3GPP TSG-RAN WG2 Meeting #121 R2-23xxxxx

Athens, Greece, 27th of Feb – 3rd of Mar 2023

**Agenda item: 8.8.2**

**Source: Nokia, Nokia Shanghai Bell**

**Title: Report from [Post120][312][UAV] Mobility Control for UAVs (Nokia)**

**WID/SID: NR\_UAV-Core – Rel-18**

**Document for: Discussion and Decision**

# 1 Introduction

This is to discuss the following:

* [Post120][312][UAV] Mobility Control for UAVs (Nokia)

Scope: Discuss aspects related to mobility control, including:

- Height dependent parameter/configuration adjustment or scaling (e.g. TTT, A4 threshold etc). Discuss which parameters/configuration, options, motivation, benefits/drawbacks.

- Event combination – discuss possible event combinations (e.g. height based event and signal strength events) and motivation/benefits

Output: set of agreeable proposals

Deadline: Long - Kick off: Jan 9th, Deadline for company inputs Jan. 20th. Inactive Period January 23 to 27. Comments on rapporteur summary Jan. 30th to February 3rd

In the next section we elaborate on the open issues for Rel-18 UAV mobility control.

# 2 Discussion

## 2.1 Height-dependent Events

Here we consider how to make use of the height/altitude which is estimated by the UAV UE and in the basic approach – used to decide if LTE-like events H1 or H2 shall be triggered. In LTE Rel-15, when the triggering condition for H1 or H2 was met, the UE was supposed to send the measurement report which could contain the RSRP/RSRQ measurements as well as the UE’s location-related information (*LocationInfo* IE) and the height information. It would be good to confirm what is to be reported in NR when event H1 or H2 is triggered.

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| **Question 1: In NR Rel-18 when event H1 or event H2 is triggered, what shall be the content of the measurement report? Please choose from the following options:**   1. **Only the parameters from *CommonLocationInfo* IE** 2. **Only the RSRP/RSRQ/SINR measurement results** 3. **The content of the report fully configurable by the network (e.g. RSRP results + *CommonLocationInfo* components)** 4. **Other** | | |
| **Company** | **Answer** | **Comments** |
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Staying still in the topic of H1/H2 events, it shall be discussed if those events can be combined/configured with Ax events (e.g. A3, A4 or A5 events) and the measurement reporting is triggered only if both events are fulfilled simultaneously. Such approach was suggested e.g. in [1] to handle vertical mobility. It would be also a similar principle as was defined for Rel-17 NTN (i.e. time or location based triggering).

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| **Question 2: Do you support combining event H1 or H2 with event Ax to ensure the measurement reporting is triggered only if both events are fulfilled simultaneously? Please note, this does not remove the support for ‘standalone’ use of H1 or H2.** | | |
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## 2.2 Height-dependent Adjustments

As the UAV UE can fly high above the ground level (up to 300 meters was supported in LTE Rel-15) it can experience largely varying radio conditions. This effect is especially pronounced when the UAV UE is ascending in NLOS conditions, below the rooftops. When the UAV UE flies higher, above the rooftops (in LOS conditions), it can monitor secondary lobes of distant base station’s antennas [2]. This can result in the UE attempting to HO not to the closest available cell. These circumstances have been used in several RAN2 papers to propose height-dependent actions to be taken for UAV UEs. Those include for example: parameter (e.g. TTT) scaling or using different configuration sets, depending on the altitude. Below we would like to ask the companies to express their support for such adaptations and provide additional information how these could be used and implemented.

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| **Question 3: Do you support allowing the UAV UE to perform height-dependent parameter scaling? If yes, please provide the details on which parameters can be scaled and in what kind of scenarios.** | | |
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If you do not think height-dependent parameter scaling is beneficial/feasible then another question is whether the UE could be configured with more than a single configuration (e.g. RRM configuration) – each to be used within certain height region.

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| **Question 4: Do you support the option where the UE can be configured with more than a single configuration (e.g. RRM configuration) – each to be used within certain height region? Please provide the details which part of the configuration can be subject to such height-dependence and how the switching between the configurations looks like.** | | |
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## 2.3 Conditional Handover

As stated in several papers submitted to RAN2#120 and RAN2#119 (e.g. in [1]), CHO is claimed to be a solution to resolve a problem of vertical mobility (i.e. when the UAV UE is ascending/descending rapidly and encounters a variation of different cells’ coverage). Even though CHO is currently not in the scope of the WID [3], we would like to check the views among the companies working on Rel-18 UAV connectivity on whether UAV-specific CHO enhancements are needed as a part of Rel-18 work. Obviously, the final decision is up to RAN Plenary.

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| **Question 5: Do you see a need to pursue UAV-specific CHO enhancements as a part of Rel-18 NR work (final decision up to the RAN Plenary)?** | | |
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In the papers submitted to RAN2, there have been different views presented regarding how CHO can be used and how it can improve UAV’s mobility. Thus, we would like to check companies’ opinions on what is the predominantly needed CHO-related enhancement for UAV UEs.

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| **Question 6: What kind of CHO-related enhancements do you see needed for UAV UEs? Choose from the following options:**   1. **Use events H1 and H2 jointly with events Ax for CHO execution triggering** 2. **Using flight path plan to prepare the UAV UE with CHO commands for multiple cells ahead** 3. **Other** | | |
| **Company** | **Answer** | **Comments** |
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# 3 Conclusion

This report has collected inputs on mobility enhancements for UAVs. As a result the following proposals are made:

# References

1. R2-2212638 *Further discussion on UAV measurement enhancements* 3GPP TSG-RAN WG2 Meeting #120 Toulouse, France, November 14-18, 2022
2. J. Stanczak, D. Kozioł, I. Z. Kovács, J. Wigard, M. Wimmer and R. Amorim, "*Enhanced Unmanned Aerial Vehicle Communication Support in LTE-Advanced*," 2018 IEEE Conference on Standards for Communications and Networking (CSCN), 2018, pp. 1-6, doi: 10.1109/CSCN.2018.8581827.
3. RP-223545 *Revised WID: NR Support for UAV (Uncrewed Aerial Vehicles)* 3GPP TSG RAN Meeting #98e Electronic Meeting, Dec 12 - 16, 2022