**3GPP TSG-RAN WG2 Meeting #113bis-e Draft R2-2104314**

**Online, 4 - 12 April, 2021**

**Agenda item:** 6.5.2

**Source:** Huawei, HiSilicon

**Title:** Summary of [AT113b-e][221][DCCA] NR-DC power control signalling (Huawei)

**Document for:** Discussion and Decision

# 1. Introduction

This document attempts to summarize the following offline discussion.

* [AT113b-e][221][DCCA] NR-DC power control signalling (Huawei)

Scope:

* + - Discuss NR-DC PC signalling corrections (for FR2) under R16 DCCA WI marked for this discussion to understand best way forward for RAN2.

 Intended outcome:

* + - Discussion summary in [R2-2104314](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113bis-e/Docs/R2-2104314.zip) (by email rapporteur).
		- Agreeable CRs (if any)

 Deadline for providing comments, for rapporteur inputs, conclusions and CR finalization:

* + - Initial deadline (for company feedback): 1st week Thu, UTC 0900
		- Initial deadline (for rapporteur summary): 1st week Fri, UTC 0900
		- Deadline for CR finalization: 2nd week Tue, UTC 1000

# 2. Discussion

The following contributions are discussing the FR2 NR-DC power control handling in RAN2 based on RAN4 agreements that in Rel-16 *p-UE-FR2* and *p-NR-FR2* will not be introduced by RAN4. See RAN4 LS R4-2103373 and R4-2011721. The proposals or proposed changes are copied here.

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| --- | --- | --- | --- |
|  | [R2-2102874](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_113bis-e%5CDocs%5CR2-2102874.zip) Correction on FR2 NR-DC power control parameter vivo, MediaTek Inc. | draftCR | Adding the same clarification for *p-UE-FR2*, *p-NR-FR2*, *nrdc-PCmode-FR2* defined in RRCReconfiguration, and for *requestedP-MaxFR2*, *nrdc-PC-mode-FR2*, *powerCoordination-FR2* defined in inter-node messages. |
|  | [R2-2103271](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_113bis-e%5CDocs%5CR2-2103271.zip) NR DC power control signaling Nokia, Nokia Shanghai Bell | discussion | Proposal: Capture in the 38.331 that p-UE-FR2 is not used in this version of specification Proposal: Capture in the 38.331 that p-NR-FR2 is not used in this version of specification if not used by RAN1 |
|  | [R2-2103272](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_113bis-e%5CDocs%5CR2-2103272.zip) NR DC power control signaling Nokia, Nokia Shanghai Bell | CR | Capture in the field descriptions of *p-UE-FR2* and *p-NR-FR2* that the field is not used in this version of specification |
|  | [R2-2103806](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_113bis-e%5CDocs%5CR2-2103806.zip) Correction on p-UE-FR2 and p-NR-FR2 for NR-DC power control Ericsson | CR | Add in field descriptions of *p-UE-FR2* and *p-NR-FR2* that “This field is ignored by the UE in this version of the specification”.Remove references to *p-Max*, *p-UE-FR2*, *p-NR-FR2* from the field descriptions of *p-NR-FR2* and *p-UE-FR2*.Add in field descriptions of *nrdc-PC-mode-FR2*, *p-maxNR-FR2-MCG,* *p-maxNR-FR2-SCG* and *powerCoordination-FR2* that “This field is ignored by the receiver in this version of the specification” |
|  | [R2-2104139](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_113bis-e%5CDocs%5CR2-2104139.zip) Clarification on intra-FR2 NR-DC power control Huawei, HiSilicon | discussion | Proposal 1: Send LS to RAN1/RAN4 to ask the following questions:Without *p-UE-FR2* and *P-NR-FR2* configured to the UE:* Whether the UE can support the power sharing for intra-FR2 NR-DC.
* Furthermore, if there is no power sharing supported whether the intra-FR2 NR-DC can be considered as supported in Rel-16

Proposal 2: RAN2 specifications should be updated based on RAN1 and RAN4 further confirmation on support of intra-FR2 NR-DC power control. |

Basically, company’s views are from 3 aspects:

Issue 1. Which RAN2 parameters are affected?

Issue 2. How to handle the affected RAN2 parameters.

Issue 3. Whether the RAN1 defined FR2 NR-DC power sharing modes (i.e. semi-static mode1, semi-static mode2 and dynamic) are supported? Furthermore if not, whether FR2 NR-DC could be supported.

From rapporteur’s point of view, it makes more sense that RAN2 can discuss issue 3 first and have a general RAN2 understanding on the issue before looking into the detailed corrections on specifications. In addition, the conclusions on issue 3 could also affect RAN2 parameters and UE capabilities. Nevertheless, in this offline we can still try to collect company’s views on issue 1 and issue 2 in parallel, in case any CR is possible.

## 2.1 Issue 3: support of intra-FR2 NR-DC power sharing and intra-FR2 NR-DC

As discussed in [5], according to the description in TS 38.213 clause 7.6.2, RRC parameter *p-NR-FR2* is used for the maximum transmission power determination for MCG and SCG in case of intra-FR2 NR-DC. All the RAN1 defined 3 power control modes (i.e. semi-static mode1, semi-static mode2 and dynamic power sharing) need to use this parameter. To be specific, the RRC parameter is used for a UE to determine whether it is an invalid transmission power configuration under semi-static mode1/ semi-static mode2. For semi-static mode2 and dynamic power sharing, this RRC parameter is used to determine when the actual maximum transmission power for SCG and MCG needs the adaptive power reduction. See highlighted part in Annex.

Then the rapporteur observes there is a misalignment between RAN4 agreements and RAN1 specification on the FR2 NR-DC power sharing mechanisms, and without the RRC parameter *p-NR-FR2* the semi-static mode1, semi-static mode2 and dynamic power sharing do not work.

**Observation 1: Without the RRC parameter *p-NR-FR2* the current RAN1 defined semi-static mode1, semi-static mode2 and dynamic power sharing do not work for intra-FR2 NR-DC.**

**Q1: Do companies agree the above observation 1?**

|  |  |  |
| --- | --- | --- |
| Company | Agree(Yes/No) | Comments |
| Nokia | - | This seems like something that belongs to RAN1 domain so RAN2 should not speculate on that. |
| Qualcomm  | - | Totally agree with Nokia. In RAN4 LS (R4-2011721), it is clear that action of RAN2 is just to clarify the related IEs are not used in this release. With regarding to whether RAN1 specified solutions works or not, it is RAN1’s issue. RAN2 don’t need to guide RAN1 on RAN1 specified solutions. |
| Huawei | Yes | We agree whether power sharing modes are supported or not should be decided by RAN1. We just want to remind of the possible results if RAN2 removes the existing parameter p-NR-FR2. And this is also related to the RRC parameter *nrdc-PCmode-FR2* and UE capabilities *intraFR-NR-DC-PwrSharingMode1, intraFR-NR-DC-PwrSharingMode2, intraFR-NR-DC-DynamicPwrSharing* in Q4. |
| vivo | - | RAN4 has indicated in LS R4-2103373 that they would not use P-NR-FR2 in Rel-16. The LS was also sent to RAN1. So, RAN1 will correct their specification accordingly. RAN2 can just follow RAN4 LS to add the corresponding clarification for the related NR-DC FR2 power control parameters. It would be better RAN2 to wait RAN1 conclusion in this meeting. |
| ZTE | - | We also prefer to wait for RAN1’s inputs.  |
| Samsung | - | We have some sympathy with Rapp’s intention but we can wait for RAN1 progress for now. |
| Ericsson | - | At least semi-static power control will probably not work for FR2 without p-NR-FR2, since it is used to share the power between MCG and SCG, but we agree with above companies to wait for RAN1. |

Furthermore, [5] also pointed out if the RAN1 defined PC modes cannot be supported it would affect the current understanding on the support of intra-FR2 NR-DC from UE capability perspective. As indicated in TS 38.306, the semi-static power sharing mode 1 is a basic UE capability of intra-FR NR-DC, without reporting this capability means intra-FR NR-DC is not supported.

| ***intraFR-NR-DC-PwrSharingMode1-r16***Indicates whether the UE supports intra-FR NR DC with semi-static power sharing mode1 between MCG and SCG cells of same frequency range 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 |
| --- | --- | --- | --- | --- |

**Observation 2: Without the support of semi-static power sharing mode1 on FR2, intra-FR2 NR-DC is considered not supported according to current TS 38.306.**

**Q2: Do companies agree the above observation 2?**

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| --- | --- | --- |
| Company | Agree(Yes/No) | Comments |
| Nokia |  | This seems like something that belongs to RAN1 domain so RAN2 should not speculate on that. |
| Qualcomm  | - | Agree with Nokia. In RAN4 LS (R4-2011721), it is clear that action of RAN2 is just to clarify the related IEs are not used in this release. With regarding to whether RAN1 specified solutions works or not, it is RAN1’s issue. RAN2 don’t need to guide RAN1 on RAN1 specified solutions.We suggest RAN2 to wait RAN1 input. |
| Huawei | Yes | This is clearly according to what captured in RAN2 specification.  |
| vivo | No | Since FR2 NR-DC semi-static power sharing mode1 is not supported in Rel-16, UE can report this capability to indicate that the UE supports intra-FR NR-DC. Then the NW will know the UE supports intra-FR NR-DC but will not to configure the UE with FR2 NR-DC power sharing.  |
| ZTE | - | We think this will also be discussed in RAN1. So we can wait for their conclusion.  |
| Samsung | - | As vivo mentioned, Observation 2 may not be acceptable. RAN1 can discuss this. We can focus on RAN2 issues based on RAN4 LS. |
| Ericsson | - | If UE does not indicate intraFR-NR-DC-PwrSharingMode1-r16 for a BC, it means that intra-FR NR-DC is not supported for that BC. However, this capability is per BC, there is no FR1/FR2 separation. So, a UE supporting intra-FR1 power sharing for NR-DC would set this to supported. If it does not support intra-FR2 power sharing for that BC then it shall not list intra-FR2 NR-DC cell grouping for that BC. Thus, in practice we tend to agree with observation 2, but we also agree with other companies that we should wait for RAN1 conclusion on this.  |

It is proposed by [5] to send LS to RAN1 and RAN4 about if power sharing and intra-FR2 NR-DC could be supported in Rel-16. The rapporteur thinks RAN4 and RAN1 should be aware of RAN2 understanding on the above observations, so that they can do further coordination on NR-DC power control on FR2. Note from RAN4 or RAN1 perspective, they may also develop other solutions to support NR-DC power control on FR2.

**Q3: Do companies agree to send LS to RAN4 and RAN1 asking if NR-DC power sharing on FR2 and intra-FR2 NR-DC can be supported in Rel-16?**

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| --- | --- | --- |
| Company | Agree(Yes/No) | Comments |
| Nokia | No | We can wait RAN1 conclusion hopefully coming soon during this meeting |
| Qualcomm  | No | We suggest RAN2 to wait RAN1 input. RAN2 don’t need to guide RAN1 on RAN1 specified solutions. |
| Huawei | Yes | We are fine to wait and see if RAN1 will send LS in this meeting to answer these questions. But if RAN1 cannot, RAN2 needs to send LS to check RAN1 and RAN4 views, otherwise RAN2 spec impact on power sharing modes related UE capabilities and RRC parameters is still not clear. |
| vivo | No | RAN2 can wait RAN1 conclusion. |
| ZTE | No | No LS is needed because RAN1 is aware of this issue.  |
| Samsung | No | We can wait for RAN1 progress.  |
| Ericsson | No | RAN1 also received the LS from RAN4 and will discuss this, so no need for LS. |

## 2.2 Issue 1: RAN2 spec impact

The following parameters are proposed to be corrected:

* ***p-UE-FR2, p-NR-FR2 [1][2][3][4][5]***
* ***p-maxUE-FR2 [4][5]***
* ***p-maxNR-FR2-MCG, p-maxNR-FR2-SCG, nrdc-PCmode-FR2, requestedP-MaxFR2, powerCoordination-FR2 [1][4][5]***

In addition, the rapporteurs thinks the UE capability of ***intraFR-NR-DC-PwrSharingMode1, intraFR-NR-DC-PwrSharingMode2, intraFR-NR-DC-DynamicPwrSharing***may be affected as well according to observation 1.

**Q4: Do companies agree the above RRC parameters and UE capabilities needs to be updated (in TS 38.331 and TS 38.306) by RAN2 if RAN1/RAN4 confirm no support of intra-FR2 NR-DC power sharing?**

|  |  |  |
| --- | --- | --- |
| Company | Agree(Yes/No) | Comments |
| Nokia | Yes | Inter-Node signaling in addition to Uu signaling parameters need to be updated. Regarding 38.306 – most likely also capabilities need to be updated |
| Qualcomm  | Yes | For RRC parameters, it is per RAN4 LS indicated. For capability, we suggest RAN2 to wait RAN1 input  |
| Huawei | FFS | It is likely all the parameters and UE capabilities need update, however without RAN1/RAN4 further input, RAN2 cannot make decisions on *nrdc-PCmode-FR2* and *intraFR-NR-DC-PwrSharingMode1, intraFR-NR-DC-PwrSharingMode2, intraFR-NR-DC-DynamicPwrSharing.* |
| vivo | No for UE capabilities | We are not clear whether the UE capabilities need to be updated. |
| ZTE | Yes | For RRC parameters, at least field description should be updated. For UE capabilities, we need to check if any change is needed. At least for following capabilities, seems the wording is ok because only general word “intra-FR” is used.

| ***intraFR-NR-DC-PwrSharingMode1-r16***Indicates whether the UE supports intra-FR NR DC with semi-static power sharing mode1 between MCG and SCG cells of same frequency range as defined in TS 38.213 [11]. If this field is absent, the UE does not support intra-FR NR DC.  |
| --- |
| ***intraFR-NR-DC-PwrSharingMode2-r16***Indicates whether the UE supports semi-static power sharing mode2 between MCG and SCG cells of same frequency range 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.* |
| ***intraFR-NR-DC-DynamicPwrSharing-r16***Indicates the UE support of dynamic power sharing for intra-FR NR DC between MCG and SCG cells of same frequency range 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.* |

 |
| Samsung | Yes | Yes for RRC parameters. For UE capabilities, we can wait for RAN1 progress.  |
| Ericsson | Yes | But it is not clear what updates would be required for the UE capability? |

## 2.3 Issue 2: How to handle the affected RAN2 RRC parameters and UE capabilities

In [1][2], it is propose to use the description that “This field is not used in this version of specification” which was agreed in RAN2 previous meeting. In [4], it is proposed to use “This field is ignored by the UE/receiver in this version of the specification”. The rapporteur understand the way of dummifying is excluded when RAN2 discussed the handling of p-UE-FR2, however considering there are more parameters affected than expected, maybe the dummifying can be still on-table.

**Q5: which options do companies prefer to handle the affected RAN2 RRC parameters and UE capabilities?**

Option1: adding “This field is not used in this version of specification” to the description of the affected parameter or capability.

Option2: adding “This field is ignored by the UE/receiver in this version of the specification” to the description of the affected parameter.

Option3: dummifying the affected parameter or UE capability.

|  |  |  |
| --- | --- | --- |
| Company | Option1/ Option2/ Option3 | Comments |
| Nokia | Option 2  | Either option would be fine. Essentially they mean the same. Dummifying has been already agreed not to be used for p-UE-FR2 and thus we do not consider dummifying to be option for other parameters either. |
| Qualcomm | Option 1 | Option 1 is exactly what RAN4 LS told RAN2. For option 2, because RAN4 has clearly indicated these IEs are not used in this release, we don’t understand how NW can send an IE not used in this release, and RAN2 needs to specify a UE requirement (i.e. ignore the useless IE) if network can avoid sending it. |
| Huawei | Option 1 or Option 3 |  |
| vivo | Option 1 |  |
| ZTE | Option 1 and/or Option 2 | Whether to use “Option 2” depends on whether the field is defined as cell-specific or UE-specific. Please refer to the discussion on [R2-2100765](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2//TSGR2_113-e/Docs//R2-2100765.zip) in last RAN2 meeting.  |
| Samsung | Option 1 | Regarding Option 2, we think it would be preferable to indicate that sender does not signal, at least for Uu signaling (so there is no need for UE to ignore). |
| Ericsson  | Option 2 | We prefer option 2, since it ensures there are no interoperability issues with earlier release UEs if intra-FR2 power sharing is later taken into use. As discussed during offline [AT112-e][225] we should use same formulation as is used for p-Max in FrequencyInfoUL. In RAN2#113e, the following formulation was agreed for p-Max: *In this release of the specification, if p-Max is present on a carrier frequency in FR2, the UE shall ignore the field and applies the maximum power according to TS 38.101-2 [39].* |

## 2.4 Any issues else?

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| Company | Comments |
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# 3. Conclusion

TBD…

4. Contact information

|  |  |
| --- | --- |
| Company | Email |
| Huawei | wangrui46@huawei.com |
| vivo | wenjuan.pu@vivo.com |
| ZTE | liu.jing30@zte.com.cn |
| Samsung | s\_dg.kim@samsung.com |

Annex TS 38.213

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 $P\_{MCG}$ for transmissions on the MCG by *p-NR-FR1* and/or by *p-NR-FR2* and a maximum power $P\_{SCG}$ for transmissions on the SCG by *p-NR-FR1* and/or by *p-NR-FR2* and with an inter-CG power sharing mode by *nrdc-PCmode-FR1* for FR1 and/or by *nrdc-PCmode-FR2* 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* or for *nrdc-PCmode-FR2*,or *semi-static-mode2* for *nrdc-PCmode-FR1* or for *nrdc-PCmode-FR2*, the UE does not expect $P\_{MCG}$ and $P\_{SCG}$ to be configured such that $\hat{P}\_{MCG}+\hat{P}\_{SCG}>\hat{P}\_{Total}^{NR-DC}$, where $\hat{P}\_{MCG}$ is the linear value of $P\_{MCG}$, $\hat{P}\_{SCG}$ is the linear value of $P\_{SCG}$, and $\hat{P}\_{Total}^{NR-DC}$ 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].

If a UE is provided *semi-static-mode1* for *nrdc-PCmode-FR1* or for *nrdc-PCmode-FR2*, the UE determines a transmission power for the MCG or for the SCG as described in Clauses 7.1 through 7.5 using $P\_{MCG}$ or $P\_{SCG}$ as the maximum transmission power, respectively.

If a UE is provided *semi-static-mode2* for *nrdc-PCmode-FR1* or for *nrdc-PCmode-FR2*

- if the UE is not provided *tdd-UL-DL-ConfigurationCommon* for the MCG or SCG, the UE determines a transmission power for the MCG or for the SCG as described in Clauses 7.1 through 7.5 using $P\_{SCG}$ or $P\_{MCG}$ as the maximum transmission power, respectively

- if at least one symbol of slot $i\_{1}$ 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 $i\_{2}$ 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 $i\_{2}$ as described in Clauses 7.1 through 7.5 using $P\_{SCG}$ or $P\_{MCG}$, respectively, as the maximum transmission power

- otherwise, the UE determines a power for the transmission on MCG or the SCG overlapping with slot $i\_{2}$, as described in [8-3, TS 38.101-3] and in Clauses 7.1 through 7.5 without considering $P\_{MCG}$ or $P\_{SCG}$, respectively

The UE expects to be provided *semi-static-mode2* for *nrdc-PCmode-FR1* or for *nrdc-PCmode-FR2* only for synchronous NR-DC operation [10, TS 38.133].

If a UE

- is provided *dynamic* for *nrdc-PCmode-FR1* or for *nrdc-PCmode-FR2*, and

- indicates a capability to support dynamic power sharing for intra-FR NR DC,

the UE determines a maximum transmission power on the SCG at a first symbol of a transmission occasion on the SCG by determining transmissions on the MCG that

- are scheduled by DCI formats in PDCCH receptions with a last symbol that is earlier by at least $T\_{offset}$ from the first symbol of the transmission occasion on the SCG, or are configured by higher layers, and

- overlap with the transmission occasion on the SCG

the maximum transmission power on the SCG is determined as

- $min\left(\hat{P}\_{SCG},\hat{P}\_{Total}^{NR-DC}- \hat{P}\_{MCG}^{actual}\right)$, if the UE determines transmissions on the MCG with a $\hat{P}\_{MCG}^{actual}$ total power

- $\hat{P}\_{Total}^{NR-DC}$, if the UE does not determine any transmissions on the MCG

where

- $T\_{offset}=max⁡\{T\_{proc,MCG}^{max},T\_{proc,SCG}^{max}\}$,

- $T\_{proc,MCG}^{max}$ and $T\_{proc,SCG}^{max}$ is the maximum of $T\_{proc,2}$, $T\_{proc,CSI}$, $T\_{proc,release}^{mux}$, $T\_{proc,2}^{mux}$, and $T\_{proc,CSI}^{mux}$based on the configurations on the MCG and the SCG, respectively, when the UE indicates the value of 'long' for the capability,

- $T\_{proc,MCG}^{max}$ and $T\_{proc,SCG}^{max}$ is the maximum of $T\_{proc,2}$, $T\_{proc,release}^{mux}$, $T\_{proc,2}^{mux}$based on the configurations on the MCG and the SCG, respectively, when the UE indicates the value of 'short' for the capability, and

- $\hat{P}\_{MCG}^{actual}$ is the total power for the transmissions on the MCG that overlap with the transmission occasion on the SCG where $\hat{P}\_{MCG}^{actual}$ is determined based on transmissions configured by higher layers and on transmissions scheduled by DCI formats in PDCCH receptions with a last symbol that is at least $T\_{offset}$ before the first symbol of the transmission occasion on the SCG.

The UE does not expect to have PUSCH, PUCCH, PRACH, or SRS transmissions on the MCG that

- are scheduled/triggered by DCI formats in PDCCH receptions with a last symbol that is earlier by less than $T\_{offset}$ from the first symbol of the transmission occasion on the SCG, and

- overlap with the transmission occasion on the SCG

The UE does not expect to receive a positive TPC command value in a DCI format 2\_2 or a DCI format 2\_3 in a PDCCH reception with a last symbol that is less than $T\_{offset}$ before the first symbol of the transmission occasion on the SCG, if the transmission on the MCG overlaps with the transmission occasion on the SCG.

The UE is not required to apply a TPC command the UE receives in a DCI format 2\_2 or a DCI format 2\_3 in a PDCCH reception with a last symbol that is less than $T\_{offset}$ before the first symbol of the transmission occasion on the SCG, if the transmission on the MCG overlaps with the transmission occasion on the SCG.