**3GPP TSG RAN WG1 Meeting #100bis-e R1-200xxxx**

**e-Meeting, April 20th –30th, 2020**

**Source: Moderator (ZTE)**

**Title: Email Discussion Summary of LS on UE Capability for NE-DC**

**Agenda item: 5**

**Document for:** **Discussion/Decision**

# Introduction

During RAN2#109e, an LS on the applicability of UE capabilities for NE-DC was sent to RAN1 [1]. In this LS, RAN2 asked RAN1 to confirm whether the UE feature *dl-1024QAM-TotalWeightedLayers* and f*d-MIMO-TotalWeightedLayers* need to be signalled for the LTE part of NE-DC band combination.

Per chairman’s guidance, this summary is to collect companies’ views on this LS and try to draft the reply based on companies’ input.

[100b-e-LS-04] Email approval of the reply LS for [R1-2001509](file:///C%3A%5CUsers%5Cwanshic%5COneDrive%20-%20Qualcomm%5CDocuments%5CStandards%5C3GPP%20Standards%5CMeeting%20Documents%5CTSGR1_100b%5CDocs%5CR1-2001509.zip) by 4/22 (ZTE, Xingguang)

# Company’s input

As indicated in RAN2’s LS, UE capability *dl-1024QAM-TotalWeightedLayers* was introduced based on RAN1’s LS (R2-1908429/R1-1907628, see appendix), which indicates the feature was only applicable to the LTE part of EN-DC case. Similarly, for UE capability *fd-MIMO-TotalWeightedLayers*, the definition in TS 38.306 also indicates it applies to the LTE part of EN-DC. The relevant description of these two UE capabilities are as following.

| Definitions for parameters | Per | M | FDD-TDDDIFF | FR1-FR2DIFF |
| --- | --- | --- | --- | --- |
| ***dl-1024QAM-TotalWeightedLayers***Indicates total number of weighted layers for the LTE part of the concerned EN-DC band combination the UE can process for 1024QAM, as described in TS 36.306 [15] equation 4.3.5.31-1. Actual value = (10 + indicated value x 2), i.e. value 0 indicates 10 layers, value 1 indicates 12 layers and so on. For an EN-DC band combination for which this field is not included, *dl-1024QAM-TotalWeightedLayers-r15* as described in TS 36.331 [17] applies, if included. | BC | No | No | No |
| ***fd-MIMO-TotalWeightedLayers***Indicates total number of weighted layers for the LTE part of the concerned EN-DC band combination the UE can process for FD-MIMO, as described in TS 36.306 [15] equation 4.3.28.13-1 and TS 36.331 [17] clause 6.3.6, NOTE 8 in UE-EUTRA-Capability field descriptions. For an EN-DC band combination for which this field is not included, totalWeightedLayers-r13 as described in TS 36.331 [17] applies, if included. | BC | No | No | No |

RAN2 would like to know whether these two UE capabilities can be signalled for NE-DC as well.

To thoroughly understand this issue and based on the contributions submitted to this LS [2][3], the following three questions are prepared for companies to answer. Later, we could draft the reply LS based on companies’ input for these three questions.

**Q1: Technically speaking (e.g., without considering the potential NBC issue), do you think feature *dl-1024QAM-TotalWeightedLayers* and *fd-MIMO-TotalWeightedLayers* need to be supported for the LTE part of NE-DC band combination?**

|  |  |
| --- | --- |
| Company | Comments |
| ZTE | Technically speaking, the two features could be supported for the LTE part of NE-DC band combination.  |
|  |  |
|  |  |

**Q2: Due to the late stage of Rel-15, do you think reusing the existing UE capability *dl-1024QAM-TotalWeightedLayers* and *fd-MIMO-TotalWeightedLayers* for the LTE part of NE-DC band combination would cause potential non-backward compatibility issues?**

|  |  |
| --- | --- |
| Company | Comments |
| ZTE | It may bring potential non-backward compatibility issues if the two existing UE capabilities are reusing for the LTE part of NE-DC band combination. One example of the potential non-backward compatible issues is as following. For a given band combination supporting both EN-DC and NE-DC, a legacy UE may support the two features for the LTE part when operating on EN-DC, but does not support the two features for the LTE part when operating on NE-DC. However, if the two existing UE capabilities are signalled for the LTE part of NE-DC band combination, network may consider this legacy UE also supports these two UE features for NE-DC as well, which is not the case. |
|  |  |
|  |  |

In addition to the above two questions, do you figure out any other potential issues? If yes, please provide your detailed comments in the below table.

**Q3: Any other issue (if any)?**

|  |  |
| --- | --- |
| Company | Comments |
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|  |  |
|  |  |

# Conclusion

Based on the contributions submitted to this meeting [2][3], a preliminary reply is drafted as below. The reply could be updated later based on companies’ input.

**Draft reply V1 (April 20th)**

RAN1 would like to thank RAN2 for the LS on the applicability of UE capabilities for NE-DC (R2-2002221).

RAN1 confirms that the feature *dl-1024QAM-TotalWeightedLayers* and *fd-MIMO-TotalWeightedLayers* need to be supported for the LTE part of NE-DC band combination. RAN1 figures out that there may be non-backward compatible issues if the existing UE capability *dl-1024QAM-TotalWeightedLayers* and *fd-MIMO-TotalWeightedLayers* are reused for the LTE part of NE-DC band combination and RAN1 assumes that RAN2 would avoid introducing any non-backward compatible issues.

One example of the non-backward compatible issue is as following. For a given band combination supporting both EN-DC and NE-DC, a legacy UE may support the two features for the LTE part when operating on EN-DC, but does not support the two features for the LTE part when operating on NE-DC. However, if the two existing capabilities are signalled for the LTE part of NE-DC band combination, network may consider this legacy UE also supports these two features for NE-DC as well, which is not the case.

**Draft reply V2**

To be updated based on more companies’ input.

# Reference

1. R2-2002221, LS on the applicability of UE capabilities for NE-DC, RAN2#109e.
2. R1-2001628, [DRAFT] Reply LS on the applicability of UE capabilities for NE-DC, ZTE.
3. R1-2002678, draft reply LS on the applicability of UE capability for NE-DC, Huawei, HiSilicon.

# Appendix: R1-1907628

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| --- | --- |
| **1. Overall Description:** 1.1 FD-MIMOIn RAN1-96b, RAN1 reached the following agreement (which was included in previous LS to RAN2 (R1-1905576):**Agreement:**Adopt the following baseband capability signalling for Rel-13 FD-MIMO:For a UE configured with FD-MIMO, for a band combination for which the UE does not report FD-MIMO capabilities, a configuration related to a set of CCs is supported by the UE if the following inequality is met$$\sum\_{i \in configured CCs}^{}w\_{i}∙l\_{i}\leq y$$where - $ l\_{i}$ is the maximum number of DL layers configured for CC $i$ * $w\_{i}=\left\{\begin{matrix}x\_{0}, if CC i is configured with FD-MIMO and l\_{i}=2\\x\_{1}, if CC i is configured with FD-MIMO and l\_{i}=4\\\begin{matrix}x\_{2}, if CC i is configured with FD-MIMO and l\_{i}=8\\1, if CC i is not configured with FD-MIMO\end{matrix}\end{matrix}\right.$
* $y$ is the “total number of weighted layers” the UE can process

Notes: * Legacy capability signalling can still be used after this capability is introduced (to e.g. signal a subset of supported band combinations).
* Detailed design of the capability signalling is left to RAN2

In RAN1#97, RAN1 made the following additional agreement:* Value of y (“Total number of weighted layers”) can also be signalled in EN-DC band combination. Signalling details are up to RAN2.
	+ Note: this agreement applies to only LTE part of EN-DC

1.2 1024QAMIn RAN1#97, RAN1 made the following agreement:

|  |
| --- |
| Introduce the following additional capability signalling to existing one for support of 1024QAM in LTE:* In a band combination, the UE supports 1024QAM in a set of CC provided that:
1. The set of CC belong to bands that are indicated to support 1024QAM in that band combination, and
2. The following inequality is met: $w'⋅Num\_{Layers, 1024QAM}+Num\_{Layers, non1024QAM}\leq y'$, where
	1. $Num\_{Layers, 1024QAM}$ is the total number of layers across all configured CCs configured with 1024QAM
	2. $Num\_{Layers, non1024QAM}$ is the total number of layers across all configured CCs not configured with 1024QAM
	3. $w'\in \left\{1,\frac{6}{5},\frac{5}{4}\right\}$ and $y'\in \{10:2:30\}$ are UE capabilities (per UE)
* In case the UE does not report w’ and y’, legacy capability signalling applies (i.e., the inequality does not apply)
* Request RAN2 to introduce a mechanism to ensure backwards compatibility considering both existing and new capability signalling
* Value of y’ can also be signalled in EN-DC band combination. Signalling details are up to RAN2.
	+ Note: this agreement applies to only LTE part of EN-DC
	+ Note: maximum data rate for LTE part of EN-DC should take y’ into account
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To address the note regarding maximum data rate, RAN1 endorsed the following TP for TS 38.306:For EUTRA in case of MR-DC, the approximate data rate for a given number of aggregated carriers in a band or band combination is computed as follows.Data rate (in Mbps) = cid:image001.png@01D50982.1DE987A0whereinJ is the number of aggregated EUTRA component carriers in MR-DC band combinationcid:image002.png@01D50982.1DE987A0is the total maximum number of DL-SCH transport block bits received within a 1ms TTI for j-th CC, as derived from TS36.213 [22] based on the UE supported maximum MIMO layers for the j-th CC, and based on the maximum modulation order for the j-th CC according to indicated UE capabilities and number of PRBs based on the bandwidth of the j-th CC.**2. Actions to RAN2:**RAN1 respectfully requests RAN2 to update the UE capability signalling according to the above agreements.RAN1 respectfully requests RAN2 to update 38.306 according to the above text proposal.**3. Date of Next TSG-RAN WG1 Meetings:**TSG RAN WG1 Meeting #98 26 - 30 Aug 2019  Prague, CZTSG RAN WG1 Meeting #98-bis 14 - 18 Oct 2019  CN |