**3GPP TSG-RAN** **WG2 Meeting #113-e R2-210xxxx**

**Electronic, January 25 – February 5, 2021**

**Source: Qualcomm Incorporated**

**Title: Summary of email discussion [Post113-e][225][DCCA] Asynchronous and synchronous NR-DC cell grouping (Qualcomm)**

**Document for: Decision**

**Agenda Item: 6.8.3**

# Introduction

This document summarizes the following email discussion.

**[Post113-e][225][DCCA] Asynchronous and synchronous NR-DC cell grouping (Qualcomm)**

Scope: Try to technically endorse a CR (for sync and async) illustrating how the signalling could work. Send LS to RAN4 to ask about the band entry vs. frequency band.

Intended outcome: LS to RAN4 and technically endorsed CRs on NR-DC cell grouping (38.331, 38.306)

Deadline: Short

RAN2 in #113e meeting made the following agreements on NR-DC cell grouping UE capability, with a few points for further study.

Agreements

2 RAN2 to take the following working assumption

For asynchronous NR-DC cell group capability, adopt the LTE DC Style with MCG/SCG differentiation. (bitmap limited to same size as in LTE)

FFS if this limit corresponds to frequency band or band entry

3 Introduce cell group capability for synchronous NR-DC with the same signaling structure as cell group capability for asynchronous NR-DC. (bitmap limited to same size as in LTE)

FFS if this is the same bitmap as for async or different bitmap

FFS: allowing the UE to indicate it supports the same cell grouping for both sync and async.

# Discussion

## Band entry or frequency band

In LTE DC style signalling, each bit in the bitmap corresponds to one band entry in the DC band combination. For example, the band combination n2A\_n5A\_n260A\_n260C is considered a band combination with four band entries, i.e. each contiguous band block, n2A, n5A, n260A and n260C, is considered a band entry.

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| [From TS36.331]  ***supportedCellGrouping***  This field indicates for which mapping of serving cells to cell groups (i.e. MCG or SCG) the UE supports asynchronous DC. This field is only present for a band combination with more than two but less than six band entries where the UE supports asynchronous DC. If this field is not present but asynchronous operation is supported, the UE supports all possible mappings of serving cells to cell groups for the band combination. The bitmap size is selected based on the number of entries in the combinations, i.e., in case of three entries, the bitmap corresponding to *threeEntries* is selected and so on.   |  |  |  |  | | --- | --- | --- | --- | | **Nr of Band Entries:** | 5 | 4 | 3 | | **Length of Bit-String:** | 15 | 7 | 3 | | **Bit String Position** | **Cell grouping option (0= first cell group, 1= second cell group)** | | | | 1 | 00001 | 0001 | 001 | | 2 | 00010 | 0010 | 010 | | 3 | 00011 | 0011 | 011 | | 4 | 00100 | 0100 |  | | 5 | 00101 | 0101 |  | | 6 | 00110 | 0110 |  | | 7 | 00111 | 0111 |  | | 8 | 01000 |  |  | | 9 | 01001 |  |  | | 10 | 01010 |  |  | | 11 | 01011 |  |  | | 12 | 01100 |  |  | | 13 | 01101 |  |  | | 14 | 01110 |  |  | | 15 | 01111 |  |  | |

A concern was raised that only 5 band entries as in LTE is too limiting, given the increased number of non-contiguous blocks for FR2, e.g. CA\_n5A-n260(8A) defined in TS38.101-3 which consists of 9 “band entries”.

Another possible solution is that each bit in the bitmap corresponds to one frequency band in the DC band combination. For example, the band combination n2A\_n5A\_n260A\_n260C will require only 3 bits.

* **Option 1:** Each bit in the bitmap corresponds to one band entry in the DC band combination
* **Option 2:** Each bit in the bitmap corresponds to one frequency band in the DC band combination

**Question 1:** Companies are requested to provide their preference.

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| **Company name** | **Option 1 / Option 2** | **Comments** |
| Apple | Option 2 | We do not see option 1 as a second choice as for one, the 5 band entry will not be useful even with current DC combinations and more importantly, we would like to make sure that the RAN4 intentions of having no simultaneous RxTx in TDD band (such as in n260) to avoid severe REFSENS impact from Tx are taken into considerations (which is not possible with option 1). |
| MediaTek | Option 2 | Option 2 basically has less granularity but would be sufficient in our understanding. |
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## Sync vs Async

There seem to be three possible ways to signal cell grouping for sync NR-DC and async NR-DC.

* **Option 1:** Single Bit-String applicable to both sync and async (if *asyncNRDC-r16* is supported)
* **Option 2:** Two independent Bit-String for sync and async

Some concerns were raised for signaling overhead associated with option 2. Option 1 may result in under-reporting of UE capability because the UE must signal “common” capability between sync and async.

**Question 2:** Companies are requested to provide their preference.

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| **Company name** | **Option 1 / Option 2** | **Comments** |
| Apple | Option 2 | Here as well, we do not see option 1 as a second choice due to fundamentally different RF/front-end impact from asynchronous operation compared to synchronous operation. The UE would have to heavily under-report if using just one bit string. But having the option of indicating that same capability can be re-used for the other is one way of reducing the signaling size. |
| MediaTek | Option 2 (with signaling optimization) | It doesn’t make too much sense to force same cell grouping for both sync and async DC, which may result in downgrade of sync NR-DC cell group capability. However, some optimization to reduce sync NR-DC cell group could be considered. As discussed online, we could have one bit to indicate that sync NR-DC supports same cell grouping as async NR-DC. (But still allow UE to report different bit string if necessary). |
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## MCG vs SCG

RAN2 agreed in #111e meeting that MCG and SCG can be differentiated in cell grouping signaling (provided that we can finally agree on a signaling solution). Together with the agreement in #113e meeting “bitmap limited to same size as in LTE”, rapporteur’s understanding is that the length of Bit-String can be extended while the size of bitmap is maintained as follows (extension highlight in green). Value ‘0’ in the bitmap indicates MCG and value ‘1’ indicates SCG.

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

**Question 3:** Companies are requested to comment if they agree to rapporteur’s observation above.

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| **Company name** | **Agree / Disagree** | **Comments** |
| Apple | Agree |  |
| MediaTek | Agree |  |
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# Conclusion

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# Reference

[1]