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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| --- | --- |
| Company | Contact: Name (E-mail) |
| Xiaomi | Gordon Young - gordonpetery@xiaomi.com |
| Ericsson | Nithin Srinivasan – nithin.srinivasan@ericsson.com |
| Nokia | Jedrzej (jedrzej.stanczak@nokia.com) |
| Intel | Candy.yiu@intel.com |
| Qualcomm | Umesh (uphuyal@qti.qualcomm.com) |
| Samsung | Hyunjeong Kang (hyunjeong.kang@samsung.com) |
| NEC | Zonghui XIE (xie\_zonghui@nec.cn) |
| ZTE | Mengjie Zhang (zhang.mengjie@zte.com.cn) |
| Huawei | Simone Provvedi (simone.provvedi@huawei.com) |
| Sharp | LIU Lei (lei.liu@cn.sharp-world.com) |
| CATT | Hao Xu(xuhao@catt.cn) |
| Apple | Yuqin Chen (yuqin\_chen@apple.com) |
| DENSO | Tomoyuki Yamamoto (tomoyuki.yamamoto.j5c@jp.denso.com) |
| Lenovo | Jing Han (hanjing8@lenovo.com) |

# 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. |
| ZTE | No | Same view as Nokia |
| Huawei, HiSilicon | Yes | We think mode 1 should also be supported for BRID due to the fact that BRID is required by the regulator and network scheduling can provide better performance than Mode2. From specification perspective, supporting of Mode1 will not require more standard effort than supporting of Mode2, in our understanding. Based on this, we think it is better not to introduce any restriction in spec and we can leave the decision to network implementation.  |
| Sharp | No | Mode-3 of LTE is not supported, then mode-1 of NR is not supported. |
| CATT | Yes | We share the similar view as HW. From our respective, the benefit of using NR PC5 mode-1 is to reduce the interference because the gNB has more comprehensive information compared to UE. We also raise to hear Operators’s view on this question. |
| Apple | No strong view | We don’t have strong view, just wondering is there a real need to restrict from using mode 1, especially if no spec change is needed to support mode 1. |
| DENSO | No strong view |  |
| xiaomi | no |  |
| Lenovo | No strong view | Can follow majority if strong concerns on interference caused by control signalling and considering mode 3 is not support for LTE. |

The majority (11 of the 13 companies providing a response) support not adopting mode-1 NR resource allocation for BRID broadcast in this release.

2 companies support the use of NR mode-1. Of these, one company indicates their understanding that this is a regulator requirement, although with no support for mode-3 LTE, as confirmed by SA2 stage 2, in this case this would be RAT specific (see 3.6). Both prefer network to have the option to control the resource selection in order to control interference.

4 of the majority companies that could support not adopting NR PC5 mode-1 indicate no strong view, with 1 of these noting that inclusion of mode-1 may not lead to extra standardisation effort.

**Proposal 1: Not support NR PC5 mode-1 for BRID broadcast.**

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. |
| NEC |  | V2X QoS requirements should be sufficient. |
| ZTE | See comments | We agree to reuse current QoS framework. Any enhancement in QoS should be guided by SA2. |
| Huawei, HiSilicon | See comments | We think that leveraging V2X configuration can meet the QoS requirements for A2X because no additional requirements are needed for NR UAV. |
| Sharp | Yes | No need to do further enhancements in QoS management or resource configuration compared to V2X. |
| CATT | Yes | V2X resource configurations can be used as baseline to support A2X services and would like to seek further guidance from SA2 if any enhancement is needed. |
| Apple | Yes | At least for now we don’t see the need to update/modify current QoS framework. |
| DENSO | Yes | V2X QoS framework seems to be enough. |
| xiaomi | Yes  | The V2X framework is sufficient, no need for further enhancement is required |
| Lenovo | See comments | Agree to reuse current QoS framework. Any enhancement in QoS should be guided by SA2. |

14 companies provided input.

All companies indicated that at least as a baseline the existing V2X QoS framework can be reused.

Of these, 9 companies indicated that no further enhancement was needed, due to the V2X existing framework being designed for strict requirements and the existing BRID/A2X requirements being within the current capability of the V2X QoS requirements.

6 companies indicated that if any enhancement is needed to this baseline that this should be based on guidance from SA2, e.g. if they consider that A2X QoS requirements need to be more than currently defined for V2X.

**Proposal 2: RAN2 adopt the existing V2X QoS framework for support of BRID/DAA broadcast as a baseline.**

**Proposal 2a: FFS whether any enhancement is necessary (see P3), depending on confirmation and definition of new QoS requirements for BRID/DAA by SA2.**

**Proposal 3: send an LS to ask SA2 whether BRID and DAA broadcast over LTE and NR PC5 requires new QoS requirements not supported within the ranges supported for V2X.**

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. |
| ZTE | No | It is unclear what’ s the benefit to have height dependent resource configuration.  |
| Huawei, HiSilicon | No | We do not think height-dependent sidelink configuration is needed. Imagine that if one UAV communicates with another UAV through the sidelink, which means they are almost flying at the same height. So, why the NW needs to set the SL configurations based on height? |
| Sharp | Comments | We have sympathy on this. The UAV specific information might be considered further.  |
| CATT | No  | Height is one part of geographical zone, we fail to see that there is any enhancement is needed.  |
| Apple | Open for discussion | Perhaps RAN1 evaluation is required to justify this? |
| DENSO | No, but | So far we don’t see the necessity of height related parameters. However, if other companies see any concrete use case, it should be better to discuss. |
| xiaomi | open | We see this adds a dimension to the 3D geography which is being utilised in this case, if it can be added without complication then may be okay |
| Lenovo | Yes | We think height related features are valuable to be discussed since it is the mainly differences between A2X and V2X communication |

13 companies provide input on this question.

7 companies felt either categorically or generally that no enhancement to resource configuration based on height was necessary.

6 companies were open to the idea, with 3 of these companies specifically supporting the use of height as a trigger for resource configuration.

At this time with no clear support to consider height as a factor for resource selection, it seems inappropriate to make a proposal either way.

**Proposal 4: RAN2 takes no decision and continues discussion regarding the need or benefits to support height as a trigger for resource reconfiguration.**

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. |
| NEC | No | It seems current configurations can already support this. |
| ZTE | See comments | To avoid interference from other services, network should have the flexibility to configure separate resource pool for A2X service. |
| Huawei, HiSilicon | No | We do not think separate resource pool is needed, a resource pool was introduced to sidelink communication due to the difference between the PC5 and Uu. At the present, the sidelink feature already has sidelink normal resource pool and sidelink discovery resource pool. It also may have sidelink positioning resource pool. It will fragment the SL resource pool if we define a separate resource pool for UAV communication. Regarding QoS requirements, the NW can configure a lager resource pool to meet the QoS requirements.  |
| Sharp | Comments | Maybe yes, if the band used for A2X is different from V2X. |
| CATT | Not yet | This question is related with QoS and can be postponed. |
| Apple | See comments | If dedicated band is assigned to UAV, then resource pool is naturally separated from V2X.If the band is shared, we are not quite sure about a separate resource pool. Note that for Prose and V2X, we don’t introduce separate resource pools. |
| DENSO | Not yet | Agree with Ericsson and CATT. This is related to QoS requirements. |
| xiaomi | No | We believe through regulation assignment of frequency and operator configuration there is no need |
| Lenovo | Comments | This relates to the QoS requirement and specific frequency band for A2X. Better to check with SA2 |

Some companies indicate that if the A2X services are transmitted on different frequency from V2X services then they understand the resource pools to be separate resource pools (e.g. unique to A2X), and the existing LTE and NR PC5 resource pool configurations can be re-used.

One of these companies indicated that if the same frequency is shared then how to manage the resource pools for A2X is uncertain.

3 companies confirmed their understanding that whether to specify separate resource pool for A2X is dependant on the QoS requirements for the services, with 1 of these companies indicating that pre-emption issues may be a factor requiring separate resource pools. Whereas 3 other companies indicated that the whole issue should be left to network implementation to manage resource pool dimensioning, rapporteur assumes this means re-uses existing resource pool configurations.

**Proposal 5: RAN2 confirm the understanding that BRID and DAA services will be delivered on a frequency designated by regulators. FFS whether this frequency is shared by other services.**

**Proposal 6: RAN2, with the understanding that no new QoS requirements are needed for BRID and DAA, adopt the existing LTE and NR resource pool framework as a baseline.**

**Proposal 6a: FFS, in the case SA2 indicates new QoS requirements (see P3) for DAA and BRID services, whether enhancements to the resource pool framework are required.**

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. |
| NEC | FFS | If gNB can get some control over the broadcasting of BRID message (i.e., the periodicity, the range), there may be something RAN2 can do about the interferences. |
| ZTE | No | It should be discussed in RAN1. |
| Huawei, HiSilicon | No | Due to the TU limitation of UAV, we do not agree to evaluate the interference for BRID/DAA. |
| Sharp | No | Seems not in RAN2 scope. |
| CATT | No | We think it is SA2’s scope. |
| Apple | No | Also agree this should be RAN1 work. |
| DENSO | No | We think this is not in RAN2 scope. |
| xiaomi | No | Not for RAN2, no scope for additional work in RAN1 to do this |
| Lenovo | No | Not in the scope of RAN2 |

14 companies expressed their opinion regarding whether RAN2 should study potential increase in interference from BRID broadcasts. 10 of these companies indicated that this was not a RAN2 area to consider. Some of these companies felt RAN1 would be a more appropriate group, although some felt there was nothing to do, due to use of dedicated BRID operational frequency. Some companies also pointed to the lack of available TUs as a reason to not start related work in release 18.

One company suggested RAN2 may control the periodicity and range of BRID transmission via gNB signalling, which rapporteur wonders if this may impact regulatory requirement for the service.

One company thinks some evaluations would be good to explore, on this the rapporteur’s observation is that the proposal appears open ended with no clear need for enhancement.

**Proposal 7: Based on current inputs RAN2 does not investigate interference for BRID and DAA broadcast, in the current release.**

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. |
| NEC | No | The maximum range supported by NR PC5 should be sufficient. |
| ZTE | See comments | We share the view that current max range of NCR PC5 may be insufficient. But we also think it is out of RAN2 scope. |
| Huawei, HiSilicon | No | There is no additional UAV-specific requirements for longer PC5 range. Thus, we do not think PC5 range extension is needed.  |
| Sharp  | No | Not in RAN2 scope.  |
| CATT | No | Fail to see the needs. |
| Apple | No | Also agree this should be RAN1 work. |
| DENSO | No | It seems to be in RAN1 scope. |
| xiaomi | no | Such a proposal is not required according to current service requirements. Also no scope or time in the current REL18 work plan to support |
| Lenovo | See comments | We are open for discussion on this issue. One potential use case is to enable ground people to receive the BRID |

14 companies indicated their thoughts on need for PC5 range extension in support of A2X broadcast services. All but 3 companies did not think this was in RAN2 scope, and 6 companies expressed the position that the current range was sufficient. One company highlighted that range extension of PC5 would be a more general sidelink enhancement matter, and as recognised by many other companies would be carried out by RAN1.

**Proposal 8: RAN2 agree the current PC5 range is sufficient to support A2X broadcast services in this release.**

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. |
| NEC | Yes |  |
| ZTE | Yes |  |
| Huawei, HiSilicon | No | Regarding the first question, see our comments in 3.1, i.e. whether the UE is in mode 3 or mode 4 should be up to network implementation.Regarding the second question, we think the LTE agreements should align with the NR agreements to avoid increasing standardization workload. |
| Sharp | Yes |  |
| CATT | No | Same concern as HW. |
| Apple | See comments | Fine to go with majority view. |
| DENSO | Yes |  |
| xiaomi | yes | The LTE framework should mirror NR unless specific differences are identified |
| Lenovo | Yes |  |

Regarding the proposal to adopt, LTE PC5 Mode-4 resource allocation and LTE PC5 Mode-3 is not supported for BRID broadcast over PC5 interface, it is observed that 12 of the 14 companies support this proposal.

The 2 companies not supporting are the same companies supporting NR PC5 mode 1 in section 3.1, and are in favour of network being able control resource allocation in order to manage interference. To do this in this case would require overturning the existing stage 2 agreement [TS23.256] that A2X services broadcast via LTE PC5 does not supporting mode-3. There seems no strong motivation to do this.

**Proposal 9: RAN2 agrees that LTE PC5 Mode-4 resource allocation is supported, and LTE PC5 Mode-3 is not supported for BRID broadcast over PC5 interface.**

In order to advance progress on LTE PC5 support for BRID and DAA it seems most if not all companies can support the principal that LTE agreements, where possible follow the same NR framework, unless explicitly identified e.g. a strong technical reason why not.

**Proposal 10: RAN2 agrees to advance the support of BRID and DAA broadcast using LTE PC5, by following the NR PC5 framework agreements, unless explicitly identified e.g. a strong technical reason**

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. |
| NEC | Yes | In our understanding, the only difference between BRID and DAA is the content of the message, which is defined outside 3GPP. |
| ZTE | Yes |  |
| Huawei, HiSilicon | Yes | RAN2 should not introduce any DAA-specific enhancements, as written in the UAV WID. Thus, we should not discuss it anymore |
| Sharp | Yes |  |
| CATT | Yes |  |
| Apple | Yes |  |
| DENSO | Yes |  |
| xiaomi | yes | SA2 indicated support of unicast for deconfliction which is not in scope for this RAN WI. We may need to make this clear to SA2  |
| Lenovo | Yes |  |

All 14 companies agree that DAA can be delivered using the same PC5 framework used to transmit BRID. It was also identified by a couple of companies that the use of optional PC5 unicast for handling DAA deconfliction was not in scope of the RAN work item, and the framework for broadcast would work from a RAN2 point of view.

**Proposal 11: RAN2 confirms that DAA can be supported using the same framework as used for BRID transmission over the LTE and NR PC5 interface, without any specific enhancements. FFS send an LS to SA2 to inform them of only supporting PC5 broadcast for deconfliction in RAN in release 18.**

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. |
| Huawei, HiSilicon | As for a), it can follow V2X logic. As for b), we do not think this issue exists because similar issue was discussed in NR V2X, i.e., how to provide service continuity during cell reselection. For NR V2X, the high-speed UE may frequently change cell and the related resource pool configuration may also change frequently. However, in Rel-16, the final conclusion was that RAN2 left it to UE implementation. |
| Apple | a) Proponent. This is simply to follow the design in sidelink.b) We think the frequent change of resource pools among cells can be addressed by network implementation, i.e. configuring the common resource pool. |
| xiaomi | We think this can be considered as optimisations or enhancements, but not in this release. |
| Lenovo | For a), can follow V2X logicFor b), proponent. Thinks a common resource pool configuration among different cells is helpful |
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With only one proposing company for each pf these proposals it is not clear whether RAN2 as a group would be ready to accept these proposals regarding mobility/reselection behaviour at this time.

However of the few companies providing an opinion 3 companies supported the proposal in R2-2303403 to adopt V2X behaviour for delivery of A2X services, by modifying the cell re-selection procedure wherein the UAV UE may consider the frequency providing NR UAV communication configuration to be the highest priority.

**Proposal 12: RAN2 discuss further whether to adopt the V2X behaviour, wherein the UAV may consider the frequency providing UAV communication configuration to be the highest priority.**

Regarding R2-2303236 of the 5 companies providing feedback on the reduction in frequency of changing of resource pools due to high mobility, 4 companies expressed concerns regarding the need for enhancement over current V2X behaviour. However, some of these indicated the potential use of common resources across cells as useful, although it was noted that current network implementations could handle this. One respondent indicated that for V2X we left a similar scenario to UE implementation. No clear support at this meeting.

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.

R2-2303903 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?, andc) 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
 |
| Huawei, HiSilicon | We do not think one-bit indication is reasonable. What should the UAV do if the NW does not broadcast the one-bit indication even though the NW supports A2X communication? We think the UAV should not perform any A2X communication. But it is said "In addition it may assist the UAV in determining whether network signalled resources or preconfigured resources should be used for UAV.", which means the UAV is allowed to apply preconfigured resources for A2X communication. Obviously, this UE behavior is in conflict with the NW configuration.[Apple]: If network does not indicate the bit, UE should not use the PC5 resource configured by network (which is for V2X purpose). However, UE should be allowed to use pre-configured A2X resource pool (same as legacy sidelink handling). Then back to the root question, should network let UE know if A2X is supported or not? Without any indication, how would UE decide if the PC5 resource is intended for A2X?On the LS update, should we wait for a bit more progress to happen before giving an update? Companies should anyway be aware of RAN news and at the time when the LS was sent it was correct information. |
| CATT | For the liaison sent to SA2 from RAN2#121 (R2-2302262), we just raise this issue to align company’s view, due to the WID was indeed updated, according to the latest information, it is no harm to discuss whether some update is needed or not instead of ignoring.  |
| Apple | a) Proponent. The reason is network should have a way to let UE know if UAV service is supported/enabled by the cell.b) Open for discussion. |
| xiaomi | Regarding (4903) the re-opening of the response to inter-PLMN support for DAA, we do not think the amendment to the SL-enh WID changes things as it is limited to contiguous band n47, for ITS purposes. |
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The proponent for R2-2303403 may care to take the feedback above into account, it seems more convincing may be required.

Regarding the re-consideration of the LS response to SA2 from the last meeting on inter-PLMN support for DAA [R2-2302262], and following the RAN#99 decision for RAN1 to support working on Carrier aggregation for ITS services in the NR sidelink enhancement work item [RP-230077] it seems some discussion may be useful to align companies thinking, although it seems there is no strong urgency to change the response to SA2 with the work only just commencing.

**Proposal 13: RAN2 monitors progress on the updated WID NR sidelink enhancements in RAN1, specifically to consider whether to update SA2 in regards to the response sent in R2-2302262 regarding DAA interPLMN support in release 18 at a later date.**

# 4 Conclusions

**Proposal 1: Not support NR PC5 mode-1 for BRID broadcast.**

**Proposal 2: RAN2 adopt the existing V2X QoS framework for support of BRID/DAA broadcast as a baseline.**

**Proposal 2a: FFS whether any enhancement is necessary (see P3), depending on confirmation and definition of new QoS requirements for BRID/DAA by SA2.**

**Proposal 3: send an LS to ask SA2 whether BRID and DAA broadcast over LTE and NR PC5 requires new QoS requirements not supported within the ranges supported for V2X.**

**Proposal 4: RAN2 takes no decision and continues discussion regarding the need or benefits to support height as a trigger for resource reconfiguration.**

**Proposal 5: RAN2 confirm the understanding that BRID and DAA services will be delivered on a frequency designated by regulators. FFS whether this frequency is shared by other services.**

**Proposal 6: RAN2, with the understanding that no new QoS requirements are needed for BRID and DAA, adopt the existing LTE and NR resource pool framework as a baseline.**

**Proposal 6a: FFS, in the case SA2 indicates new QoS requirements (see P3) for DAA and BRID services, whether enhancements to the resource pool framework are required.**

**Proposal 7: Based on current inputs RAN2 does not investigate interference for BRID and DAA broadcast, in the current release.**

**Proposal 8: RAN2 agree the current PC5 range is sufficient to support A2X broadcast services in this release.**

**Proposal 9: RAN2 agrees that LTE PC5 Mode-4 resource allocation is supported, and LTE PC5 Mode-3 is not supported for BRID broadcast over PC5 interface.**

**Proposal 10: RAN2 agrees to advance the support of BRID and DAA broadcast using LTE PC5, by following the NR PC5 framework agreements, unless explicitly identified e.g. a strong technical reason**

**Proposal 11: RAN2 confirms that DAA can be supported using the same framework as used for BRID transmission over the LTE and NR PC5 interface, without any specific enhancements. FFS send an LS to SA2 to inform them of only supporting PC5 broadcast for deconfliction in RAN in release 18.**

**Proposal 12: RAN2 discuss further whether to adopt the V2X behaviour, wherein the UAV may consider the frequency providing UAV communication configuration to be the highest priority.**

**Proposal 13: RAN2 monitors progress on the updated WID NR sidelink enhancements in RAN1, specifically to consider whether to update SA2 in regards to the response sent in R2-2302262 regarding DAA interPLMN support in release 18 at a later date.**

**Ranking for comeback session**

**DAA specific - Not necessarily first but clear support**

**Proposal 11: RAN2 confirms that DAA can be supported using the same framework as used for BRID transmission over the LTE and NR PC5 interface, without any specific enhancements. FFS send an LS to SA2 to inform them of only supporting PC5 broadcast for deconfliction in RAN in release 18.**

**Network scheduled resource allocation / LTE support for BRID/DAA**

**Proposal 9: RAN2 agrees that LTE PC5 Mode-4 resource allocation is supported, and LTE PC5 Mode-3 is not supported for BRID broadcast over PC5 interface.**

**Proposal 1: Not support NR PC5 mode-1 for BRID broadcast.**

**Proposal 10: RAN2 agrees to advance the support of BRID and DAA broadcast using LTE PC5, by following the NR PC5 framework agreements, unless explicitly identified e.g. a strong technical reason**

**QoS framework/Resource pool configuration**

**Proposal 5: RAN2 confirm the understanding that BRID and DAA services will be delivered on a frequency designated by regulators. FFS whether this frequency is shared by other services.**

**Proposal 6: RAN2, with the understanding that no new QoS requirements are needed for BRID and DAA, adopt the existing LTE and NR resource pool framework as a baseline.**

**Proposal 2: RAN2 adopt the existing V2X QoS framework for support of BRID/DAA broadcast as a baseline.**

**Proposal 3: send an LS to ask SA2 whether BRID and DAA broadcast over LTE and NR PC5 requires new QoS requirements not supported within the ranges supported for V2X.**

**Proposal 2a: FFS whether any enhancement is necessary (see P3), depending on confirmation and definition of new QoS requirements for BRID/DAA by SA2.**

**Proposal 6a: FFS, in the case SA2 indicates new QoS requirements (see P3) for DAA and BRID services, whether enhancements to the resource pool framework are required.**

**Proposal 4: RAN2 takes no decision and continues discussion regarding the need or benefits to support height as a trigger for resource reconfiguration.**

**Liaison sent to SA2 at R2#121**

**Proposal 13: RAN2 monitors progress on the updated WID NR sidelink enhancements in RAN1, specifically to consider whether to update SA2 in regards to the response sent in R2-2302262 regarding DAA interPLMN support in release 18 at a later date.**

**Others requiring more discussion**

**Proposal 7: Based on current inputs RAN2 does not investigate interference for BRID and DAA broadcast, in the current release.**

**Proposal 8: RAN2 agree the current PC5 range is sufficient to support A2X broadcast services in this release.**

**Proposal 12: RAN2 discuss further whether to adopt the V2X behaviour, wherein the UAV may consider the frequency providing UAV communication configuration to be the highest priority.**

# 5 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