3GPP TSG-RAN WG2 #121bis-e R2-23xxxx

April 17-26, 2023

**Agenda item: 7.8.5**

**Source: Xiaomi**

**Title:** **[AT121bis-e][304][UAV] BRID and DAA(Xiaomi)**

**Document for: Discussion and Agreement**

# 1 Introduction

This document is to kick off the following email discussion:

**[AT121bis-e][304][UAV] BRID and DAA(Xiaomi)**

      Scope:

      - Summarize and get inputs on key issues related to AI 7.8.5

      NOTE: only high priority areas of DAA will be discussed (i.e. if something requires an LS to SA2)

      - Identify acceptable proposals for agreement

      Outcome

      -  Proposals for potential agreement/discussions

      Deadline: Company comments (Thursday, 20 10:00 UTC),  Proposals by Friday 21st, Final report (Monday 24th 10:00 UTC)

Companies are invited to put their comment in the file and change the file name in the folder according to the convention below:

File\_v00\_Rapp

File\_v01\_company1

File\_v02\_company2

…

File location: https://www.3gpp.org/ftp/tsg\_ran/WG2\_RL2/TSGR2\_121bis-e/Inbox/Drafts/[AT121bis-e][304][UAV] BRID and DAA(Xiaomi)/

# 2 Contact Information

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# 3 Discussions

The Work items for BRID broadcast over PC5 were updated at RAN#99, to include DAA if it can be supported in the same framework as BRID transmission. And to provide a separate work item to capture and mirror the necessary work for LTE PC5 operation, compared to the NR PC5.

RP-230782 Revised WID: NR Support for UAV (Uncrewed Aerial Vehicles) Nokia, Nokia Shanghai Bell

3. Specify the support for UAV identification broadcast (BRID) in NR PC5. Support of DAA using the same framework as BRID without DAA specific enhancements can be considered [RAN2]. Note:. UAV use of NR PC5 is to be used only in designated bands as defined in regulation for BRID/DAA use.

RP-230783 New WID: Enhanced LTE Support for UAV (Uncrewed Aerial Vehicles) Nokia

1. Specify the support for UAV identification broadcast (BRID) in LTE PC5. Support of DAA using the same framework as BRID without DAA specific enhancements can be considered [RAN2]. Note: UAV use of LTE PC5 is to be used only in designated bands as defined in regulation for BRID/DAA use.

Recalling also that RAN2#121 discussed and agreed the following in regards to BRID operation:

**Agreements:**

- PC5-U is used to support BRID for UAV

- Support both in-coverage and out-of-coverage scenarios

- Mode 2 will be supported. FFS whether further mode 1 will be supported.

- FFS whether separate pools are needed

- FFS whether current configurations can support UAV requirements

3.1 Network scheduled resource allocation

The first open FFS from R2#121bis-e was whether NR Resource allocation mode-1 is supported in addition to mode-2.

Mode-2 was agreed based on several factors not least the need to support both in-coverage and Out-of-Coverage UAVs.

Concern was also expressed over the potential for increased interference generated by frequent signalling in support of mode-1 transmission. However, some companies felt that the control in resource configuration afforded by mode-1 enabled better interference mitigation and an ability to reduce pre-emption.

It is also noted that for LTE PC5, SA2 stage 2 already captures that network scheduled operation mode-3 is not supported.

Some companies point out that supporting mode-1 NR PC5 would not cause much if any impact in additional specification for BRID broadcast over PC5.

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| Companies are asked whether they support NR PC5 mode-1 resource allocation for BRID broadcast over NR PC5, noting that LTE PC5 has been confirmed not to support mode-3 scheduling, and autonomous selection is agreed already to support in-coverage NR UAVs.  In particular companies supporting the use of NR PC5 mode-1 are invited to confirm the advantages, for supporting the additional mechanism. | | |
| Company | Yes / No | Comment |
| Ericsson | No | Autonomous resource allocation works under all considered scenarios. |
| Nokia | No support | As we have commented during RAN2#121 and in our R2-2303174, we see no additional gains of supporting BRID via PC5 Mode 1. It will increase the signalling over Uu interface, which is not desirable, especially when the UE is an aerial vehicle, flying high above the rooftops/base stations. |
| Intel | No | Agree with Nokia |
| Qualcomm | No strong view |  |
| Samsung | No | As mode-3 of LTE PC5 is not supported, we think that mode-1 of NR PC5 does not have to be supported in this release. |
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3.2 Sidelink Resource Configuration

Another open question relates to Sidelink resource configurations for use by UAVs and whether the current configurations can support UAV requirements. It was stated that a number of regulatory requirements exist pertaining to the delivery of the A2X messages for both BRID and DAA messages.

SA2 have confirmed that A2X is based on V2X message delivery [TS23.287], however some companies further question whether the configuration used for V2X is sufficient considering potentially very stringent regulatory requirements relating to these devices and the broadcast of safety related messages.

3.2.1 Need for QoS Enhancements

The A2X messages are delivered to the Access Stratum from the upper layers with their associated QoS information, PPPP for LTE PC5 and PC5 QoS profile for NR PC5, and the Access Stratum configures the radio bearer accordingly. Some companies believe that as no additional QoS profiles have been indicated to support A2X and that V2X support is the baseline for the solution, therefore A2X can be supported without further enhancements. Noting that V2X services support advanced services with strict performance requirements. Other companies have concerns that new or tighter QoS requirements are needed.

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| Companies are asked to indicate whether they agree that V2X resource configurations can be considered as a baseline for support of A2X services (BRID and DAA) broadcast over PC5.  Companies could also indicate whether they see a need for further enhancements in QoS management or resource configuration compared to V2X, and whether it is necessary to seek further guidance from SA2. | | |
| Company | Yes / No | Comment |
| Ericsson | See comments | No further enhancements are necessary. V2X has been designed to support more complex use cases and requirements. Our understanding of the requirements for BRID/DAA messages are a 1 second periodicity and around 250 bytes of information. This is easily supported by the current QoS framework. |
| Nokia | Yes | Reuse V2X resource configurations. As rightly noticed by the e-mail discussion rapporteur, V2X was also supposed to meet strict performance requirements. Thus, V2X QoS requirements should be sufficient for BRID, unless we are explicitly told by SA2 to design a separate advanced QoS framework. |
| Intel |  | We don’t see any enhancement is needed. V2X can be re-used |
| Qualcomm | See comments | We understand the philosophy to reuse QoS profiles, and we completely agree to reusing current QoS “framework”.  However, we think the QoS requirements for U2X can be different from V2X, but this has not been discussed by SA2. |
| Samsung | Yes | We think that existing QoS framework of LTE PC5 or NR PC5 can be a baseline. Any requirement of A2X specific QoS enhancement should be guided by SA2.  Regarding resource configuration, it is not clear for us whether this is related to resource pool configuration or something else. If this resource configuration includes resource pool configuration, then we think that the pool configuration for LTE PC5 or NR PC5 can be a baseline. |
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3.2.2 Height dependent Sidelink configuration

Amongst proposals receiving some common support the use of height as a trigger for specific resource configurations is noted. In particular it is proposed in order to enable better resource configuration for interference management. The use of a single height, range of heights or multiple height triggers may be seen as further optimisations.

This is proposed as being somewhat similar to the geographical zone resource control used for V2X.

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| Do companies agree to the specification of height as a trigger for specific resource configurations? Companies are invited to provide their thoughts as to how to further specify this trigger. Also companies may indicate whether they consider other parameters that may assist the configuration of resources, and the benefit this may bring. | | |
| Company | Yes / No | Comment |
| Ericsson | No | It is unclear which sidelink configurations need to be updated based on height. |
| Nokia | Not necessary | We see the point and if we are also working on height-dependent parameters/configurations for Uu then maybe it makes some sense to introduce height-depedent Tx parameters for PC5. But this is not essential and can be deprioritized in R18. |
| Intel | No | We don’t see this is needed. |
| Qualcomm | Yes | Note that for V2X, different (pre)configurations for PSSCH transmission parameters for different speed are currently supported. For low speed and high speed, PSSCH tx parameters including MCS, sub-channel number, retransmission number, max power can be separately (pre)configured.  Similarly, for UAVs, different heights result in variant channel conditions and interference impact. Therefore, different configurations of PSSCH tx parameters for different UE heights should be supported. |
| Samsung | Yes | We think that for example UE’s height could be an input to apply zone based resource configuration. |
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3.3 Resource Pool Configuration

Discussion regarding resource pool configuration for BRID and DAA.

When considering the re-use of existing V2X resource pool configurations in RAN2#121, some companies expressed concern that the use of resource pools for BRID/DAA transmission with other (UAV) services, may impose limits on the performance of BRID/DAA which would be unacceptable considering their requirements may be specified by regulators.

It is also noted that discussion submitted to RAN2#121bis-e indicates that QoS management is a motivating factor for supporting separate pools for these A2X services. Some companies question whether the existing pools can meet the BRID/DAA QoS requirements and suggest RAN2 seeks guidance from SA2 regarding the need for special QoS for these A2X services and possibly the need for a separate resource pool.

However other companies note that the specification of further dedicated pools further creates fragmentation in available resources, so may not be desirable.

Further, some companies highlight that the work item confirms that for this release UAVs use PC5 “only in designated bands as defined in regulation for BRID/DAA use”, and as such regulation allows for sufficient configuration of resources to ensure no impact to the intended QoS performance for these services. Also that as the configurations are based on V2X then the resource pool format can handle the existing QoS requirements so V2X resource pool configuration can remain unchanged.

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| Companies are asked to indicate whether they see a need for separate resource pools for BRID/DAA delivery and confirm the benefit it brings.  Does RAN2 have sufficient information to take a decision at this time, or should it seek SA2 assistance? | | |
| Company | Yes / No | Comment |
| Ericsson | Yes | The issue is the possible pre-emption of transmission when using mode-2 resource allocation. Can also check with SA2 on required QoS performance. |
| Nokia | No need | We think it should be up to the network how to configure those pools. We do not want to introduce further static resource fragmentation. |
| Intel |  | This can be up to NW implementation. |
| Qualcomm | Yes | Agree with Ericsson.  Also wondering about Nokia and Intel’s comment: what does it mean to be ‘up to the network’ if there is no separate pool configurability in the specification? |
| Samsung | Yes | Regarding separate resource pool for A2X service, we understand this issue is about whether to use the same resource pool with V2X service or to use different resource pool from V2X service. Our understanding is that this is related with the band(s) for A2X service. If a designated band for A2X service is not same as that for ITS/V2X service then it is so natural to define separate resource pool.  But regardless of separate resource pool, we think that existing resource pool configuration of LTE PC5 or NR PC5 can be a baseline.  We do not see any need of SA2 assistance on resource pool configuration. RAN2 may study any impact on resource pool configuration if additional QoS requirement for A2X service is guided by SA2. |
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3.4 Interference from BRID/DAA PC5 Broadcast

During discussion at RAN2#121 and RAN#98 the potential for increased levels of interference at higher altitudes (e.g. above roof tops) with LOS conditions, from deployed UAVs with frequent transmissions of PC5 broadcast BRID/DAA messages was raised as a concern.

Some contributions to RAN2#121bis-e discuss the A2X message contents, size and transmission periodicity parameters. These may be used to model the message transmissions for these features and provide a basis for further discussion/ enhancements. Whereas other companies do not think further evaluation or enhancements are necessary.

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| As a first step it is suggested that companies indicate whether they agree that evaluation of potential increased interference levels from BRID broadcast over the is required and in scope.  If RAN2 is to evaluate the interference caused by these PC5 transmissions then companies could indicate what parameters, conditions and assumptions RAN2 needs to consider e.g. average message size, frequency and deployment/evaluation scenarios? | | |
| Company | Yes / No | Comment |
| Ericsson | See comments | As UAV UEs over PC5 operate on designated bands, there is no interference to existing deployments. Any OOBE requirements should be studied by RAN4. In any case, we do not think RAN2 is the right WG to evaluate interference. |
| Nokia | No | We do not think RAN2 (or other RAN WG) needs to study this. BRID is supposed to be broadcast every ~1 s, in a separate spectrum, so we do not expect this will cause excessive interference we need to separately address. |
| Intel |  | Also don’t see the need RAN2 needs to study this. |
| Qualcomm | Yes, see comments | It would be good to have some evaluations to see e.g. the density of UEs that can be supported at certain height. This also gives insight to how far the PC5 transmissions can be decoded correctly within target error rate in case of UAV propagation scenarios such as direct line of sight channels.  We can take typical message size of 250bytes and periodicity of 1s for such evaluation. Path loss models could be reused from LTE UAV study, and V2X with needed modifications for UAV scenarios (e.g. 3D distance). |
| Samsung | No | PC5 interference evaluation should be studied by RAN1. |
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3.5 PC5 Range Extension

Some papers highlight concerns that PC5 transmit power may not be sufficient to fulfil the UAV regulatory service range requirements. The rapporteur has the understanding that no specific regulatory distance was identified, however companies are requested to confirm either way.

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| Do companies agree that PC5 range extension is required? And if so is there any understanding regarding required range performance relating to UAVs use of PC5 for BRID/DAA message broadcast.  It would also be useful if proponents could indicate their thoughts as to where the work would be carried out and under what work item, as currently there is no existing RAN1 TU exists for this objective. | | |
| Company | Yes / No | Comment |
| Ericsson | No | There is no clear requirement on the increased range for BRID/DAA communications. This would require changes to the PHY design of SL for UAV, which would require careful study and evaluation by companies in RAN1. It is out of RAN2’s scope. |
| Nokia | No extension needed | We do not think the scenario presented in one of the papers (R2-2303060) is valid. The maximum range supported today for NR PC5 should be sufficient. In any case, more densely deployed BRID receivers could also help in this case (i.e. when UAV is high above the ground). Please note that any work on PC5 power control would require RAN1 involvement, while they are about to conclude their R18 UAV work. |
| Intel | No | Out of RAN2 scope |
| Qualcomm | Yes, but see comment | In terms of requirement, FAA does say “maximize the broadcast range” but doesn’t give a specific number. Our understanding is the requirements may be further clarified and similar requirements may be imposed in other regions.  To Nokia: “The maximum range supported today for NR PC5 should be sufficient.” 🡪 this is questionable and needs study.  Further, it is unclear what “densely deployed BRID receivers” means. We don’t think BRID receivers can be ‘densely deployed’ as they are typically not equipment/network deployed by operators but rather are devices belonging to e.g. law enforcement officers.  We recognize some RAN1 work may be needed to support extending range. Considering Rel18 is unlikely to add RAN1 TUs for UAV, this could wait for Rel19 for normative work, but our intent was to make aware that the current max range of NR PC5 may not be sufficient for U2X and this is something that would need enhancements for proper support of U2X. |
| Samsung | No | PC5 range extension should be studied by RAN1. |
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3.6 LTE BRID broadcast over LTE PC5

At RAN#99 a new WID RP-230783 was introduced to specifically handle the BRID/DAA objective in parallel to the BRID/DAA objective captured in the NR UAV. One company addressed this RAT separately and considering that it is supposed to be a mirror objective, it is expected that agreement related to the functions of the framework between RATs should be fairly straight forward.

It is proposed that LTE PC5 Mode-4 resource allocation is supported, and LTE PC5 Mode-3 is not supported for BRID broadcast over PC5 interface. This aligns with SA2 stage 2.

Whilst there is no other specific proposal RAN2 may consider how to capture LTE related aspects whilst making progress on NR\_UAV framework decisions.

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| Do companies agree with the proposal?   * LTE PC5 Mode-4 resource allocation is supported, and LTE PC5 Mode-3 is not supported for BRID broadcast over PC5 interface.   Companies are also invited to provide their opinions for progressing LTE agreements in line with the NR framework solution. E.g. are separate proposals required or can they be taken in tandem unless some difference is identified? | | |
| Company | Yes / No | Comment |
| Ericsson | Yes |  |
| Nokia | Agree | We shall try copying the framework defined in NR to LTE PC5. |
| Intel | Yes |  |
| Qualcomm | Yes |  |
| Samsung | Yes | We agree that LTE mode 4 is supported but LTE mode 3 is not supported. We think that high level solutions for NR PC5 based BRID/DAA can be applied for LTE PC5 based BRID/DAA. |
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3.7 DAA

Work Item objectives for both NR UAV and LTE UAV, (RP-230782 and RP-230783 respectively), capture that DAA support can be considered with the understanding that it should utilise the same framework as BRID and that no specific enhancements, for DAA, can be supported. RAN2 have been asked to consider whether this is achievable i.e. supported with the same framework and with no specific DAA enhancements, i.e. no (critical) gaps in DAA behaviour would exist.

RP-230782

3. Specify the support for UAV identification broadcast (BRID) in NR PC5. Support of DAA using the same framework as BRID without DAA specific enhancements can be considered [RAN2]. …

RP-230783

1. Specify the support for UAV identification broadcast (BRID) in LTE PC5. Support of DAA using the same framework as BRID without DAA specific enhancements can be considered [RAN2]. …

With this in mind several proposals have considered DAA alongside BRID and their respective requirements and functions as defined in TR23.007-058 and TS23.256, and made the following considerations regarding DAA support in RAN2.

Some contributions specifically propose similar functionalities for DAA support as agreed or proposed to this meeting for BRID, to illustrate that an aligned framework can be re-use for delivery of DAA.

For example BRID/DAA both use,

* PC5-U to transmit A2X messages which have contents defined outside of 3GPP
* Both can be delivered using only broadcast mode
* Use autonomous resource selection mode (mode-2 NR PC5, mode-4 LTE PC5 operation)
* in-coverage and out-of-coverage scenarios
* Same UAV/A2X resource pool configuration is shared for BRID and DAA

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| Companies are invited to indicate whether they agree that DAA can be supported using the same framework as to be used for BRID transmission over the PC5 interface, without any specific enhancements for DAA?  Companies are asked to confirm any assumptions or limitations that may be incurred as a result of only supporting delivery within this framework. | | |
| Company | Yes / No | Comment |
| Ericsson | Yes |  |
| Nokia | Yes | Reuse all BRID principles to support DAA. |
| Intel | Yes |  |
| Qualcomm | Yes | For Rel-18, this would mean PC5-broadcast based DAA would be supported, however PC5-unicast based DAA which is included in SA2 conclusions would not be supported. |
| Samsung | Yes | We think that the same framework for BRID transmission over PC5 can be applied for DAA over PC5. |
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3.8 Other

Proposals captured elsewhere in this document are intended to reflect, based on contributions to this meeting, the interest of multiple proponents to this meeting for support of BRID and DAA.

The intention in this section is to capture other aspects not identified elsewhere.

I have noted a couple of specific cases below but they are not intended to indicate any preference over other items not specifically captured, companies are encouraged to capture proposals made in contributions to this meeting that they seek to progress.

It is noted that with limited company input for each of these proposals it may be considered that more time is needed to consider these. Companies are encouraged to seek further group support in order to have them prioritised for this meeting.

3.8.1 Mobility Considerations

Due to the increased height and in particular the speed of the UAVs a couple of papers proposed enhancements to mobility handling due to foreseen issues.

a) One paper (R2-2303403) points out that in order to maintain connectivity and resources a UAV should apply a similar behaviour to a V2X UE, but in this case the UAV considers the frequency providing the UAV configuration as the highest priority.

b) Another (R2-2303236) indicates that due to a higher frequency of cell reselection this could mean a more frequent change in resource pool configuration, leading to undesirable impact to the resource selection and the available sensing results.

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| Companies are invited to express their thoughts related to these proposals or more generally device mobility and resource pool selection.  With only a single company making each of these proposals it may be considered more time is needed to consider these. | |
| Company | Comment |
| Nokia | We do not think any changes to cell reselection mechanism are needed due to the introduction of BRID/DAA. Regarding b), the fact the UAV UE can see more cells while airborne does not automatically mean it will handover to those cells so frequently. However, some coordination of the PC5 resources within the network could be needed (but that is perhaps already feasible since the introduction of NR/LTE sidelink). |
| Samsung | For a) we think that UE should prioritize A2X service specific frequency in cell reselection similar to V2X service.  For b) we do not see a need of enhancement in resource pool configuration for mobility comparing with V2X service. |
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3.8.2 Others

R2-2303403 also introduces the use of a single bit in the SIB to indicate support of UAV within a network. This bit may be used to facilitate the UAV attempting to register with the network for authorisation, authentication, etc.). In addition it may assist the UAV in determining whether network signalled resources or preconfigured resources should be used for UAV.

R2-2304903 addresses the liaison sent to SA2 from RAN2#121 (R2-2302262) in relation to inter-PLMN DAA support. Specifically it asks RAN2 to re-discuss the response on the basis of the changes to the WID description for NR sidelink evolution (RP-230077), which re-activated some limited work relating to support of NR sidelink CA for V2X use cases.

The omission of proposals not captured elsewhere is not intended to discount from consideration these proposals and companies are encouraged to capture in the following table proposals for progression at this meeting.

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| Companies are invited to express their thoughts related to these proposals and also any other proposals not covered in the section below,  a) availability of resource configuration  b) Does RAN2 need to re-discuss inter-PLMN support of DAA as captured in R2-2302262?, and  c) more generally to highlight aspects submitted to RAN2#121bis-e but not covered above. | |
| Company | Comment |
| Nokia | We see no need to support such single bit indication. |
| Qualcomm | 1. Is the bit supposed to be a network-capability bit? Could be useful. 2. Ok to update the LS reply but no strong view |
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# 4 References

R2-2303811 Consideration on subscription-based UAV identification Huawei, HiSilicon

R2-2302907 On Broadcasting UAV Identification Ericsson España S.A.

R2-2303060 RAN2 aspects of PC5-based BRID and DAA support Qualcomm Incorporated

R2-2303174 RAN2 Aspects of BRID and DAA for UAVs in Rel-18 Nokia, Nokia Shanghai Bell

R2-2303236 Discussion on broadcasting remote id for UAV Lenovo

R2-2303403 Network enabling indication on UAV over PC5 Apple

R2-2303529 Further discussion on UAV identification broadcast CMCC

R2-2303784 UAV Analysis of BRID and DAA Broadcast over PC5 Xiaomi Mobile Software

R2-2303810 Further discussion on UAV remote identification broadcast Huawei, HiSilicon

R2-2303903 Re Discussion on the LS from SA2 for NR UAV CATT

R2-2303904 The Gap for Supporting DAA as BRID CATT

R2-2303954 Discussion on UAV identification broadcast vivo

R2-2303988 Discussion on UAV identification and DAA broadcast Samsung

R2-2304157 On UAV identification broadcast ZTE Corporation, Sanechips