**3GPP TSG-SA WG1 Meeting #99e S1-22xxxx**

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**pCR Title: Pseudo-CR on Detection of UAVs illegal flying in a restricted area**

**Draft Spec: 3GPP TR 22.837 0.1.0**

**Agenda item: 7.2**

**Document for: Approval**

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*Abstract: This contribution proposes a new use case for FS\_Sensing which is about detection of UAVs illegal flying in a restricted area*

**1. Proposal**

It is proposed to agree the following changes to 3GPP TR 22.837 0.1.0.

\* \* \* 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] W. Favoreel, "Pedestrian sensing for increased traffic safety and efficiency at signalized intersections," 2011 8th IEEE International Conference on Advanced Video and Signal Based Surveillance (AVSS), 2011, pp. 539-542, doi: 10.1109/AVSS.2011.6027406.

[3] Advances in Wildlife Crossing Technologies: <https://highways.dot.gov/public-roads/septoct-2009/advances-wildlife-crossing-technologies>.

[4] Protection Detection: Making Roads Safe for Drivers and Wildlife: <https://onlinepubs.trb.org/onlinepubs/webinars/201118.pdf>.

[5] F. Liu et al., "Integrated Sensing and Communications: Towards Dual-functional Wireless Networks for 6G and Beyond," in IEEE Journal on Selected Areas in Communications, doi: 10.1109/JSAC.2022.3156632.

[6] T. S. Rappaport, G. R. MacCartney, M. K. Samimi and S. Sun, "Wideband Millimeter-Wave Propagation Measurements and Channel Models for Future Wireless Communication System Design," in IEEE Transactions on Communications, vol. 63, no. 9, pp. 3029-3056, Sept. 2015, doi: 10.1109/TCOMM.2015.2434384.

[7] C. Han, Y. Bi, S. Duan and G. Lu, "Rain Rate Retrieval Test From 25-GHz, 28-GHz, and 38-GHz Millimeter-Wave Link Measurement in Beijing," in IEEE Journal of Selected Topics in Applied Earth Observations and Remote Sensing, vol. 12, no. 8, pp. 2835-2847, Aug. 2019, doi: 10.1109/JSTARS.2019.2918507.

[8] Moore, Erik George, "Radar Detection, Tracking and Identification for U AV Sense and Avoid Applications" (2019). Electronic Theses and Dissertations. 1544.

\* \* \* Next Change \* \* \* \*

Followings are all new texts

### 5.4 Detection of UAVs illegal flying in a restricted area

#### 5.4.1 Description

With the development of unmanned aerial vehicle technology, the application of UAVs is becoming more and more extensive, and the flying height is getting higher. Some serious safety problems have also arisen, while the illegal flying in restricted area is one of main problems. The main scenarios of the UAV illegal flying in restricted area include: light rail, airports, government facilities, research institutes, high-speed railway stations and other permanent or temporary restricted areas.



Figure 5.4.1-1 UAV collision risks at light rail

At present, the intrusion detection of UAV is addressed through manual monitoring, or automatic monitoring via high-definition optical cameras and radars. But in some scenario, high-definition cameras and radars can’t always deployed and even if there have, the cameras can’t work well in special weathers (such as rain, fog and snow), and the radars have sensing blind spots, thus the sensing range and accuracy are limited.

While 5G network can provide sensing service, it can be used to detect UAVs while the UAVs are in the sensing coverage. Furthermore, the 5G system can sense presence or proximity of UAVs illegal flying in a specific area. Considering that the UAV entering the restricted area is illegal and the UAV itself even may be illegal, this kind of sensing operation should not depend on participation of UAVs. That means the UAV should be unaware of the sensing operation. When multiple UAVs appear in the same restricted area, the 5G system can sense presence or proximity of multiple UAVs illegal flyings at the same time.

When the 5G system senses a UAV illegal flying near a restricted area, the 5G system can expose the sensing results to the application platform or management platform to assure low-altitude space safety.

The following service flow gives an example of operation that effectively detects UAV illegal flying along the light rail track.

#### 5.4.2 Pre-Conditions

Operator ‘MM’ provides 5G sensing service.

Light rail operator ‘XX’ has an agreement with Operator ‘MM’ on this service and registers as a user of the service.

The 5G system has been deployed covering the light rail track, and the light rail operator ‘XX’ has provided its restricted area information to 5G system.

The light rail operator ‘XX’ configures that once a UAV is detected that its distance from the border of the restricted area is less than 10m, the 5G system should report the event to the light rail operator ‘XX’.

The light rail operator ‘XX’ can configure energy consumption sensing mode with different sensing period, e.g. operate sensing one time per 50 seconds, per 10 seconds, per second etc. The period is decided by the platform. And in emergency condition, the 5G system can provide continuously sensing service according to the platform request.

The light rail works from 5:30 am to 23:00 pm every day.

#### 5.4.3 Service Flows

The 5G system periodically senses the restricted area requested by the light rail operator “XX” whether there are UAVs flying into the light rail restricted area border.

When one UAV flying near the light rail is detected and closely tracked with required accuracy in the sensing area, the 5G system reports the sensing results to the light rail operator ‘XX’ real time and begins continuously sensing.

When multiple UAVs flying near the light rail are detected, and closely tracked with required accuracy in the sensing area, the 5G system reports the sensing results to the light rail operator ‘XX’ in real time and continuously senses.

The sensing results should at least includes the detected UAV information e.g. location, moving speed, acceleration, altitude, etc.

To reduce energy consumption, the 5G system will notify the light rail operator ‘XX’ that the 5G system cannot detect any UAVs illegal flying after a time period which is configured by the light rail operator ‘XX’. After that, the 5G system stops continuously sensing and begins periodically sensing operation.

When the light rail stops operation between 23:00 pm to 5:00am next morning which can be configured by the light rail operator ‘XX’, the 5G system also can stop sensing operation to save energy.

#### 5.4.4 Post-Conditions

The light rail operator ‘XX’ takes actions to eliminate the UAV intrusion risks after receives the sensing results to ensure the normal operation of light rail.

#### 5.4.5 Existing features partly or fully covering the use case functionality

#### 5.4.6 Potential New Requirements needed to support the use case

[PR 5.4.6 -1] Based on the sensing requirement from a trusted 3rd party, the 5G RAN node shall be able to sense a target object and multiple target objects with specific conditions, e.g. the target object distance from the restricted area border less than 10m or entering restricted area.

[PR 5.4.6 -2] The 5G RAN node shall be able to sense a target object without the target object’s participation or awareness.

[PR 5.4.6 -3] The 5G RAN node shall be able to periodically or continuously operate sensing based on the sensing configuration from a trusted 3rd party.

[PR 5.4.6-4] The 5G system shall be able to support to adjust sensing operation period based on the request from a trusted 3rd party.

[PR 5.4.6 -5] The 5G network shall be able to periodically report sensing result to trusted 3rd party or when requested by trusted 3rd party.

[PR 5.4.6 -6] The 5G system shall be able to stop to operate sensing based on the stop condition configured by a trusted 3rd party.

[PR 5.4.6-7] The 5G system shall be able to provide a mechanism for a trusted 3rd party to configure and adjust sensing operation condition, sensing operation period and sensing operation time window.

[PR 5.4.6-8] The 5G system shall be able to provide sensing service with KPIs given in Table 5.4.6-1.

Table 5.4.6-1 KPI Table of detection of UAV’s illegal flying

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Scenario** | **Sensing Distance** | | | **Sensing Angle/direction** | | | **Sensing Moving Speed** | | | **Interval between two consecutive sensing fixes** | **Latency** |
| **Accuracy** | **Resolution** | **Distance Range** | **Accuracy** | **Resolution** | **Angle range** | **Accuracy** | **Resolution** | **Speed range** |
| Guaranteed Sensing for NLOS area at crossroads | FFS | 10m | 1km | FFS | FFS | FFS | FFS | 10m/s | ≤90m/s | FFS | FFS |
| NOTE: The KPI values are sourced from [8] | | | | | | | | | | | |