**3GPP TSG RAN WG2 Meeting #111-e R2-200xxxx
E-Conference, 17th – 28th August 2020**

**Agenda item: 6.1.2**

**Source: Qualcomm Incorporated**

**Title: Summary of Offline discussion#021: UE cap NR-DC (Qualcomm)**

**Document for: Discussion and Decision**

1. Introduction

This is a summary of phase3 offline discussion:

* [AT111-e][021][NR16] UE cap NR-DC (Qualcomm)

 Scope: Treat R2-2006558, R2-2007946, R2-2007605,

 Deadlines: Short UE cap

It was agreed (because latest Chair notes is not available yet, below is rapporteur’s memory):

**=>For *sync NR-DC:***

* **Agree 38.306 CR to capture “The UE shall not report this UE capability from this release” in field description of *sfn-SyncNRDC***
* **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.**

**=> 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:**

* **Cell grouping signaling is supported. FFS: signaling detail of cell grouping (LTE cell grouping capability can be considered)**
* **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)**
* **MCG and SCG can be differentiated in cell grouping signaling. FFS how to signal**

**=> Continue discussion P3 and target for signalling (async and sync NR-DC) in this meeting.**

 2. Discussion

## 2.1 Support of sync NR-DC cell grouping

In Phase-2 discussion, majority (8/10) agreed the requirement that that **Rel-16 UEs is allowed to support only Rel-15 cell grouping (i.e. MCG fully in FR1 and SCG fully in FR2) in early Rel-16 deployment**:

* **Support:** Qualcomm, Apple, vivo, Ericsson, Futurewei, MediaTek, ZTE, Samsung
* **OPEN:** Huawei, OPPO

So, rapporteur think we can agree it as a requirement.

**Proposal 1: For sync NR-DC, Rel-16 UEs is allowed to support only Rel-15 cell grouping (i.e. MCG fully in FR1 and SCG fully in FR2). FFS how to achieve it via signaling**

However, how to achieve it in signalling needs further discussion. The key issue is that we are not sure whether RAN2 will introduce cell grouping signalling for sync NR-DC, and whether it can be compatible with current spec. Meanwhile, two companies requested to specify (sync and async NR-DC) signalling in this meeting. Based on current situation, Rapporteur have below way-forward:

* **Solution 1**: Introduce 1 bit capability to indicate the support for FR1+FR2 only.
* **Solution 2:** Introduce cell grouping capability. The absence of this parameter means the UE supports FR1+FR2 only.
* **Solution 3:** Agree that RAN2 is going to introduce a releasre-16 UE capability (can be 1 bit, cell grouping or else) in a future meeting. Absence of such UE capability parameter means the UE supports FR1 +FR2 only.
* **Others?**

**Q1: For sync NR-DC, what is your preference for 3 solution (company is welcome to raise new solutions to address the requirement)?**

|  |  |  |
| --- | --- | --- |
| Company | Solution1/2/3 | Comments |
| Qualcomm | Prefer solution 2;All are acceptable | Our requirement:* The Rel-16 UE can indicate its only support of Rel-15 sync NR-DC (i.e. MCG fully in FR1 and SCG fully in FR2) in early Rel-16 deployment.
* We can accept specific signaling specified in Dec.2020, but hope to agree absence of such signaling means the UE only supports Rel-15 FR1+FR2 sync NR-DC in this meeting.

Thus, solution 2 provides more flexibility than solution 1. And we are also fine with solution 3 and solution 1.  |
|  |  |  |
|  |  |  |

## 2.2 Async NR-DC cell grouping signalling

During online discussion, majority companies agreed to reuse LTE cell grouping signalling. Only one company had different opinion because of the concern of signalling change due to MCG and SCG differentiation. Considering two companies requested to specify (sync and async NR-DC) signalling in this meeting, rapporteur would like to propose below way forward:

* **Solution**: LTE cell grouping signaling is reused for cell grouping of async NR-DC.

FFS whether to use existing other signaling or introduce new signaling on top of LTE signaling, to differentiate MCG and SCG

**Q2: Do you agree the way-forward for detailed signalling design for async NR-DC cell grouping?**

|  |  |  |
| --- | --- | --- |
| Company | Solution1/2/3 | Comments |
| Qualcomm | Yes |  |
|  |  |  |
|  |  |  |

# 3. Conclusion

**TBD**

# References

[1] [R2-2006558](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_111-e%5CDocs%5CR2-2006558.zip), Introduce capabilities on Async NR-DC and cell-grouping configuration Qualcomm Incorporated discussion Rel-16 LTE\_NR\_DC\_CA\_enh-Core

[2] [R2-2007946](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_111-e%5CDocs%5CR2-2007946.zip), Correction on non-SFN-sync NR-DC support Huawei, HiSilicon CR Rel-16 38.306 16.1.0 0398 - F LTE\_NR\_DC\_CA\_enh-Core

[3] [R2-2007605](file:///D%3A%5CDocuments%5C3GPP%5Ctsg_ran%5CWG2%5CTSGR2_111-e%5CDocs%5CR2-2007605.zip) UE capabilities for NR-DC Ericsson discussion

[4] TS 36.306

[5] RAN#88-e, Chair Notes

[6] TS 38.101-3

[7] R2-2004437, Clarification on supported NR-DC cell grouping, Qualcomm Incorporated

[8] R2-2008422, Summary of Offline discussion#021: UE cap NR-DC (Qualcomm), Qualcomm Incorporated

# Appendix A (LTE cell grouping signalling)

The related signalling is captured in TS 36.306 [3] and TS 36.331 [4]. It includes two UE capabilities *asynchronous-r12* and *supportedCellGrouping-r12* per band combination.

#### Copy from TS 36.306

##### 4.3.5.9.1 *asynchronous-r12*

In addition to the UE capability indicated by *dc-Support*, this field defines whether asynchronous DC and power control mode 2 is supported by the UE which is capable of *simultaneousRx-Tx*. If the band combination is comprised of a single band entry for more than two carriers, the UE shall support any permutations of carriers to CGs. If the concerning band combination is comprised of more than two band entries, the carriers corresponding to a band entry shall belong to one cell group. For this band combination, the UE may indicate the supported carrier permutations to CGs.

##### 4.3.5.9.2 *supportedCellGrouping-r12*

In addition to the UE capability indicated by *asynchronous*, this field defines for which mapping of serving cells to cell groups (i.e. MCG or SCG) the UE supports asynchronous DC.

Copy from TS 36.331

BandCombinationParameters-v1250::= SEQUENCE {

 dc-Support-r12 SEQUENCE {

 asynchronous-r12 ENUMERATED {supported} OPTIONAL,

 supportedCellGrouping-r12 CHOICE {

 threeEntries-r12 BIT STRING (SIZE(3)),

 fourEntries-r12 BIT STRING (SIZE(7)),

 fiveEntries-r12 BIT STRING (SIZE(15))

 } OPTIONAL

 } OPTIONAL,

 supportedNAICS-2CRS-AP-r12 BIT STRING (SIZE (1..maxNAICS-Entries-r12)) OPTIONAL,

 commSupportedBandsPerBC-r12 BIT STRING (SIZE (1.. maxBands)) OPTIONAL,

 ...

}

Note that the capability *supportedCellGrouping-r12* provides a mapping from bands to (one or more than one feasible) cell grouping configuration, as indicated in Note5 under *UE-EUTRA-Capability* in 36.331:

===================Extract from TS 36.331================

NOTE 5: The grouping of the cells to the first and second cell group, as indicated by *supportedCellGrouping*, is shown in the table below. The leading / leftmost bit of *supportedCellGrouping* corresponds to the Bit String Position 1.

|  |  |  |  |
| --- | --- | --- | --- |
| 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 |  |  |

=========================================================

The table seems to be complex. We take a simple example for illustration: Assume that the given band combination includes 4 bands (e.g. band A, B, C, D) the UE supports simultaneously. Then if the UE reports ‘0001’ and ‘0110’, it means the UE supports two Async cell grouping: 1) band ABC in first cell group and band D in secondary cell group; 2) band AD in first cell group and band BC in secondary cell group.

# Appendix B (Status of RAN1/RAN2 interaction)

In RAN1 LS on Rel-16 RAN1 UE features lists, RAN1 has requested RAN2 to introduce similar signalling to LTE, as illustrated in their agreement:

|  |
| --- |
| * RAN1 lists NR-DC power-sharing features as FG18-1/1a/1b. Apart from them, RAN1 see the need of following:
	+ RAN2 to introduce an FG that indicates support of asynchronous operation
		- RAN1 will discuss whether this FG is mandatory or optional
	+ RAN2 to discuss whether or not to introduce an optional FG that indicates supported cell-grouping configurations for a BC where the UE supports NR-DC operation
		- If the UE reports a cell-grouping configuration in which MCG cell(s) and SCG cell(s) are in the same FR, the UE must support FG18-1 (FG18-1a/1b are optional).
* The capability signalling structure is up to RAN2.
* The requirements for sync-DC and async-DC are up to RAN4.
 |

In RAN2#110-e, RAN2 agreed to use LTE style cell grouping capability signalling with restriction to 5 bands, which was included in reply LS to RAN1:

*Omit part*

1. **NR-DC cell grouping capability4:**

RAN2 has agreed to design the NR-DC cell grouping capability for the UE using the LTE style of capability signaling. RAN2 intends to restrict the NR-DC cell grouping signaling to NR DC combinations with up to 5 bands and for NR DC combinations with more than 5 bands in the combination, the UE cannot signal NR-DC cell grouping. The motivation for the above is that in LTE, there were no DC combinations defined with more than 5 bands, and RAN2 views the same with NR.

*Omit part*

By the end of RAN2#110-e, RAN1 response that “There is no additional suggestion from RAN1 for now.” in R1-2005096.

*Omit part*

|  |
| --- |
| **4.1 Further restrictions that are applicable to NR -DC combinations**RAN2 would like to request RAN1 and RAN4 if they see any additional restrictions in the definition of NR-DC combinations that can help reduce the NR-DC cell grouping capability reporting at the UE. |

**RAN1 view:** There is no additional suggestion from RAN1 for now.

*Omit part*