3GPP TSG-RAN WG2 Meeting #119bis Electronic draftR2-2210xxx

Elbonia, 10 – 19 October 2022

**Agenda item: 8.8.2**

**Source: Nokia, Nokia Shanghai Bell**

**Title: [PRE119bis-e][UAV][301] Summary of UAV papers 8.8.2**

**WID/SID: NR\_UAV - Release 18**

**Document for: Discussion and Decision**

# 1 Introduction

In December 2021 RAN#94 has approved Rel-18 work on NR Uncrewed Aerial Vehicles (UAVs), see [1]. At RAN2#119 the following topics are to be considered in the pre-meeting summary:

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| 1. Details on flight path plan reporting 2. Using height (H1/H2) for measurement reporting and parameter adjustments 3. Details of reporting when *numberOfTriggeringCells* is met and other means to avoid excessive reporting |

This paper is aimed at summarizing the most popular aspects raised in the papers submitted to agenda item 8.8.2 at RAN2#119bis meeting.

# 2 Discussion

## 2.1 Flight path reporting

There were multiple aspects highlighted in the agreements taken during RAN2#119 [2]:

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| As in LTE, flight path plan reporting will be introduced. Location list of waypoints (3D location information) and timestamp is adopted as the basic content of flight path report.  FFS if timestamp is mandatory or optional for NR.  FFS if further enhancements are needed |

During RAN2#119 it was raised that timestamp for flight path plan does not need to be sent always. Similar opinion is expressed in [25] where it is argued the UE may not always know what timestamp is associated with particular waypoint. Timestamp is proposed to be optional e.g. in [18][16]. On the other hand, the authors of [12] suggest the timestamp needs to be always included when flight path plan is reported, as otherwise the information conveyed to the network is somewhat meaningless and incomplete. A similar opinion, i.e. to make the timestamp mandatory if available at the UE side, is expressed in [17]. Thus, we suggest to discuss it further in RAN2, as the views provided in the papers are not uniform.

**Proposal 1: Discuss if the timestamp needs to be always reported as a part of flight path plan, considering when it may not be available and whether the information provided via waypoint without timestamp is still useful for the network.**

Another aspect related to flight path plan is whether to study the mechanism where the flight path plan may be updated/modified. The authors of [12] [15][17] and [18] express their support for such enhancement on top of Rel-15 LTE framework. In [25] it has been indicated there is no such need, as ‘’flying cars are out of scope in this WI”.

**Proposal 2: Discuss the scenarios where flight path modification may be needed and how to implement such path plan updating procedure.**

Still on the content of such flight path plan – it is widely supported to include timestamp and waypoint. However, in several papers, such as [12][18], it is suggested to further discuss the meaning of those. In particular, it is raised that waypoint definition should be improved, so that the flight path plan contains useful information and it is known what is the granularity of the waypoints (i.e. the distance between consecutive points) [18]. The authors of [12] underline the importance of providing the information on the destination of the flight and also emphasize the waypoints should be somehow organized and not left fully to the UE what location information to provide.

**Proposal 3: Discuss the definition of waypoints, whether they should have a fixed or configurable granularity in space domain, if the waypoint related to the flight destination should be signalled.**

## 2.2 Using height for measurement reporting and parameter adjustments

The following has been agreed at RAN2#119 on this topic [2]:

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| 1 Use LTE principle as a baseline, introduce similar event H1 (aerial UE height become higher than threshold) and H2 (aerial UE height become lower than threshold).  FFS if further NR enhancements are needed.  FFS study scaling of RRM parameters (e.g. which parameters and what is the purpose/benefit of the scaling and how)  FFS how to limit excessive measurements and measurement reporting  FFS if user consent is needed for location reporting in CONNECTED  FFS study the vertical movement and associated mobility for UAV UEs |

As can be seen above, lots of FFSs were captured, so it would be desirable to start discussing at least some of them at this meeting. First of all, let’s focus on the scaling/adjusting of parameters. In [19] it is suggested that scaling of the parameters (such as TTT) is not needed for mobility optimization. It is claimed that the network will have sufficient information, such as flight path plan, so further adjustment of parameters is not necessary. [5] indicates that scaling of TTT is not needed as there may be multiple instances of the same event configured. The authors of [21] propose to introduce height-dependent scaling of TTT used to trigger the measurement reporting. Interestingly, in [9] it is proposed to send the LS to RAN1/RAN4 and ask them to conduct simulations to show which parameters and in what scenarios may require adjustments. [12] suggests the adjustments can be done for the following exemplary parameters: A3/A4 TTT or A3/A4 Threshold using UAV UEs altitude. It is also proposed to combine multiple conditions (e.g. height and location) before such adjustment can be applied. Eventually, [4] points out speed-dependent TTT scaling was supported in LTE, so height-dependent scaling could be considered for NR UAVs. Views are very diverse, so further focused discussion is required.

**Proposal 4: Discuss the scenarios where NW-configured height-dependent parameter adjustment is beneficial. Consider both IDLE/Inactive and CONNECTED mode UEs.**

Next topic considered in multiple papers is how to avoid excessive measurement reporting. [21] proposes to introduce a prohibit timer to curb down the number of reports sent. [4] provides simulation results analysing the use of prohibit timer to reduce the reporting ratio. The study has been conducted for UAVs flying with the velocity of 44 m/s. [6] also wants to consider either prohibit timer or multi-cell triggering scheme, while in [3] it is suggested to reduce the number of beam measurement reporting by applying different height thresholds for measurement of specific beams.

**Proposal 5: Identify the scenarios where measurement reporting reduction is necessary (e.g. UAV UE ascending/descending). Consider possible solutions, such as multi-cell triggering and/or prohibit timer.**

We propose not to discuss the user consent issue at this meeting, while the last FFS quoted above can be partly addressed via height-dependent parameter adjustment, already considered above and/or via CHO-related UAV enhancements, which are currently not in the scope of this WI.

## 2.3 *numberOfTriggeringCells* and other means to avoid excessive reporting

The following has been agreed at RAN2#119 on this topic [2]:

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| Introduce similar functionality to LTE (numberofTriggeringCells).  FFS whether numberoftriggerbeams for NR is required or other enhancements.  FFS study how to avoid sending the measurement reports mainly due to reportOnLeave |

The topic of excessive reporting has been partly covered in 2.2, when considering the heigh-dependent actions. However, several open points can be identified here, directly associated with *numberOfTriggeringCells*. In [8] it is suggested to introduce a multi-cell trigger for *reportOnLeave* so that the report is sent only when a configurable number of cells meet the leaving criteria. [14] proposes to use *numberOfTriggeringCells* to other purposes than interference management, e.g. to reduce the inter-RAT measurement reporting for events B1 and B2. The authors of [15] want to make *numberOfTriggeringCells* applicable at least to events A3, A4 and A5 (LTE baseline), while keeping other events FFS. [4], on the other hand, considers also beam-level measurement criteria, in addition to cell-level triggering when more than a single cell fulfils the reporting condition. [13] proposes to study if particular cells can be only considered for *numberOfTriggeringCells*. [13] provides also simulation results for multi-cell triggering and among the others it is observed that introducing a number of cells for *reportOnLeave* (as suggested also in [8]) can help in reducing the reporting overhead, but at the expense of slightly degraded performance. It is finally suggested to apply enhanced multi-cell trigger where the number of changed cells in the *cellsTriggeredList* will be considered for measurement reporting decision.

Considering the content of the papers referred above, we suggest the following:

**Proposal 6: Consider the following aspects for multi-cell measurement report triggering:**

1. **Multi-cell trigger for *reportOnLeave***
2. **Applying *numberOfTriggeringCells* for inter-RAT events (i.e. B1 and B2 triggering)**
3. **Beam-level measurement criteria in addition to cell-level triggering**
4. **Enhanced multi-cell triggering, when *cellsTriggeredList* changes by a number of cells**

# 3 Conclusion

This paper summarized the measurement related UAV papers submitted to RAN2#119bis. The following proposals are made:

**Proposal 1: Discuss if the timestamp needs to be always reported as a part of flight path plan, considering when it may not be available and whether the information provided via waypoint without timestamp is still useful for the network.**

**Proposal 2: Discuss the scenarios where flight path modification may be needed and how to implement such path plan updating procedure.**

**Proposal 3: Discuss the definition of waypoints, whether they should have a fixed or configurable granularity in space domain, if the waypoint related to the flight destination should be signalled.**

**Proposal 4: Discuss the scenarios where NW-configured height-dependent parameter adjustment is beneficial. Consider both IDLE/Inactive and CONNECTED mode UEs.**

**Proposal 5: Identify the scenarios where measurement reporting reduction is necessary (e.g. UAV UE ascending/descending). Consider possible solutions, such as multi-cell triggering and/or prohibit timer.**

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1. **Multi-cell trigger for *reportOnLeave***
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4. **Enhanced multi-cell triggering, when *cellsTriggeredList* changes by a number of cells**

# References

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