**3GPP TSG-RAN WG4 Meeting #101-bis-e R4-211xxxx**

**Electronic Meeting, January 17-25, 2022**

**Agenda item:** 5.30

**Source:** Moderator (China Telecom)

**Title:** Email discussion summary for [101-bis-e][112] NR\_PC2\_SUL\_CA\_lowMSD

**Document for:** Information

# Introduction

This discussion summary will cover two agendas:

5.30 High power UE (power class 2) for NR inter-band Carrier Aggregation with 2 bands downlink and 2 bands uplink

5.32 Power Class 2 UE for NR inter-band CA and SUL configurations with x (x>2) bands DL and y (y=1, 2) bands UL

According to the contributions submitted, this discussion summary will focus on the following topics:

* Topic#1: Discussion on general issues for HPUE CA
	+ Sub-topic 1-1: Power Class notation for BCSs
	+ Sub-topic 1-2: MSD update checking
* Topic#2: HPUE CA correction and introduction
	+ Sub-topic 2-1: Corrections
	+ Sub-topic 2-2: TPs/draft CRs to introduce UE requirements for combos

Note that the tables for collecting comments for sub-topic issues are arranged just below each issue...

# Topic #1: Discussion on general issues for HPUE CA

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations/Abstracts** |
| [R4-2202020](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202020.zip) | Skyworks Solutions Inc. | Proposal: Potential MSD increase or new MSD should be checked for the added HPUE UL configurations listed above before the end of Release 17 to maintain those cases in the specification. |
| [R4-2202041](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202041.zip) | T-Mobile USA | Proposal: Add superscripts to BCSs to indicate which BCSs have been analyzed for support of PC2 and PC1.5 |

## Open issues summary

### Sub-topic 1-1: Power Class notation for BCSs

**Proposal (R4-2202041):**

* Add superscripts to BCSs to indicate which BCSs have been analyzed for support of PC2 and PC1.5



**Recommended WF:**

* Collect views on this proposal

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| **Company** | **Comments on Sub-topic 1-1: Power Class notation for BCSs**  |
| ZTE | It seems only BCS0 was analized for PC2 and PC1.5 since usually the BCS information were not included when requesting the HPUE NR CA combinations. However, when combining the PC2/PC1.5 table with the existing PC3 table in last meeting, companies think the BCS should be same for all the power classes band combinations although BCS information for the HPUE band combination in TR38.841 are not totally the same with PC3. So far we don’t think the proposal in 2202041 is a good approach, it does not make sense to check all the HPUE combinations one by one since the approaches and templates for HPUE inter-band CA band combination requesting are quite different compared with PC3. on the contrary, it would make the table a bit difficult to understand when joint all the power classes band combinations in the same table but with different BCS information. In addition, HPUE rapporteur may need to maintain this table which might cause overlapping when PC3 rapporteur maintain the same table in the same meeting.It might be better to remove the BCS information for HPUE combs in TR38.841, instead using a common wording like BCS for the HPUE inter-band CA band combination are the same with the corresponding PC3 inter-band CA band combination, in both TR38.841 and TS38.101-1. |
| Skyworks | One of the topis that should be clarified is that in our view a PC2 inter-band combination that use PC1.5 1UL cannot work without the increased power feature otherwise it is clamped at 26dBm (without changes to PCMAX). Since this is still discussed in 114 I am not sure how these should be treated in the spec. at least some additional note is needed to clarify this. Also in the TR, even is the 29dBm MSD is there it should add a note that this is applicable only if the UE is capable of “increased power”. Furthermore there are companies wanting to limit PC2 increased power to 28.6dBm and thus would not fully work for 1Ul PC1.5. I am supportive of enabling those but at this point these cases are not complete without a solution in the PC2 “increased power” PCMAX enabling up to 29dBm. These are already in the draft spec and I am not suggesting to remove them but at least the note for PC1.5 should aknowledge the dependency to “increased power” capability and the associated MSD requirement should also do the same. |
| Huawei | We tend to support that BCS should be independent of power classes. It’s not clear about the consequence if certain BCS is not analysed for PC2/PC1.5. On the other hand, if it’s analysed, maybe we’ll get a different MSD. But will that mean tightened UE requirements?Regarding Skyworks’ comments above, for PC1.5 1UL, the UL is in non-CA mode, though the DL may be inter-band CA. But for 1UL, maybe the single-band power class should apply? I think the intention of the table in question is to indicate the combination of DL and UL configurations including power classes. |
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### Sub-topic 1-2: MSD update checking

**Proposal (R4-2202020):**

* Potential MSD increase or new MSD should be checked for the added HPUE UL configurations listed below before the end of Release 17 to maintain those cases in the specification.
* CA\_n25A-n41C or CA\_ n25A-n41(2A) DL with PC2 or PC1.5 n41 UL or PC2 CA\_n25A-n41A UL
* CA\_n41(2A)-n66A DL with PC2 or PC1.5 n41 UL or PC2 CA\_ n41A-n66A UL
* CA\_n41C-n66A DL with PC2 or PC1.5 n41 UL or PC2 CA\_ n41A-n66A UL
* CA\_n41C-n71A DL with PC2 or PC1.5 n41 UL or PC2 CA\_ n41A-n71A UL
* CA\_n1A-n78A DL with PC2 n78 UL or PC2 CA\_ n1A-n78A UL
* CA\_n2A-n77/78A or CA\_n2A-n77(2A) DL with PC2 n77/n78 UL or PC2 CA\_n2A-n77A UL
* CA\_n3A-n41A DL with PC2 n41 UL or PC2 CA\_n3A-n41A UL
* CA\_n3A-n78A DL with PC2 n78 UL or PC2 CA\_n3A-n78A UL
* CA\_n5A-n77A or CA\_n5A-n77(2A) DL with PC2 n77 UL or PC2 CA\_n5A-n77A UL
* CA\_n12A-n77A or CA\_n12A-n77(2A) DL with PC2 n77 UL or PC2 CA\_n12A-n77A UL
* CA\_n14A-n77A or CA\_n14A-n77(2A) DL with PC2 n77 UL or PC2 CA\_n14A-n77A UL
* CA\_n25A-n77A DL with PC2 n77 UL
* CA\_n28A-n41A DL with PC2 n41 UL or PC2 CA\_n28A-n41A UL
* CA\_n28A-n79A DL with PC2 n79 UL or PC2 CA\_n28A-n79A UL
* CA\_n30A-n77A or CA\_n30A-n77(2A) DL with PC2 n77 UL or PC2 CA\_n30A-n77A UL
* CA\_n40A-n41A with PC2 n41 UL or PC2 CA\_n40A-n41A UL (MSD unless non-simultaneous Tx/Rx is granted, note is missing)
* CA\_n41A-n77A DL with PC2 or PC1.5 n41 UL or PC2 n77 UL or PC2 CA\_ n41A-n77A UL (unclear if both can be PC2 and simultaneously, MSD unless non-simultaneous Tx/Rx is granted, note is missing)
* CA\_n41A-n79A DL with PC2 n41 or n79 UL or PC2 CA\_ n41A-n79A UL (unclear if both can be PC2 and simultaneously, MSD unless non-simultaneous Tx/Rx is granted, note is missing)
* CA\_n66A-n77A or CA\_n66A-n77(2A) DL with PC2 n77 UL or PC2 CA\_ n66A-n77A UL
* CA\_n71A-n77A DL with PC2 n77 UL or PC2 CA\_ n71A-n77A UL

**Recommended WF:**

* Collect views for this proposal.
* Please contacts for the above CAs check if MSD values have been analyzed? Or if Skyworks could further clarify the proposal? As we have TR 38.841 that have captured the MSD analysis and also reflected the corresponding requirements into TS 38101-1.

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| **Company** | **Comments on Sub-topic 1-2: MSD update checking**  |
| ZTE | We think the MSD values for PC2 UL inter-band CA have already defined for all the PC2 UL inter-band CA band combination, i.e. IMD MSD needs to be checked and defined if there are IMD issues in the corresponding PC3 combs.However, for PC2 UL intra-band CA, such as PC2 n77(2A) for some combs, the MSD should be discussed but it seems the MSD were not checked. |
| Xiaomi | Generally we agree with the intention that the MSD issue should be carefully checked since more and more PC2 band combinations are introduced. However, It seems the MSD values for most of listed band combination have been correctly reflected in the latest spec. For CA\_n40A-n41A, although it can found that this band combination only applicable for UE supporting inter-band carrier aggregation without simultaneous Rx/Tx from Table 6.2A.4.2.3-1, it is better the same wording note 9 should be added as subscript in Table 5.2A.2.1 in operation band section. |
| LGE | RAN4 need further discuss which impact will be issued in each CA/DC band combinations. So we are support SKW proposals. Continually RAN4 discussed in Rel-18 TEI or create new WI even though the Rel-17 WI was closed.  |
| Verizon | The MSD values for PC2 UL inter-band CA should be already defined for all the PC2 UL inter-band CA band combination with the agreed case a, b, c and d.However, RAN4 may need to introduce additional requirements as what Skyworks commented out, and we support the proposal.  |
| T-Mobile USA | For out combinations, we feel MSD has been thoroughly studied. Specifically: CA\_n25A-n41C or CA\_ n25A-n41(2A) DL with PC2 or PC1.5 n41 UL or PC2 CA\_n25A-n41A UL                 DL CA\_n25A-n41A with PC2 UL CA\_n25A-n41A UL and PC2 and PC1.5 n41 was already analyzed. Does DL 41C or 41(2A) change anything? CA\_n41(2A)-n66A DL with PC2 or PC1.5 n41 UL or PC2 CA\_ n41A-n66A UL                DL CA\_n41A-n66A with PC2 UL CA\_n41A-n66A and DL CA\_n41A-n66A with UL PC2 and PC1.5 n41 was already analyzed. Does DL 41(2A) change anything?CA\_n41C-n66A DL with PC2 or PC1.5 n41 UL or PC2 CA\_ n41A-n66A UL                DL CA\_n41A-n66A with PC2 UL CA\_n41A-n66A and DL CA\_n41A-n66A with UL PC2 and PC1.5 n41 was already analyzed. Does DL 41C change anything?CA\_n41C-n71A DL with PC2 or PC1.5 n41 UL or PC2 CA\_ n41A-n71A UL                DL CA\_n41A-n71A with PC2 UL CA\_n41A-n71A and DL CA\_n41A-n71A with UL PC2 and PC1.5 n41 was already analyzed. Does DL 41C change anything?CA\_n25A-n77A DL with PC2 n77 UL                This was studied long ago and MSD documented, although in Table 7.3A.4-4 and  Table 7.3A.5-1a,  although Table 7.3A.5-1a is out of order.                                                                                                  CA\_n41A-n77A DL with PC2 or PC1.5 n41 UL or PC2 n77 UL or PC2 CA\_ n41A-n77A UL (unclear if both can be PC2 and simultaneously, MSD unless non-simultaneous Tx/Rx is granted, note is missing)                Not sure what is not clear. The notes indicate PC2 or PC1.5 for n41, PC2 for n77, or PC2 for n41\_n77. All have been analyzedCA\_n66A-n77A or CA\_n66A-n77(2A) DL with PC2 n77 UL or PC2 CA\_ n66A-n77A UL                Analysis was done for PC2 UL CA\_n66A-n77a. See cross band isolation in Table 7.3A.6-1a, intermodulation in Table 7.3A.5-1aCA\_n71A-n77A DL with PC2 n77 UL or PC2 CA\_ n71A-n77A UL                MSD for PC2 intermodulation can be found in Table 7.3A.5-1a |
| Skyworks | To ZTE: MSD related to UL configurations including intra-band UL CA (like n77(2A) have been discussed in the not for block approval thread and MSD specs exist for the single band cases. For the two band cases, it involves triple beat calcualtion which are still not fully mature and work is on going in R17 to come to a stable frameworkFor the cases to be checked: I apologize again that I did not have a chance to go through all the CRs to know what was there or not and it was too late when the draft spec was available but based on the TR, after further crosscheck and letting aside the PC1.5 cases already discussed above, here are my remaining questions:* I could not find CA\_n2-n78 and CA\_n1-n78 although they have been added as PC2 inter-band CR last meeting.
* For MB (DL)+HB (UL) cases I’d like to have clarification if cross-band isolation MSD has been considered for PC2 even though they do not exist all for PC3 (it is worth checking), this is for: CA\_n2A-n77, CA\_n3-n78, CA\_n25A-n77A, CA\_n30A-n77A, CA\_n41A-n77A (n41 UL to n77 DL if simultaneous Tx/Rx is supported), CA\_n66A-n77A.
* For PC2 n41-n77 as both can be PC2, or even PC1.5+PC2 or PC1.5+PC1.5: if I agree that MSD for single and dual UL have been considered, It would be of interest to indicate what are the per band max power in the 2UL case to understand whther this needs “increased power” capability to work.

I did not have time to fully check but at least we want to be able to reconsider values, or add requirement if needed in next meeting. It also means that we may also need to have a completed “increased power” framework for some of those to be complete. |
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# Topic #2: HPUE CA correction and introduction

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations/Abstracts** |
| R4-2201225 | Xiaomi | Draft CR to 38.101-1 corrections on Tx power configuration on IMD requirement for high power UE inter-band CA |
| [R4-2201680](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2201680.zip) | AT&T | TP for TR 38.841 Addition of CA\_n29-n77 |
| [R4-2201717](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2201717.zip) | Verizon, AT&T | DraftCR to 38.101-1 for HPUE CA with 2 bands downlink and x bands uplink (x =1,2) |
| [R4-2202042](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202042.zip) | T-Mobile USA | Draft CR for 38.101-1: Addition of PC2 and PC1.5 for DL CA\_n41(2A) UL n41 |
| [R4-2202043](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202043.zip) | T-Mobile USA | Draft CR for 38.101-1: Addition of PC2 and PC1.5 for combinations with n25 and n41 |
| [R4-2202044](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202044.zip) | T-Mobile USA | Draft CR for 38.101-1: Addition of PC2 and PC1.5 for combinations with n41 and n66 |
| [R4-2202045](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202045.zip) | T-Mobile USA | Draft CR for 38.101-1: Addition of PC2 and PC1.5 for combinations with n41 and n71 |

## Open issues summary

### Sub-topic 2-1: Corrections

**Proposed CR:**

* R4-2201225 Draft CR to 38.101-1 corrections on Tx power configuration on IMD requirement for high power UE inter-band CA

**Recommended WF:**

* Collect the comments for proposed draft CR.

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| **CR/TP number** | **Comments collection for Sub-topic 2-1: Corrections** |
| R4-2201225 | Xiaomi: It can be noted. We didn’t note that the change has been reflected in the latest version. Sorry for the confusion. |
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### Sub-topic 2-2: TPs/draft CRs to introduce UE requirements for combos

**Proposed CRs/TP:**

* [R4-2201680](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2201680.zip) TP for TR 38.841 Addition of CA\_n29-n77
* R4-2201717 Draft CR to 38.101-1 for HPUE CA with 2 bands downlink and x bands uplink (x =1,2)
* R4-2202042 Draft CR for 38.101-1: Addition of PC2 and PC1.5 for DL CA\_n41(2A) UL n41
* R4-2202043 Draft CR for 38.101-1: Addition of PC2 and PC1.5 for combinations with n25 and n41
* R4-2202044 Draft CR for 38.101-1: Addition of PC2 and PC1.5 for combinations with n41 and n66
* R4-2202045 Draft CR for 38.101-1: Addition of PC2 and PC1.5 for combinations with n41 and n71

**Recommended WF:**

* Collect the comments for proposed TP and draft CRs. If no comments for certain of TP or draft CR, the TP or draft CR will be recommended as approved.

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| **CR/TP number** | **Comments collection for Sub-topic 2-2: TPs/draft CRs to introduce UE requirements for combos** |
| [R4-2201680](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2201680.zip) |  |
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| [R4-2201717](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2201717.zip) | ZTE: It is a bit weird to use band number in the UL column. What does it mean? We think it cannot equal to single carrier. In addition, if PC2 UL intra-band CA is supported/requested, what should we do? |
| Verizon: For the 1UL part in the first part of ZTE comment, it should be same as the Skyworks one in [R4-2202020](file:///E%3A%5C%5C01%20%E6%A0%87%E5%87%86%5C%5C14%20HPUE%5C%5C02%20UL_interCA%5C%5CRAN4_101b_e%5C%5CDocs%5C%5CR4-2202020.zip), then we remove the n778 from UL column from this contribution. Please refer the revision ([Rev R4-2201717 DraftCR to 38.101-1 for HPUE CA -5-30-1.docx](https://view.officeapps.live.com/op/view.aspx?src=https%3A%2F%2Fwww.3gpp.org%2Fftp%2Ftsg_ran%2FWG4_Radio%2FTSGR4_101-bis-e%2FInbox%2FDrafts%2F%255B101-bis-e%255D%255B112%255D%2520NR_PC2_SUL_CA_lowMSD%2FRound%25201%2FRev%2520R4-2201717%2520DraftCR%2520to%252038.101-1%2520for%2520HPUE%2520CA%2520-5-30-1.docx&wdOrigin=BROWSELINK)) here.For the 2UL, the draftCR is created based on the approved PC2 requirements which have been specified in both 38.101-1 and TR 38.841 for the following CA combos. The contribution is only to add the “Note 8” from the early approved PC2 CA combos.* CA\_n2A-n77A
* CA\_n5A-n77A
* CA\_n66A-n77A

This should be what we exactly should do. Otherwise, it is great ZTE to narrate the comment in detail. |
| T-Mobile USA: To ZTE: There are lots of combinations with n41, n77 or m78 with superscript notes already in the table. At the last meeting it was agreed that the second column would indicate uplink CA or single uplink carrier with a power class other than power class 3: Uplink CA configuration or single uplink carrier10NOTE 10: Only single uplink carriers with power class other than PC3 are listed. |
| Skyworks: Just for clarification these are just PC2 cases, I assume that MSDs have already been captured in the spec. In my view it would be better if the CRs had all of the spec aspects in them or at least point that the combinations have been completed. I will further crosscheck these for next meeting. Should we rather have a big CR approach? Also even if things are already in the spec I should say the CR did not have much visibility. One aspect is whether the single UL nXX is the best way to capture or whather we should have some text saying that for PC2 inter-band CA with one UL bands that support PC2 , 1UL PC2 in that band is a valid fallback. Similarly for PC2 inter-band with increased power capability with one UL bands that support PC1.5 , 1UL PC1.5 in that is a valid fallback. This may be more generic and provide proper conditions to apply. |
| [R4-2202042](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202042.zip) | ZTE: Same as above |
| T-Mobile USA: Same response as above |
| Skyworks, the PC1.5 case needs “increased power” framework for completness |
| [R4-2202043](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202043.zip) | ZTE: Same as above |
| T-Mobile USA: Same response as above |
| Skyworks, the PC1.5 case needs “increased power” framework for completness |
| [R4-2202044](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202044.zip) | ZTE: Same as above |
| T-Mobile USA: Same response as above |
| Skyworks, the PC1.5 case needs “increased power” framework for completness |
| [R4-2202045](file:///E%3A%5C01%20%E6%A0%87%E5%87%86%5C14%20HPUE%5C02%20UL_interCA%5CRAN4_101b_e%5CDocs%5CR4-2202045.zip) | ZTE: Same as above |
| T-Mobile USA: Same response as above |
| Skyworks, the PC1.5 case needs “increased power” framework for completness |

# Recommendations for Tdocs

## 1st round

## 2nd round