**3GPP TSG-RAN** **WG2 Meeting #111-e R2-200xxxx**

**Electronic, 17th – 28th August 2020**

**Agenda Item: 6.1.2**

**Source: Huawei, HiSilicon**

**Title: Summary of offline 018 UE cap MR-DC Power Class**

**Document for: Discussion and decision**

# Introduction

This document summarizes the following offline discussion for MR-DC Power Class.

* [AT111-e][018][NR16] UE cap MR-DC Power Class (Huawei)

Scope: Treat R2-2007112, R2-2007113, R2-2007114, R2-2008077, R2-2008078 (proponents to drive),

Deadlines:

Phase I: solution selection, Wednesday 2020-08-19 07:00 UTC

Phase II: CR details,Friday 2020-08-21 07:00 UTC

# Discussion

## Background

In RP-201392 it is requested RAN2 to introduce new capability signalling for the below case:

*RAN4 has discussed an ambiguity that may arise in regard to the output power available on individual carriers when the UE is configured with an MR-DC configuration. Depending on UE implementation, in some circumstances a UE reporting PC2 for an NR band and PC2 for the MR-DC band combination may provide PC2 in NR part (single NR band or intra-band NR CA) of the MR-DC combination, whereas in other cases the UE would provide PC3 in the NR part of the MR-DC combination.* *It is ambiguous to the network whether PC2 or PC3 is applicable in the NR part of the MR-DC band combination. To resolve this, RAN#88e agreed that a new power class capability signalling for Rel-16 should be introduced in addition to the existing MR-DC power class.*

*RAN respectfully requests RAN2 to develop new power class UE capability signalling applicable for the NR part of the MR-DC band combination.* *This is in addition to the MR-DC power class, i.e. indicates that UE supports the newly indicated power class for the NR part of the MR-DC band combination also in addition the indicated power class for the MR-DC band combination. The value range for the signalled power class values is { pc1, pc2, pc3, pc5 }.*

## Phase I discussion: Option selection

There are two options to capture the signalling based on contributions:

* Option 1: per BC reporting [1][2]
* Option 2: per band per BC reporting [1][2][3]

It would be good to try to have a consensus to adopt one option, and discuss details.

**Q1. Which option is preferred?**

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| --- | --- | --- |
| **Company** | **Option 1/Option 2** | **Comments** |
| ZTE | Option 2 | Our understanding is that for the BC that supports PC2, currently there is only one NR band, thus both options can work, but we think the option 2 is more consistent with RAN4’s understanding. |
| Ericsson | Option 3 | We see some drawbacks with both Option 1 and Option 2.  Option 1: Solves only the case of one NR UL carrier, and only for the MR-DC case. This is fully aligned with what is requested in the LS. But RAN2 should expect to soon extend this to more that one NR UL band  Option 2 seems to not have this limitation, but risks to lead to increased number of BCs advertised by UE (for UE to express multiple PA configurations).  We see benefits in the more generic approach proposed in option 2. However, the power class should instead be introduced in the FeatureSetUplink. It would give the same flexibility as Option 2 but avoids signalling additional BCs. We name this Option 3 and show the corresponding ASN.1 and field descriptions below. Since UEs may indicate their power limits on several levels (per-BC, per-Band, per-FSU) an accurate field description is as important as the signalling itself.  Then RAN2 can discuss whether the same field should also be added to FeatureSetUplinkEUTRA so that the UE could also indicate a power limit for a set of contiguous LTE UL serving cells.  It should however be noted that there is already a power class in the CA-ParametersEUTRA which is apparently meant to restrict the power that the UE could use across all the ETURA UL cells in a BC. However, there is no proper field description but just a pointer to the 36.306 spec. And the Field Description therein does not make any sense in the context of EN-DC. Either we clarify existing field description (which might be sufficient for EN-DC with just one LTE UL carrier) or we also signal a value in the FSU-EUTRA. |
| Apple | Option 2 | We sympathise with the concerns from Ericsson. However, the UE Tx configuration does not change or rather the Ue does not many options when using the available front-end architectures (PA etc) and so we do not see the situation where the UE reports multiple BCs just to provide variants of PC support (and rather the UE provides the maximum power class it can support for each of the bands in the BC).  This is more of the current front-end capability in terms of power-class for a particular BC.  Also, as mentioned by Ericsson, the other power-class parameters are reported in BC (even for EN-DC) and so moving to featureSetUplink might not be a better approach. |
| Huawei, HiSilicon | Option 1 | We understand Option 2 and Option 3 could probably be more future proof, however we are also a bit worried that such addition might cause interoperability issue if UEs started to report different power classes for different bands. So far we only see need to address what has described from the RAN plenary LS. |
| MediaTek | Option 1 | We understand that option 1 is based on guideline from plenary LS and could solve the current issue. Although option 2 and 3 seems provide more flexibility, we prefer that R4 could identify the need first. |
| CATT | Option 1 | We share the view from Huawei and MediaTek that per BC cap fulfils what’s requested by RP. |
| Qualcomm Incorporated (Masato) | Option 1 | We would follow RAN request, i.e. the UE capability is applicable to the case where NR part of UL is a single CC or intra-band CA.  The CR to 38.306 can clarify that such restriction is only for UL. |
| CMCC | Option 1 | We prefer to focus on the issue raised in the LS and have the per BC cap for now. Enhancement could be done if RAN2 receives further requests. |
| Nokia | Option 1 | Yes, agree to stick to RAN plenary guidelines. When the “NR part” of an MR-DC band combination comprises of multiple NR bands and also CA possibility, how should this capability be interpreted? Looks like “single NR band or intra-band NR CA” is implied so please make sure to capture how to interpret the capability. |
| Intel | Option 1 | Agree that it is aligned with RAN plenary agreement. Regarding Nokia’s question, it should be applied to both non-CA and CA part of MR-DC. In addition, we understand that the same power class value should be applied to all carriers in NR part in MR-DC. |

Option 3: Add power class field to FeatureSetUplink:

    -- Indicates the TX power that the UE supports on the set of contiguous

-- uplink serving cell(s) in the associated band of the band combination.

-- The total available power is additionally limited by the power class

-- indicated per BC (e.g. BandCombination-> powerClass-v1530, or is default)

    -- and by the power class indicated per Band (e.g. BandNR-> ue-PowerClass,

-- or its default). If this field is absent, only those other limits apply.

    powerClassFSU-v16xy       ENUMERATED {pc1, pc2, pc3, pc5}       OPTIONAL

Intermediate summary:

10 companies joined the discussion and 7 companies prefer Option 1, 2 companies prefer Option 2 and 1 company proposed Option 3. As even within these 3 companies who are not in favour of Option 1, it is also acknowledged that option 1 can address the case described in the RANP LS. From moderator’s point of view, to introduce a future-proof signalling could be helpful in general, however for this particular case we even don’t know what would be the new cases from RAN4 and it is now difficult to justify whether the RAN2 signalling matches what RAN4 wants appropriately in the future. Thus it is proposed to adopt Option 1.

## Phase II discussion: CR details

Based on Phase I discussion, it is proposed to check the CR details in R2-2008077 and R2-2008078 and the author of these CRs will do an update based on the comments received.

**Q2: please companies provide your comments on whether anything needs to be improved on the CRs.**

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| **Company** | **Comments** |
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# Reference

1. R2-2008077 Introduction of new PowerClass for NR part in MR-DC Huawei, HiSilicon, CMCC
2. R2-2008078 Introduction of new PowerClass for NR part in MR-DC Huawei, HiSilicon, CMCC
3. [R2-2007112](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_111-e\Docs\R2-2007112.zip) Discussion on UE capability for power class for NR band in MR-DC combination Apple
4. [R2-2007113](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_111-e\Docs\R2-2007113.zip) UE capability for power class for NR band in MR-DC combination Apple
5. [R2-2007114](file:///D:\Documents\3GPP\tsg_ran\WG2\TSGR2_111-e\Docs\R2-2007114.zip) UE capability for power class for NR band in MR-DC combination Apple