Sensing UE’s location, velocity, motion trajectory, and channel environment for beam prediction, and reducing the overhead of beam measurement and the delay of beam tracking.
* Sensing UE’s property and channel environment to improve the performance of channel estimation.

It is therefore proposed to perform an SA1 study, as per objectives listed in the next section.

# 4 Objective

The objectives of the study include:

- Study use cases and potential requirements for enhancement of the 5G system to provide integrated communication and sensing services addressing different target verticals/applications, e.g. autonomous/assisted driving, V2X, aviation/UAVs, 3D map reconstruction, smart city/factories, public sectors, healthcare, smart home, maritime sector.

NOTE1: Use cases will focus on NR based sensing and could include non-3GPP type sensors (e.g., Radar, camera).

- Identify potential service requirements in the areas of:

* + Collection and reporting of the sensing information.
	+ Exposure of the sensing capabilities and information to 3rd party.

- Identify KPIs related to NR based sensing (e.g., sensing range, motion, velocity, sensing resolution) and performance requirements for transferring sensing data.

- Aspects related to security, privacy, regulatory requirements and charging.

- Gap analysis between the identified potential requirements and existing 5GS requirements or functionalities.

# 5 Expected Output and Time scale

|  |
| --- |
| New specifications {One line per specification. Create/delete lines as needed} |
| Type  | TS/TR number | Title | For info at TSG#  | For approval at TSG# | Rapporteur |
| “Internal TR” | 22.XXX | Study on Integrated Sensing and Communication | (Mar 2023) | (Jun 2023) |  |

|  |
| --- |
| Impacted existing TS/TR {One line per specification. Create/delete lines as needed} |
| TS/TR No. | Description of change  | Target completion plenary# | Remarks |
|  |  |  |  |

# 6 Work item Rapporteur(s)

[TBD]

# 7 Work item leadership

SA1

# 8 Aspects that involve other WGs

None

# 9 Supporting Individual Members

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| --- |
| Supporting IM name |
| [China Mobile, Xiaomi, Qualcomm] |
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