**3GPP TSG-RAN** **WG2 Meeting #109 electronic R2-xxxx**

**E-Meeting, 28th Feb– 6th Mar, 2020**

Source: vivo

Title: Power Control NR DC

Agenda Item: 6.10.2

Document for: Discussion and Decision

# Introduction

This document is summarized for the following email discussion:

* [AT109e][044][DCCA] Power Control NR DC (vivo)

 Scope: Treat Email discussion + additional issues from the other papers to this Agenda item

 Intended outcome: Agreed Issues resolutions

 Deadline: Mar 3 1200 CET

The document is organized as follows:

* Whether send an LS to RAN4 to inform the agreed new NR-DC power control parameters in RAN2 and the wording of LS if needed
* Discuss whether NR-DC power control mode should be indicated in *CG-ConfigInfo* message
* Discuss whether TDD pattern of MCG should be indicated in *CG-ConfigInfo* message

# Discussion

## 2.1 Send an LS to RAN4

In the email discussion [1], we have the following proposals for NR-DC power control:

***Proposal 2: The existing parameter p-UE-FR1 defined in TS 38.331 can be reused to configure the total maximum transmit power to be used by the UE across all cell groups for NR-DC on FR1.***

***Proposal 3: Introducing a new parameter p-UE-FR2 in the RRCReconfiguration message to configure the total maximum transmit power to be used by the UE across all cell groups for NR-DC on FR2.***

Proposal 2 and proposal 3 have been captured in the corresponding endorsed TP. From our understanding the ***p-UE-FR1*** and ***p-UE-FR2*** will impact maximum output power calculation in RAN4. Similar with EN-DC case according to TS 38.101-3, the total maximum transmit power to be used by the UE across all cell groups for EN-DC, is signaled by RRC within the parameter ***p-MaxUE-FR1*** defined in TS 36.331.

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| 6.2B.4.1.1 Intra-band contiguous EN-DCThe following requirements apply for one component carrier per CG configured for synchronous DC.…The configured maximum output power PCMAX\_ E-UTRA,*c* (*p*) in sub-frame *p* for the configured E-UTRA uplink carrier shall be set within the bounds:PCMAX\_L\_ E-UTRA,*c* (*p*) ≤ PCMAX\_ E-UTRA,*c* (*p*) ≤ PCMAX H \_ E-UTRA,*c* (*p*)where PCMAX\_L\_ E-UTRA,*c* and PCMAX H \_ E-UTRA,*c* are the limits for a serving cell *c* as specified in TS 36.101 [4] subclause 6.2.5 modified by PLTE as follows:PCMAX\_L\_ E-UTRA,*c* = MIN {MIN(PEMAX,*c* , PEMAX, EN-DC, PLTE) – tC\_ E-UTRA, *c*, (PPowerClass, EN-DC – ΔPPowerClass,EN-DC ), (PPowerClass – ΔPPowerClass) – MAX(MPR*c* + A-MPR*c* + ΔTIB,c + TC\_ E-UTRA, *c* + TProSe, P-MPR*c*)}PCMAX H \_ E-UTRA,*c* = MIN {PEMAX,*c*, PEMAX, EN-DC , PLTE, PPowerClass, EN-DC, PPowerClass – ΔPPowerClass}where- PEMAX,EN-DC is the value given by the field *p-maxUE-FR1* of the *RRCConnectionReconfiguration-v1530* IE as defined in TS 36.331 [8];- PLTE is the value given by the field *p-maxEUTRA-r15* of the *RRCConnectionReconfiguration-v1510* IE as defined in TS 36.331 [8] which is the same as PLTE in TS 38.213 [10];- ∆tC\_EUTRA, c = 1.5 dB when NOTE 2 in Table 6.2.2-1 of TS 36.101 [4] applies; ∆tC\_EUTRA, c = 0 dB otherwise; |

So, we suggest to send an LS to RAN4 to inform two new parameters introduced in RAN2. The drafted LS can be found in [3].

Now, companies are invited to provides their comments for the draft LS out [3].

**Q1: Do you agree to send an LS to RAN4 to inform two new parameters introduced in RAN2, and do you have any comments for the drafted LS out [3] if the LS is needed?**

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| **Company** | **Any comments** |
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## 2.2 NR-DC power control mode indication

Two semi-static power sharing and dynamic power sharing defined by RAN1 are as follows.

* Semi-static power sharing:

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| In RAN1#98, it was agreed to consider the following two alternatives for semi-static power sharing with $P\_{MCG}+P\_{SCG}\leq P\_{Total}^{NN-DC}$:* Alt.1: For the UL transmission in MCG, the UE checks the semi-statically configured direction of the overlapping symbols of all serving cells of SCG, and vice versa.
	+ If such overlapping with UL transmission on the SCG is possible (i.e. collides with semi-static ‘UL’ and ‘flexible’ symbols on some CCs of SCG), UE limits its actual transmission power $p\_{MCG}$ in MCG such that $p\_{MCG}\leq P\_{MCG}$;

* + Otherwise (i.e. collides with only semi-static ‘DL’ symbols on all CCs of SCG), $p\_{MCG}$ can be up to $P\_{MCG}^{'}$ and $p\_{SCG}$ can be up to $P\_{SCG}^{'}$.
		- Alt.1-1: $P\_{MCG}^{'}$ and $P\_{SCG}^{'}$ are configured by RRC signalling.
		- Alt.1-2: $P\_{MCG}^{'}$ and $P\_{SCG}^{'}$ are determined by RAN4 requirement.
* Alt.2: For the uplink transmission in MCG and in SCG, UE limits its actual transmission power $p\_{MCG}$ to be up to$ P\_{MCG} $and $p\_{SCG}$ to be up to $P\_{SCG}$.
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* Dynamic power sharing:

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| * For NR-DC dynamic power sharing, to compute the transmit power for SCG UL transmission starting at time T0,
* UE checks for PDCCH(s) received before time T0-T\_offset that trigger an overlapping MCG UL transmission, and
	+ If such PDCCH(s) are detected, UE sets it’s transmit power in SCG (pwr\_SCG) such that pwr\_SCG <=min{PSCG, Ptotal– MCG tx power} where ‘MCG tx power’ is the actual transmission power of MCG
	+ Otherwise, pwr\_SCG <= Ptotal;
* UE does not expect to be scheduled by PDCCH(s) received on MCG after T0-[T\_offset] that trigger(s) MCG UL transmission(s) that overlaps with the SCG transmission.
	+ (working assumption) No new RRC signaling is introduced for T\_offset:
		- Alt.1: T\_offset <= T\_proc,2
		- Alt.2: T\_offset <= 2\*T\_proc,2
		- Alt.3: T\_offset reasonbly larger than Alt 1. & Alt 2 but <=4ms
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In RAN1#99 meeting, *NR-DC-PC-mode* is introduced in the IE *PhysicalCellGroupConfig* to indicated UE which mode is selected.

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| LTE\_NR\_DC\_CA\_enh-Core | NR-DC | PhysicalCellGroupConfig | NR-DC-PC-mode | New | Selects the uplink power control mode to use for NR-DC. |

According to the above agreements, UE behaviour is clear, i.e., UE adjusts its transmit power as the way defined for different power control modes. And in the email discussion [1], all companies agreed that it is MN to decide the power control mode.However, whether *NR-DC-PC-mode* needs to be indicated to the SN should be further discussed.

In this RAN2#109e meeting, 3 companies support that *NR-DC-PC-mode* is indicated to the SN [2][4][5], and 1 company does not support [6]. The main argument why the companies support is:

Since thatdifference from EN-DC power control, it is possible that $P\_{MCG}+P\_{SCG}\leq P\_{Total}^{NN-DC}$when dynamic power control is set by MN in NR-DC power control. Thus, SN can’t distinguish whether MN sets dynamic or semi-static power sharing via *CG-ConfigInfo.* As a results, SN cannot determine whether SN is allowed to set the max SCG power such that the sum of MCG and SCG power exceeds the total UE max power.

**Q2: Do you think *NR-DC-PC-mode* is indicated to SN by MN?**

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| **Companies** | **Yes or No**  | **Comments** |
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## 2.3 TDD pattern indication

In this RAN2#109e meeting, whether semi-static TDD pattern of MCG should be included in *CG-ConfigInfo* message is discussed in [2]. The main argument is

If semi-static power control solution Alt 1-2 is selected, SCG UL performance can be improved if SN can also know the semi-static TDD pattern of MCG because SN scheduler can take into account when the UE can allocate larger power to SCG transmissions.

**Q3: Do you agree that the TDD pattern of MCG can be indicated to SN?**

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| **Companies** | **Yes or No**  | **Comments** |
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# Summary

1. Reference
2. R2-2000293, Report of email discussion power control for NR-DC, vivo, discussion
3. R2-2000137, Remaining issues of power control in NR-DC, Qualcomm Incorporated, discussion
4. R2-2000294, Draft LS on NR-DC power control, vivo, LS out, To:RAN4, Cc:RAN1
5. R2-2000674, NR DC power control Nokia, Nokia Shanghai Bell, discussion
6. R2-2000872, Remaining issues for NR-DC power control, Ericsson, discussion
7. R2-2001391, NR-DC power control Huawei, HiSilicon, discussion