3GPP TSG-RAN WG2 #113-e R2-2101980

eMeeting, 25th Jan – 5th Feb, 2021

Agenda Item: 6.8.3

Source: MediaTek Inc.

**Title: Report of e-mail discussion [AT113-e][223][DCCA]**

Document for: Discussion and decision

# 1 Introduction

This is report for the following AT113-e mail discussion.

* [AT113-e][223][DCCA] Asynchronous and synchronous NR-DC cell grouping (MediaTek)

Scope:

* + - Attempt to resolve NR-DC cell grouping **at least** for asynchronous NR-DC. Can try also to consider the synchronous NR-DC, but if it doesn't progress well, it may be postponed to next meeting
    - Discuss contributions related to all 3 alternatives.

Intended outcome:

* + - Discussion summary in [R2-2101980](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_113-e/Docs/R2-2101980.zip) (by email rapporteur).

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

* + - Initial deadline (for companies' feedback): 2nd week Thu, UTC 0100
    - Initial deadline (for rapporteur's summary): 2nd week Thu, UTC 1700

# 2 Contact Points

Respondents to the email discussion are kindly asked to fill in the following table.

|  |  |  |
| --- | --- | --- |
| Company | Name | Email Address |
| Apple | Naveen Palle | naveen.palle@apple.com |
| Ericsson | Stefan Wager | stefan.wager@ericsson.com |
| Huawei, HiSilicon | Rui Wang | wangrui46@huawei.com |
| ZTE | LiuJing | liu.jing30@zte.com.cn |
| MediaTek | Felix Tsai | chun-fan.tsai@mediatek.com |
| Nokia | Jarkko Koskela | Jarkko.t.koskela@nokia.com |
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# 3 Discussion on NR-DC Cell Group

## 3.1 Cell Group capability for asynchronous NR-DC

### 3.1.1 Agreements

The following is current RAN2 agreements related to the cell group capability of **asynchronous** NR-DC.

RAN2#111e

* For async NR-DC, introduce 1-bit indication on whether Rel-16 UE supports asynchronous operation and its supported cell grouping for a given band combination,

Absence of cell grouping signaling means the UE only support Rel-15 cell grouping (i.e. MCG fully in FR1 and SCG fully in FR2)

Cell grouping is supported, FFS: signaling detail of cell grouping (LTE cell grouping capability can be considered)

MCG and SCG can be differentiated in cell grouping signalling (provided that we can finally agree on a signalling solution) FFS how to signal

### 3.1.2 Solutions

The need for asynchronous NR-DC cell grouping capability has been concluded in both RAN1 and RAN2. In addition, RAN2 also agreed to have MCG and SCG differentiation for cell group signalling. The only leftover issue is the detail ASN.1 define for this asynchronous NR-DC capability.

In RAN2#113e, there are basically two different proposal on how to define the asynchronous NR-DC cell group capability.

* **Option 1** – LTE DC Style with MCG/SCG differentiation [2][3]
* **Option 2** – Network filtering [4]

Further option are not precluded, but companies are invited to provide more information on new proposals (if any).

In [4], it is further pointed out that the PUCCH group style could also be used. And it is proposed to wait implementation of FG 22-7 on PUCCH grouping before deciding the NR-DC cell group signalling. The rapporteur understand there is no company really propose to use PUCCH group style for asynchronous NR-DC. Therefore, we could check whether companies think RAN2 should wait more details on PUCCH group capability before introducing the asynchronous NR-DC cell group capability.

**Question 1: Do companies agree to wait PUCCH group capability (R1 FG 22-7) complete before introducing the asynchronous NR-DC cell group capability?**

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| --- | --- | --- |
| **Company** | **Agree or not** | **Comments** |
| Qualcomm incorporated | Agree | We believe RAN2 has enough information to start discussing PUCCH group capability, and application to NR-DC cell group capability. |
| Apple | No need to wait and no need to link to PUCCH grouping | We agree with rapporteur’s view that there is no purpose to use PUCCH group style for async NR-DC. |
| Ericsson | Agree | We think the PUCCH group capability framework is a candidate also for asynchronous NR-DC cell grouping. If it has the potential to solve the cell grouping for synchronous NR-DC as suggested in the RAN1 LS [6], we don’t see why it could not be applied also to asynchronous NR-DC. The cell group signalling needs to be discussed jointly for async and sync NR-DC. This is why RAN2 in autumn decided to wait for the RAN1/RAN4 input regarding synchronous NR-DC. The RAN4 LS [7] pointed out that “The same cell grouping signaling structure can apply for both synchronous and asynchronous NR-DC for a given band combination”. Thus, if the UE signals a certain cell grouping for BC supporting async NR-DC, it means the same cell grouping would also be supported for sync NR-DC operation on that BC (if we conclude that cell group signalling is needed for synchronous NR-DC). |
| Huawei | No | We also feel there is no need to wait for PUCCH group discussion. Considering it is late stage already, prefer to conclude NR-DC cell group capability soon. |
| ZTE | No | We also prefer not wait for PUCCH grouping discussion, it is better to finish asynchronous NR-DC cell grouping capability as early as possible. |
| MediaTek | No | We see no need to wait PUCCH group capability for this cell group capability. We understand that some company may want to have PUCCH group style for async NR-DC, so we could just discuss this alternative. It is unclear to us what are we waiting.  In addition, we agree with Apple that we should not link PUCCH group with cell group. It is just that we could reuse the “framework” from PUCCH group to cell group. |
| Nokia | Not | Similar to the Rel-15 PUCCH grouping capabilities being independent of whether they were used for CA or for DC, these new capabilities that were originally motivated by CA deployment cases should be applicable as-is also for sync-DC. One could either duplicate the capability to separate CA and DC PUCCH group support, or follow the Rel-15 approach where the PUCCH group support works for both CA and sync DC if the UE supported both.  The RAN1 FFS points should not have relation to the applicability to NR-DC |
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The LTE DC style is originated from R2-2010593 [5]. And both [2] and [3] suggest to adopt option 1 style from [5]. The suggested ASN.1 code and the corresponding table are shown below. Companies are invited to provide their feedback on this option.

CA-ParametersNRDC-v16xy ::= SEQUENCE {

supportedCellGrouping-r16 CHOICE {

threeEntries-r16 BIT STRING (SIZE(6)),

fourEntries-r16 BIT STRING (SIZE(14)),

fiveEntries-r16 BIT STRING (SIZE(30))

} OPTIONAL

}

|  |  |  |  |
| --- | --- | --- | --- |
| Nr of Band Entries: | 5 | 4 | 3 |
| Length of Bit-String: | 30 | 14 | 6 |
| Bit String Position | Cell grouping option (0= master cell group, 1= secondary cell group) | | |
| 1 | 00001 | 0001 | 001 |
| 2 | 00010 | 0010 | 010 |
| 3 | 00011 | 0011 | 011 |
| 4 | 00100 | 0100 | 110 |
| 5 | 00101 | 0101 | 101 |
| 6 | 00110 | 0110 | 100 |
| 7 | 00111 | 0111 |  |
| 8 | 01000 | 1110 |  |
| 9 | 01001 | 1101 |  |
| 10 | 01010 | 1100 |  |
| 11 | 01011 | 1011 |  |
| 12 | 01100 | 1010 |  |
| 13 | 01101 | 1001 |  |
| 14 | 01110 | 1000 |  |
| 15 | 01111 |  |  |
| 16 | 11110 |  |  |
| 17 | 11101 |  |  |
| 18 | 11100 |  |  |
| 19 | 11011 |  |  |
| 20 | 11010 |  |  |
| 21 | 11001 |  |  |
| 22 | 11000 |  |  |
| 23 | 10111 |  |  |
| 24 | 10110 |  |  |
| 25 | 10101 |  |  |
| 26 | 10100 |  |  |
| 27 | 10011 |  |  |
| 28 | 10010 |  |  |
| 29 | 10001 |  |  |
| 30 | 10000 |  |  |

**Question 2: Do companies have further questions/comments on the option 1 (LTE-DC Style)?**

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| **Company** | **Comments** |
| Qualcomm Incorporated | We initially liked this solution, but now think it may not be scalable enough.  Looking at band combinations defined in RAN4 specification, more than 10 non-contiguous (NC) blocks are becoming normal. For NR-DC band combination in particular, they already have a band combination with 5 NC blocks.  Let’s say we try to be future proof and to support up to 8 NC blocks, we will need 254-bit bit-string per band combination to be able to signal all possible cell groupings. |
| Apple | We already sent an LS to RAN4 on the preference of using LTE- style where the 5-band limitation is present. There was no concern from RAN4. Regarding the comment from Qualcomm about 10 NC, e think that inter-band NR-DC would still be limited to <5 bands, while the sub-blocks within the bands might be more. It is also our view that doing Async DC with intra-band is not very practical, and so the sub-blocks would be part of 1 CG itself.  We think that Async DC is important to not delay the signaling. |
| Ericsson | We agree with Qualcomm that the problem with the LTE style cell group signalling is the overhead. Even though RAN4 did not raise any concern at the moment, as Qualcomm pointed out the possibility to need an async NR-DC signaling for more than 5 band entries is not impossible, and it is RAN2 responsibility to design a signaling which is future proof enough and can account for that.  With explicit MCG/SCG indication, the overhead becomes even double to that of LTE, which was already high. This will severely increase the signalling overhead in capability signalling, since UE may report hundreds of BCs. The price for the high granularity provided is too high. The question is whether this high granularity is really needed, or a coarser grouping as in the PUCCH grouping capability could be used? |
| Huawei, HiSilicon | We share the similar view with Apple. In the LS R2-2006030 RAN2 sending to RAN1/RAN4 in R2 #111e meeting, RAN2 indicated the NR-DC cell grouping signalling is to be restricted to the BC with up to 5 bands, while for the BC with more than 5 bands UE cannot report cell grouping capability, and check views with RAN1 and RAN4. No concern was raised by RAN1 and RAN4 in their response LSs. Even though we have the sympathy on the future proof consideration, for the time being there seems no better choice than the LTE style signalling structure. In addition, we would like to remind that RAN4 response LS actually suggests to use LTE style signalling for both asyc NR-DC and sync NR-DC. |
| ZTE | We share the same view as Apple and Huawei, RAN1/RAN4 haven’t raised their concern on the limitation of 5 bands, so it is ok to consider up to 5 bands for now, and LTE style can be reused. |
| MediaTek | We understand there is concern on size and extensible of option 1. But it seems that both RAN1 and RAN4 could accept the 5 band limitation for now. So, we have similar view as Apple and Huawei, at least the solution could work. We know there is limitation for this would be an acceptable solution. |
| Nokia | We share the view from Apple |
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In [4], the filtering method is proposed with the following illustration. Companies are invited to provide their feedback on this option.

The network could indicate to the UE in the filtered capability request how it intends to group the requested bands into MCG and SCG. For instance, a network deploying bands n3, n7 and n78 as MCG and band n260 as SCG could include the following field in *UECapabilityEnquire*:

requestedCellGrouping    SEQUENCE {

    MCG                                {n3, n7, n78} - List of bands that the network considers for MCG

    SCG                                {n260} - List of bands that the network considers for SCG

In the above example the explicit cell grouping in terms of MCG and SCG is used, but it could also use the same cell group type agnostic signalling as used in LTE, in which case the first cell group could be called cellGroup1 corresponding to MCG or SCG and the second cell group could be called cellGroup2 corresponding to SCG or MCG, respectively, see example in the frame below. Note that this is not the same as signalling band combinations in the *UECapabilityEnquire*. It is merely one list of bands for MCG and one list for SCG. Upon receiving the *UECapabilityEnquire*, the UE would then report NR-DC support only for band combinations for which it supports the requested cell grouping.

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| **Example:**  A UE supports all bands n3, n7, n78 and n260. But n3 and n7 must be in the same group and n78 and n260 must be in the same group.  {n3, n7}  {n78, n260}  If the network sends:  requestedCellGrouping    SEQUENCE {      cellGroup1                                {n3, n7, n78}      cellGroup2                                {n260}  The UE responds by indicating that it supports DC only for the band combinations where n3, n7 and n260 are present. But since the NW intends to put n78 in the "wrong" group the UE does not include it in any band combination for which DC support is indicated.  If the network sends:  requestedCellGrouping    SEQUENCE {      cellGroup1                                {n3, n78}      cellGroup2                                {n7, n260}  The UE responds by indicating that it supports DC only for the band combinations where n3 and n260 are present, and for band combinations where n7 and n78 are present. But the UE will not indicate that it supports DC between n3 and n78 or between n7 and n260, since the UE requires them to be in different groups, but the NW intends to put them in the same group. |

**Question 3: Do companies have further questions/comments on the option 2 (Network filtering)?**

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| **Company** | **Comments** |
| Qualcomm Incorporated | We like this solution, but have some concerns about scalability as commented previously.   * Can it be done by signalling several sets of (not like 10s of) band combination from the network side? * Can we expect frequent re-enquiries of UE capability won’t happen with this solution?   We should conclude on this solution one way or another in this meeting. |
| Apple | We think this can be revisited if at all we have at address >5 band Async DC. Even there, we have similar concerns as Qualcomm on the scalability. For now the LTE-style with MCG/SCG differentiation is good. |
| Ericsson | As mentioned in our contribution, compared to the LTE-DC approach, network filtering has the potential to:   * reduce signalling overhead per signalled band combination in the UE capability information. * reduce the number of band combinations reported by the UE, since UE would only report BCs network is interested in. * reduce network processing for parsing the UE capabilities.   Regarding scalability we believe network filtering solution provides better scalability compared to LTE-DC approach, which is limited to max 5 bands per BC. We don’t expect that a network would support 10s of different NR-DC configurations in terms of supported bands in different areas. What could potentially also be considered would be to apply some grouping as in the PUCCH grouping framework also in the network filtering solution. |
| Huawei, HiSilicon | The solution is not crystal clear. For instance, whether network can only send one filter with one cell grouping option? If so, it is not reasonable assuming network only support one cell grouping option in a large area. If not, how network requests more than one cell grouping options. Furthermore, from specification perspective, if multiple options can be request, the signalling overhead may not be reduced at all, as the UE still needs to indicate which option(s) it supports anyway.  In short, we think LTE style with MCG/SCG differentiation is straightforward and the signalling overhead is acceptable. |
| ZTE | Similar view as Apple, we can discuss this proposal later. In our understanding it can be considered as enhancement to LTE-style. |
| MediaTek | We agree that this solution is more scalable but would like to discuss this if we have to extend the capability to support more than 5 bands. Unfortunately this solution come up late after Rel-16 ASN.1 freeze and there are still too much details to discuss. We also wonder whether there would be lots of clarification CR later on for this two array filtering. |
| Nokia | We share the view Huawei |
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**Question 4: Which option(s) does company prefer to use for asynchronous NR-DC cell group capability?**

* **Option 1 – LTE DC Style with MCG/SCG differentiation [2][3]**
* **Option 2 – Network filtering [4]**
* **Others – please specify**

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| --- | --- | --- |
| **Company** | **Prefer Option** | **Comments** |
| Qualcomm Incorporated | Option 1 , Other | We think RAN2 should conclude if option 1 is a viable solution.  If not, we prefer PUCCH group type signalling because we believe it can come with less overhead than option 1 (see our comment in Q2).  In case of PUCCH group type signalling, there are 7 combinations of xDD-FRx mapping for each CG (=C(3,1) + C(3,2) + C(3,3)). So possible combinations are 49 (MCG x SCG). This means 49-bit bit-string per band combination. |
| Apple | Option 1 |  |
| Ericsson | Option 2, but | As mentioned in Q1 we think also the PUCCH grouping framework needs to be taken into the equation, so we should not decide this without a proper comparison of the alternatives. It would be a mistake that could prove costly in the future. |
| Huawei, HiSilicon | Option 1 |  |
| ZTE | Option 1 |  |
| MediaTek | Option 1 | We don’t want to delay the Rel-16 capability signalling furthermore. Option 1 is not prefect but acceptable. |
| Nokia | Option 1 |  |
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## 3.2 Cell Group capability for synchronous NR-DC

### 3.2.1 Agreements

The following is current RAN2 agreements related to the cell group capability of **synchronous** NR-DC.

RAN2#111e

* [021] RAN2 intends to introduce a releasre-16 UE capability for sync-DC (can be 1 bit, cell grouping or else) in a future meeting. Absence of such UE capability parameter means the UE supports release-15 cell grouping only (i.e. FR1 MCG + FR2 SCG)
* For sync NR-DC:

Confirm that Rel-16 UE shall support Rel-15 grouping (i.e. MCG fully in FR1 and SCG fully in FR2), for backward compatibility with Rel-15 network. No new signaling is required to be introduced.

RAN2#112e

**Agreements**

* 3 Await input from RAN1/RAN4 on cell grouping for synchronous NR-DC before deciding the RAN2 signalling.

RAN2#113e

**Agreement**

2 **For a Rel-16 UE supporting only synchronous NR-DC, absence of possible future cell grouping indication means that it only supports FR1-FR2 NR-DC (with MCG in FR1 and SCG in FR2).**

**3 Intra-FR power sharing capabilities can be used to indicate inter-CG power sharing support for synchronous NR-DC and implicitly whether UE supports intra-FR DC. Hence, no additional bits are needed to indicate this.**

### 3.2.2 Discussion

RAN2 has sent an LS R2-2008662 to RAN1 and RAN4 and asked them on whether NR-DC cell grouping capability for synchronous NR-DC is needed. The reply LS from RAN1 [6] does not provide clear answer on this while the LS from RAN4 [7] clearly indicate that cell group capability of synchronous NR-DC is beneficial. So far there is no solid agreement in RAN2 to have cell group capability for synchronous NR-DC. But it seems that RAN2 at least has intention to define some new capability (maybe just one bit) and so that we can say absent this “capability” implies only FR1-FR2 synchronous NR-DC is supported.

In this meeting, [2] proposed to define cell group capability using the LTE DC style and also one bit to indicate if the cell grouping capability reported for async NR-DC can also apply to sync NR-DC. In [3], it is proposed to use the PUCCH group style for synchronous NR-DC cell group capability.

Since the status to have cell group capability for synchronous NR-DC is a bit clear for now, we would like to check the company’s intention first before discussing the detail solutions. Companies are invited to provide general comment on this issue. Hope that we can establish some common understanding.

**Question 5: Do companies agree to introduce cell group capability also for synchronous NR-DC? (Detail method FFS). Please provide your general view on current proposals and any further comment on this capability.**

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| **Company** | **Agree or not** | **Comments** |
| Qualcomm Incorporated | Agree | We think RAN1 and RAN4 recommendations are clear. We understand some companies do not like it, but let’s not do further back and forth.  Also from our implementation perspective, it is clear that we cannot launch release-16 sync NR-DC without a proper way to indicate supported cell groupings to the network. |
| Apple | Agree | It is clear from our perspective, based on the LS resposnses from RAN1 and RAN4, cell grouping for sync NR-DC is needed. And similar to Qualcomm’s views, we need to agree to doing this in this meeting. We can discuss the details after this. |
| Ericsson | No | As discussed and concluded in email discussion [Post112-e][255] [1], RAN2 needs first solve the open issues in observations 1&2:  [Observation 1 Further study is needed to conclude how to indicate PUCCH grouping support for synchronous NR-DC, either via a combination of FG 22-7 (once implemented) and other capabilities, or by introducing cell grouping signalling.](#_Toc61517247)  [Observation 2 Further study is needed to conclude how to indicate FR2 MCG support for synchronous NR-DC, either via a combination of existing capabilities or by introducing cell grouping signalling.](#_Toc61517247) |
| Huawei, HiSilicon | Agree | We did not see the need in the first place, but considering RAN4 confirmed the need in their LS, we are fine to have it, and prefer to adopt aligned solution with asyn NR-DC. |
| ZTE | Agree | We are fine to follow RAN1/RAN4’s decisions. Regarding the detailed signalling design, we are ok to discuss it later. |
| MediaTek | Agree | We think that RAN4’s reply is clear. How to signal could be discussed but we should try to progress. |
| Nokia | Agree | Like indicated in earlier comments 22-7 has no relevance to this discussion |
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# 4 Conclusions

Base on the discussion in section 3, we propose the following:

**Proposal 1:**

# 5 References

[1] R2-2101093, “Summary of [Post112-e][255][R16 DCCA] Cell grouping for synchronous NR-DC”, Ericsson

[2] R2-2101694, “NR-DC cell grouping for async and sync NR-DC”, Huawei, HiSilicon

[3] R2-2101799, “Discussion on cell group capability”, MediaTek Inc.

[4] R2-2101091, “Cell grouping for asynchronous NR-DC”, Ericsson

[5] R2-2010593, “MCG and SCG differentiation in asynchronous NR-DC”, Samsung

[6] R1-2009570/R2-2011118, “LS reply on cell-grouping UE capability for synchronous NR-DC”, RAN1

[7] R4-2017847/R2-2100062, “LS response on cell-grouping UE capability for synchronous NR-DC”, RAN4