**3GPP TSG-RAN WG1 #102-e R1-200xxxx**

**e-Meeting, August 17th – 28th, 2020**

**Source: Moderator (Apple Inc.)**

**Title: Feature lead summary #1 on UL Power Control for NN-DC**

**Agenda item:** **7.2.10**

**Document for:** **Discussion and Decision**

# 1 Introduction

### This contribution summarizes the MR-DC related contributions submitted under the “Maintenance of Multi-RAT Dual-Connectivity and Carrier Aggregation enhancements (LTE, NR)” agenda item 7.2.10 Rel-16 Maintenance of Multi-RAT Dual-Connectivity and Carrier Aggregation enhancements (LTE, NR).

# 2. Discussion

Table 1 summarized the identified issues in accordance to the contributions submitted and more details for each issue were provided in the following sections.

**Table 1: Issues scoping based on contributions**

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Index | Description | ZTE  [1] | MTK  [2] | HW  [3] | OPPO [4] | SS  [5] | Apple [6] | E///  [7] | QCM  [8] | Nokia  [9] | Total |
| 1 | T\_offset determination WA for DPS | A close up of a sign  Description automatically generated |  | A close up of a sign  Description automatically generated |  | A close up of a sign  Description automatically generated | A close up of a sign  Description automatically generated | A close up of a sign  Description automatically generated | A close up of a sign  Description automatically generated | A close up of a sign  Description automatically generated | 7 |
| 2. | Granularity for inter-node signaling | A close up of a sign  Description automatically generated |  |  |  |  | A close up of a sign  Description automatically generated | A close up of a sign  Description automatically generated | A close up of a sign  Description automatically generated |  | 4 |
| 3 | Removal of earlier text on dynamic power sharing |  |  |  |  |  |  | A close up of a sign  Description automatically generated | A close up of a sign  Description automatically generated |  | 2 |
| 4 | Handling of PDCCH-ordered PRACH transmission on MCG |  |  |  |  |  |  |  | A close up of a sign  Description automatically generated |  | 1 |
| 5 | Introducing new signaling to indicate maxToffsetSCG to UE |  |  |  |  | A close up of a sign  Description automatically generated |  |  |  |  | 1 |
| 6 | Data rate handling for NR-DC |  |  |  |  |  |  | A close up of a sign  Description automatically generated |  |  | 1 |
| 7 | Clarification on UL cancelation on MCG |  | A close up of a sign  Description automatically generated |  |  |  |  |  |  |  | 1 |
| 8 | Scheduling offset K2 of MCG |  | A close up of a sign  Description automatically generated |  |  |  |  |  |  |  | 1 |
| 9 | Clarification on the of Different UE Capabilities |  |  |  | A close up of a sign  Description automatically generated |  |  |  |  |  | 1 |
| 10 | RRC parameter alignment |  |  |  | A close up of a sign  Description automatically generated |  |  |  |  |  | 1 |

## 2.1 Issue-1: RAN2 LS reply on T\_offset determination WA

One working assumption was made in ran1 #100-eMeeting related to T\_offset determination and corresponding UE capability signaling. According to LS [10], MN is required to process the SCG configuration to identify the T\_offset used by the UE; Otherwise, possible largest value of T\_offset has to be assumed by MN for dynamic power sharing operation.

Two LS replies were received from RAN2 [11][12] in the recent meetings with providing different information updates. In the first email [11], it stated the following on the

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| Excerpt from RAN2 reply LS [11]  “*RAN2 would like to thank RAN1 for the LS on uplink power control for NR-NR Dual-Connectivity.*  *RAN2 is still discussing the reply to RAN1 but has no consensus yet on introducing new inter-node signalling for T\_offset.*  *However, RAN2 would like to remind that it was agreed in Rel-15 that MN and SN are not required to comprehend each other’s UE configuration for MR-DC. Therefore, RAN1 making assumption that such comprehension is possible is not correct in RAN2 view.”*  Excerpt from RAN2 reply LS [12]  *“RAN2 further discussed and agreed to introduce new inter-node signaling for T\_offset exchange between node as below.*   1. *MN signals the maxToffset restriction (i.e. maxToffset) in CG-ConfigInfo to SN, and SN shall respect the restriction when deciding the SCG configuration, such that  <= maxToffset.* 2. *RAN2 understanding is that if SN cannot accept the maxToffset restriction set by MN, SN can at least reject the procedure. RAN2 companies assume that current procedures will be reused.* 3. *RAN2 understanding is that upon receiving and accepting maxToffset restriction from MN, SN can provide the actual maxToffsetSCG (e.g.) in IE requestedToffset according to the SCG configuration.* 4. *SN may request, in CG-Config, a change in the maxToffset restriction imposed by MN. The SN may request MN to increase/decrease maxToffset and It is up to the MN to decide whether to and how to respond to the SN request.*   *RAN2 further understands that RAN1 will decide whether this solution shall be used, and if so, RAN2 would need information on value range.”* |

The T\_offset values determination remains as working assumption. How to handle the working assumption, especially taking into account the RAN2 LS replies, was discussed in several contributions [1][3][5][6][7][8][9] with different proposals:

* Opt.1: Confirm the working assumption with introducing inter-node signaling for T\_offset.
* Opt.2: Introduce new inter-node signaling candidate i.e. SN should share information to MN to inform the maximum value of Toffset  or SCS information and send RAN2 for down selection between the one agreed already and the two new candidates.

|  |  |  |  |
| --- | --- | --- | --- |
| Index | No. of companies | Companies | Reasoning |
| Opt.1 | 6 | ZTE[1], HW[3], SS [5], Apple [6], E///[7], QCM[8] | * inter-node signaling agreed by RAN2 ensures that T\_offset determination WA aligns with RAN2 NR-DC assumption. * Late stage of the WI. |
| Opt.2 | 1 | Nokia [9] |  |

## 2.2 Issue-2: Granularity of inter-node signaling

In addition, RAN2 asked in [12] for information on the value range of T\_offset as copied below:

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| *RAN2 further understands that RAN1 will decide whether this solution shall be used, and if so, RAN2 would need information on value range.* |

Different options were proposed on this regard as follows:

* Option 1: A granularity of 0.1ms with a range of **[**0.4ms, 0.5ms, …, 3.0ms].
* Option 2: A set of value {0.5ms, 0.75ms, 1ms, 1.5ms, 2ms, 2.5ms, 3ms, 4ms}
* Option 3: The range of maxToffset is 0.375ms to 3ms and the granularity of maxToffset is 0.125ms.

## 2.3 Issue-3: Removal of earlier text on dynamic power sharing

Two companies [7][8] proposed to remove the following paragraph due to lack of agreement support or redundancy:

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| *- if UE transmission(s) in slot of the MCG overlap in time with UE transmission(s) in slot of the SCG and if in any portion of slot of the SCG, the UE reduces transmission power in any portion of slot of the SCG so that in all portions of slot , where and are the UE transmission powers in slot of the MCG and in slot of the SCG, respectively, that the UE determines according to Clauses 7.1 through 7.5 using and , respectively, as the maximum transmission powers on the MCG and the SCG and is the linear value of a configured maximum transmission power for NR-DC operation in FR1 as defined in [8-3, TS 38.101-3]*  *- if UE transmission(s) in slot of the MCG or in slot of the SCG do not overlap in time with any UE transmission(s) on the SCG or the MCG, respectively, the UE determines a transmission power in slot of the MCG or in slot of the SCG as described in [8-3, TS 38.101-3] and in Clauses 7.1 through 7.5 without considering or , respectively* |

## 2.4 Issue-4: PDCCH-ordered PRACH transmission on MCG

One fundamental design rule of dynamic power sharing is that UE does not expect to receive a DCI format on a MCG serving cell that would impact on the power of a SCG uplink transmission after the deadline. On the other hand, the following text in section 8.1 of TS 38.213 was identified:

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| If a random access procedure is initiated by a PDCCH order, the UE, if requested by higher layers, transmits a PRACH in the selected PRACH occasion, as described in [11, TS 38.321], for which a time between the last symbol of the PDCCH order reception and the first symbol of the PRACH transmission is larger than or equal to msec, where  - is a time duration of symbols corresponding to a PUSCH preparation time for UE processing capability 1 [6, TS 38.214] assuming corresponds to the smallest SCS configuration between the SCS configuration of the PDCCH order and the SCS configuration of the corresponding PRACH transmission  - if the active UL BWP does not change and is defined in [10, TS 38.133] otherwise  - msec for FR1 and msec for FR2  - is a switching gap duration as defined in [6, TS 38.214]  For a PRACH transmission using 1.25 kHz or 5 kHz SCS, the UE determines assuming SCS configuration . |

One concern raised in [8] is that this context implies that UE shall be able to process dynamic power-sharing between MCG and SCG when a DCI triggered PRACH transmission on MCG serving cell takes place, even if the DCI is received after *T*offset from the start of an SCG uplink transmission that overlaps with the PRACH transmission on MCG. If the concern was justified, new TP was proposed in [8] to address it.

## 2.5 Issue-5: New signaling to indicate maxToffsetSCG to UE

One more discussion point related to inter-node signaling raised in [5] is whether a new signaling is needed to provide *maxToffsetSCG* with value  to UE or alternatively inter-node signaling is invisible at the UE side without any impact.

## 2.6 Issue-6: Data rate handling for NR-DC

In [7], one issue of data rate splitting across CGs for NR-DC was brought up for the following cases at least:

* MCG in FR1 and in FR2
* SCG in FR1 only

In this case, both MCG and SCG have the carriers in FR1. Reusing the Rel-15 determination in current specification may cause the sum data rate across cgs exceeding the UE processing capability. The proposal in [7] is that the data rate for a CG is the maximum data rate based on the band/band combination signaling and feature set information for carriers in a frequency range in one cell group from the capability signaling associated with multiple cell groups – since the SCG (and MCG) know the feature set partition that the SCG can use, the SCG can determines the data rate schedulable for a UE within SCG.

## 2.7 Issue-7: Clarification on UL cancelation on MCG

In [2], it is proposed to clarify whether UL cancellation on MCG after ‘T0-Toffset’ is allowed according to current spec since the MCG UL sum power becomes smaller after ‘T0-Toffset’ with this UL cancellation on MCG. It is feature leader understanding that this issue was discussed in RAN1 #102 e-meeting and it is true that the actual transmission power on MCG becomes smaller due to late cancelation and cannot be shared with overlapped transmission on SCG simply due to processing time limit.



## 2.8 Issue-8: Scheduling Offset

One more clarification was proposed in MTK paper [2] about the scheduling offset restriction for K2. MTK proposed to clarify the following:

Proposal 2: For Rel-16 UL dynamic power sharing of NR-DC, MCG NW always uses K2 > Toffset when scheduling a UL transmission.

## 2.9 Issue-9: Clarification on the of Different UE Capabilities

In [4], OPPO proposed to clarify the of Different UE Capabilities.

There are two different UE capabilities for the value of , which are corresponding to *long* and *short*, respectively. The corresponding descriptions in TS 38.306 and TS 38.331 are copied as below

| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
| --- | --- | --- | --- | --- |
| ***intraFR-NR-DC-PwrSharingMode1-r16***  Indicates whether the UE supports intra-FR NR DC with semi-static power sharing mode1 as defined in TS 38.213 [11]. If this field is absent, the UE does not support intra-FR NR DC. | BC | No | No | No |
| ***intraFR-NR-DC-PwrSharingMode2-r16***  Indicates whether the UE supports semi-static power sharing mode2 for synchronous intra-FR NR DC as defined in TS 38.213 [11]. The UE indicating the support of this also indicates the support of *intraFR-NR-DC-PwrSharingMode1-r16.* | BC | No | No | No |
| ***intraFR-NR-DC-DynamicPwrSharing-r16***  Indicates the UE support of dynamic power sharing for intra-FR NR DC with long or short offset as specified in TS 38.213 [11]. The UE indicating the support of this also indicates the support of *intraFR-NR-DC-PwrSharingMode1-r16.* | BC | No | No | No |
| ***sfn-SyncNRDC***  Indicates the UE supports NR-DC only with SFN and frame synchronization between PCell and PSCell. If not included by the UE supporting NR-DC, the UE supports NR-DC with slot-level synchronization without condition on SFN and frame synchronization. | UE | No | No | No |

CA-ParametersNRDC-v1610 ::= SEQUENCE {

-- R1 18-1: Semi-static power sharing mode1 between MCG and SCG cells of same FR for NR dual connectivity

intraFR-NR-DC-PwrSharingMode1-r16 ENUMERATED {supported} OPTIONAL,

-- R1 18-1a: Semi-static power sharing mode 2 between MCG and SCG cells of same FR for NR dual connectivity

intraFR-NR-DC-PwrSharingMode2-r16 ENUMERATED {supported} OPTIONAL,

-- R1 18-1b: Dynamic power sharing between MCG and SCG cells of same FR for NR dual connectivity

intraFR-NR-DC-DynamicPwrSharing-r16 ENUMERATED {short, long} OPTIONAL

}

In TS 38.213, these two values of are refer to the first value and the second value of the UE capability.

- ,

- and is the maximum of , , , , and based on the configurations on the MCG and the SCG, respectively, when the UE indicates a first value for the capability,

- and is the maximum of , , based on the configurations on the MCG and the SCG, respectively, when the UE indicates a second value for the capability, and

However, the first value of in TS 38.213 is larger than the second one. In contrast, the first value of UE capability in TS 38.306 and TS 38.331is short. OPPO thought that “the current descriptions in different TSs are not aligned with each other” and propose the following:

* Clarify the relationship between the values of and the candidate values of UE capability.

## 2.10 Issue-10: RRC parameter alignment

Some editorial changes were proposed in OPPO [4] to align on RRC parameter names.

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| **In TS 38.213 Section 7.6**  *<omitted text>*   * 7.6.2 NR-DC   If a UE is configured with an MCG using NR radio access in FR1 or in FR2 and with a SCG using NR radio access in FR2 or in FR1, respectively, the UE performs transmission power control independently per cell group as described in Clauses 7.1 through 7.5.  If a UE is configured with an MCG and a SCG using NR radio access in FR1 and/or in FR2, the UE is configured a maximum power for transmissions on the MCG by *p-NR-FR1* and/or by *p-NR-FR2-r16* and a maximum power for transmissions on the SCG by *p-NR-FR1* and/or by *p-NR-FR2-r16* and with an inter-CG power sharing mode by *nrdc-PCmode-FR1-r16* for FR1 and/or by *nrdc-PCmode-FR2-r16* for FR2. The UE determines a transmission power on the MCG and a transmission power on the SCG per frequency range.  If a UE is provided *semi-static-mode1* for *nrdc-PCmode-FR1-r16* or for *nrdc-PCmode-FR2-r16*,or *semi-static-mode2* for *nrdc-PCmode-FR1-r16* or for *nrdc-PCmode-FR2-r16*, the UE does not expect and to be configured such that , where is the linear value of , is the linear value of , and is the linear value of a configured maximum transmission power for NR-DC operation in FR1 as defined in [8-3, TS 38.101-3].  If a UE is provided *semi-static-mode1* for *nrdc-PCmode-FR1-r16* or for *nrdc-PCmode-FR2-r16*, the UE determines a transmission power for the MCG or for the SCG as described in Clauses 7.1 through 7.5 using or as the maximum transmission power, respectively.  If a UE is provided *semi-static-mode2* for *nrdc-PCmode-FR1* or for *nrdc-PCmode-FR2*  - if at least one symbol of slot of the MCG or of the SCG that is indicated as uplink or flexible to a UE by *tdd-UL-DL-ConfigurationCommon* and *tdd*-*UL-DL-ConfigurationDedicated*, if provided, overlaps with a symbol for any ongoing transmission overlapping with slot of the SCG or of the MCG, respectively, the UE determines a power for the transmission on the SCG or the MCG overlapping with slot as described in Clauses 7.1 through 7.5 using or , respectively, as the maximum transmission power  - otherwise, the UE determines a power for the transmission on MCG or the SCG overlapping with slot , as described in [8-3, TS 38.101-3] and in Clauses 7.1 through 7.5 without considering or , respectively  The UE expects to be provided *semi-static-mode2* for *nrdc-PCmode-FR1-r16* or for *~~nrdc-PCmode-FR1-r16~~* *nrdc-PCmode-FR2-r16* only for synchronous NR-DC operation [10, TS 38.133].  *<omitted text>* |

in addition, one more editorial change was proposed in [1] as follows:

|  |
| --- |
| **7.6.2 NR-DC**  If a UE is configured with an MCG using NR radio access in FR1 or in FR2 and with a SCG using NR radio access in FR2 or in FR1, respectively, the UE performs transmission power control independently per cell group as described in Clauses 7.1 through 7.5.  If a UE is configured with an MCG and a SCG using NR radio access in FR1 and/or in FR2, the UE is configured a maximum power C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsE9ED.tmp.jpg for transmissions on the MCG by *p-NR-FR1* and/or by *p-NR-FR2-r16* and a maximum power C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsE9FE.tmp.jpg for transmissions on the SCG by *p-NR-FR1* and/or by *p-NR-FR2-r16* and with an inter-CG power sharing mode by *nrdc-PCmode-FR1-r16* for FR1 and/or by *nrdc-PCmode-FR2-r16* for FR2. The UE determines a transmission power on the MCG and a transmission power on the SCG per frequency range.  If a UE is provided *semi-static-mode1* for *nrdc-PCmode-FR1-r16* or for *nrdc-PCmode-FR2-r16*,or *semi-static-mode2* for *nrdc-PCmode-FR1-r16* or for *nrdc-PCmode-FR2-r16*, the UE does not expect C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsE9FF.tmp.jpg and C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsEA0F.tmp.jpg to be configured such that C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsEA20.tmp.jpg, where C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsEA21.tmp.jpg is the linear value of C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsEA32.tmp.jpg, C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsEA42.tmp.jpg is the linear value of C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsEA43.tmp.jpg, and C:\Users\10240317\AppData\Local\Temp\ksohtml\wpsEA54.tmp.jpg is the linear value of a configured maximum transmission power for NR-DC operation in FR1 or FR2 as defined in [8-3, TS 38.101-3]. |

# 3. Issues scoping for next step

Company are asked to provide views on issues by ranking in the following table: (using High, medium and Low) with brief reasoning.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Company | Issue 1 | Issue 2 | Issue 3 | Issue 4 | Issue 5 | Issue 6 | Issue 7 | Issue 8 | Issue 9 | Issue 10 |
| ZTE | High | High | Medium | High | Medium | Medium | Medium | Medium | Medium | Medium |
| Samsung | High | High  (part of #1) | Medium  (include, simple) | Low | High  (part of #1) | Low | Low  (no issue) | Low  (no issue) | Editorial  (include, simple) | Editorial  (include, simple) |
| MTK | High | High  (part of #1) | Medium | Medium | Medium | Medium | Medium  (include, simple) | High (scheduling impact) | Editorial  (include, simple) | Editorial  (include, simple) |
| OPPO | High | High (Part of #1) | Editorial | Medium | Medium | Medium | No issue | No issue | Editorial | Editorial |
| Qualcomm | High | High | High | High | [Low] (not sure why necessary) | Low (already clear) | Low (already clear) | Low  (already clear) | High (editorial but good to fix) | High (editorial but good to fix) |

# References

1. [R1-2005420](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005420.zip) Remaining Issues of Power Control for NR-DC ZTE
2. [R1-2005625](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005625.zip) Remaining issues on Rel-16 uplink power control for supporting NR-NR dual- connectivity MediaTek Inc.
3. [R1-2005805](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005805.zip) UL power control for NR-NR dual connectivity Huawei, HiSilicon
4. [R1-2005981](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2005981.zip) Text proposals for UL Power Sharing for NR-DC OPPO
5. [R1-2006122](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006122.zip) Maintenance on UL Power Control for NR-DC Samsung
6. [R1-2006481](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006481.zip) Remaining issues of UL Power Control for NN-DC Apple
7. [R1-2006664](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006664.zip) Maintenance for remaining aspects of MR-DC Ericsson
8. [R1-2006787](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006787.zip) Remaining issues on NR-DC power-control Qualcomm Incorporated
9. [R1-2006879](file:///C:\Users\wanshic\OneDrive%20-%20Qualcomm\Documents\Standards\3GPP%20Standards\Meeting%20Documents\TSGR1_102\Docs\R1-2006879.zip) Discussion for Rel-16 DC uplink power control Nokia, Nokia Shanghai Bell
10. R1-2001421, LS on uplink power control for NR-NR Dual-Connectivity, RAN1, RAN1#100-e
11. R1-2003262, LS reply on uplink power control for NR-NR Dual-Connectivity, RAN2, RAN1#101-e
12. R1-2004922 LS Reply to RAN1 on UL PC for NR-DC RAN2, Apple, RAN2 #110-e