**3GPP TSG-RAN WG4 Meeting # 98-e R4-21xxxx**

**Electronic Meeting, Jan. 25-Feb. 5, 2021**

**Agenda item:** 8

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for [98e][114] R16\_UE\_ feature

**Document for:** Information

1. Introduction

This is a document for email discussion on Rel-16 LTE and NR UE features in RAN4#98e. Companies are encouraged to discuss the open issues and provide comments during 98e meeting if any.

The document in RAN4#97e is R4-2016961, and the UE feature list agreed in RAN4#97e is R4-2016850.

1. Topic#1: R16 NR UE feature list
   1. Companies’ contributions summery

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| **TDoc** | **Title** | **Source** |
| [**R4-2101155**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101155.zip) | Discussion on UE feature list | MediaTek inc. |
| [**R4-2101659**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101659.zip) | Discussion on per-FR gap capability | Huawei, HiSilicon |
| [**R4-2102891**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2102891.zip) | UE feature on Simultaneous dormant BWP switching | Qualcomm Incorporated |

* 1. Open issues summery
     1. MR DC/CA enhancement

**Issue 1-1: New feature simultaneous dormant BWP switching**

**Option 1 (MTK, R4-2101155):**

* **D’ = 100us or 200us for UE indicating type1 in bwp-SwitchingDelay**
* **D’ = 200us or 400us for UE indicating type2 in bwp-SwitchingDelay**

**Option 2 (Qualcomm, R4-2102891): Add the following UE capability for simultaneous dormant BWP switching to the feature list.**

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| Features | Index | Feature group | Components | Prerequisite feature groups | Need for the gNB to know if the feature is supported | Applicable to the capability signalling exchange between UEs (V2X WI only)”. | Consequence if the feature is not supported by the UE | Type | Need of FDD/TDD differentiation | Need of FR1/FR2 differentiation | Capability interpretation for mixture of FDD/TDD and/or FR1/FR2 | Note | Mandatory/Optional |
| 6. LTE\_NR\_DC\_CA\_enh | 6-[X] | Dormant BWP switching on multiple CCs RRM requirements | Incremental delay for BWP switch processing on additional SCells in timer/DCI based simultaneous dormant BWP switching on multiple SCells | RAN1 feature 18-4 and 18-4a | Yes | N/A | There may be additional unclear BWP switching delay if network trigger dormant BWP switching on multiple SCells simultaneously. | Per UE | No | No | N/A | For component 2), the candidate values are:  ● {100us, 200us} for UE indicates type1 in bwp-SwitchingDelay  ● {200us, 400us, 800us, 1000us} for UE indicates type 2 in bwp-SwitchingDelay  The total BWP switching delay will be captured in TS38.133  UE needs to indicate either of the candidate values in case it supports dormant BWP | Optional with capability signalling |

**Recommended WF:**

**The technical discussion on the set of D’ values are in [211].**

**Focus on the discussion on the rest of the aspects in this email thread (e.g. pre-requisite features, feature description, etc)**

* + 1. Others

**Issue 2-1: New per BC indication of the per-FR gap**

**Option 1 (Huawei, R4-2101155): The per-BC indication of the per-FR gap to be introduced and the original per-UE indication to be kept.**

**Recommended WF:**

**More discussion is needed.**

* 1. Companies views’ collection for 1st round
     1. Open issues

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| **Company** | **Comments** |
| **MTK** | **Issue 1-1 New feature simultaneous dormant BWP switching**   * It should be fine to put it as a feature under LTE\_NR\_DC\_CA\_enh rather than RRM enh * We are fine with the feature description suggested by Qualcomm * Prerequisite feature groups should be 18-4 or 18-4a in RAN1 feature least * Agree to leave technical discussion in RRM session   **Issue 2-1: New per BC indication of the per-FR gap**   * No. Not necessary. * During any measurement gap occasions, all data receptions and transmissions in carriers in the same FR are stopped. UE only has to receive one single frequency layer per FR during one gap occasion. It is strange to link this capability to the band combination. * Regarding relation to interruption requirement, it was introduced by pure considering whether FR1 and FR2 RFs have mutual influence to each other, which does not seem to be changed with band combination. * RRM session already agreed that a baseline UE should at least implement 2 searchers for measurement. The 2 searchers can directly be used for per-FR gap. Therefore, we do not see this feature demands a UE complexity in baseband side. |
| **Ericsson** | Issue 1-1: We are also fine to discuss this feature. But the values of D’ should be discussed and decided under LTE\_NR\_DC\_CA\_enh WI in the RRM session.  Issue 2-1: We also agree with MTK that there is the need to define any additional BC capability within per FR gap capability. If the UE can support per FR gaps for certain FR1+FR2 band combination then there is no reason not to support per FR gaps for another FR1+FR2 band combination. |
| **Verizon** | Issue 2-1: Yes, it is reasonable to define the concept of per-FR gap in Rel-16 UE. Besides of reasons in [R4-2101659](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_98_e/Docs/R4-2101659.zip), two more major benefits for us are that UE could enlarge more CCs in CA combination (for spectrum efficiency) and define more consistence behaviors of CC configurations in both UE and NW. |
| **Qualcomm** | **Issue 1-1: New feature simultaneous dormant BWP switching**  Agree to the comment from MTK “Prerequisite feature groups should be 18-4 or 18-4a in RAN1 feature least”. FG 18-4 and 18-4a are “SCell dormancy indication **within** active time” and “SCell dormancy indication **outside** active time”, respectively.  Agree to Recommended WF “leave technical discussion on the set of D’ values in [211]”.  **Issue 2-1: New per BC indication of the per-FR gap**  We fully support the proposal from Huawei, this is inline with our proposal from the last meeting. As we stated in the last meeting, there are also baseband constraints, especially considering measurements in FR2 which are a lot more demanding from a hardware point of view. If the signaling is done in a backwards compatible manner, the added overhead is very small. Without this capability, per FR gaps will see very limited use in real UEs. |
| **Huawei** | **Issue 2-1:**  Yes. It is necessary to introduce the per-BC indicated Per-FR gap capability. UE may only needs to perform measurement on one frequency layer within the gap occasion within the certain FR even there are numerous CCs configured within the same FR, but the data transmission and other procedure shall not be interrupted in the other FR, which means the hardware resource is required to guarantee the active procedures in one FR and the measurement within gap in the other one. Thus, the resources demanded to support this feature varies from different CA combinations.  Another constraint is the coupling issue pointed out during the GTW session. We don’t believe it is a feasible way to investigate the issue case by case. The related requirements/features are from different features and different releases, which may cause tremendous efforts and leads to compatibility issues. It is not possible to reopen the discussion for all requirements and features from R15 and revert the related discussion case by case if we really want to fix this issue.  Most companies agreed that there is no compatibility issue by combining the original per-UE indication and the per-BC indication. And there are clear demand from UE side and operator to make full usage of the feature and enlarge the CC combinations. We didn’t see any convinced reason not to have this per-BC indication but turn to tremendous discussion about implementations design and reverting the previous requirements in a less feasible way |

* 1. Summary for 1st round
     1. Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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|  | Status summary |
| **Issue 1-1: New feature simultaneous dormant BWP switching** | Agreement in RRM session:  • Session chair: Agreed capability needs to be captured in the LS to RAN2/1 on UE feature list.  C:\Users\cmcc\AppData\Local\Temp\1611816482(1).png |
| **Issue 2-1: New per BC indication of the per-FR gap** | 5 companies discuss this issue, 3 companies support the new per BC indication of per-FR gap, and 2 companies don’t agree to introduce this.  This issue was also discussed on the GTW RRM session, no consensus was reached.  **Recommended WF for 2nd round discussion:**  Continue discussion. Identify the implementation constraints which may come from per-UE per-FR gap capability. Further capture the conclusion in the WF in the 2nd round. |

*Recommendations on WF/LS assignment*

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|  | WF/LS t-doc Title | Assigned Company,  WF or LS lead |
| #1 | WF on new per BC indication of the per-FR gap | CMCC |

* 1. Discussion on 2nd round (if applicable)
     1. Open issues summary

**Issue 2-1: New per BC indication of the per-FR gap**

**Option 1 (Huawei, R4-2101155): The per-BC indication of the per-FR gap to be introduced and the original per-UE indication to be kept.**

**Recommended WF:**

Further discuss in 2nd round on the following aspects:

* Is there any compatibility issue by combining the original per-UE indication and the per-BC indication?
* What are the implementation constraints for per-UE per-FR gap capability?

**Issue 2-2: Transient period**

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| 7-4 | Transient period | Report the shorter transient capability supported by the UE: 2, 4 or 7us  Note: SCS dependency is FFS |  | Yes | N/A | Ue does not support enhanced UL performance | Type 2 | No | FR1 | N/A | No value reported means UE supports the legacy 10us transient period | Optional with capability signalling |

**Recommended WF:**

The SCS dependency for transient period is still FFS. In order to let RAN2 implement “transient period” capability, it is necessary to remove the FFS.

Companies please provide your comments on SCS dependency for transient period.

* + 1. Open issues

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| **Company** | **Comments** |
| **Huawei** | **Issue 2-1**  For the compatibility issue. By keeping the original indication and adding the per-BC indication, no compatibility issue is foreseen which is also the common understanding during the 1st round discussion and GTW session with no concerns on it.  For the implementation constraints, our first thinking is that it is up to the implementation. For other requirements/features, we introduce different/finer capability indications to make better usage of these features and allows different implementations. We cannot see what is special here.  According to the comments of opponent companies in the 1st round, it is stated that UE only has to receive one single frequency layer per FR during one gap occasion and stops data transmission/receptions if UE support FR1+FR2. But one example is that, if UE want to support a CC combination with more CCs only within the same FR (e.g. FR1 only), UE has to allocate dedicated resource for FR2 measurement even though it could not be configured with a FR2 CC under this BC. Thus, it is more reasonable for UE to save the efforts to support combinations with more CCs instead of supporting the per-FR gap. It means, the per-UE indication will limit the CC combination supporting in some scenarios.  Another constraint is related to the requirements bundling issue. Multiple requirements has been bundled to this feature since R15. Per-BC indications is a good way out to handle the issue without reverting all related features. We don’t think it is even possible to reopen the discussion of all related features for the following reasons:   * Tremendous discussions and meetings are needed to revert the requirements from different releases and different WIs case by case. * And we cannot see feasible solutions if we take the efforts to start the redundant discussion. Are we going to revert all related requirements? * There will certainly be compatibility issues if we are going to change the requirements. OR companies prefer to introduce tons of new capability for these related features?   In summary, introducing the per-BC indication can not only handle the bundling issues with other RRM requirements but also enlarge the CC combinations without compatibility issues. And also the impact to the existing requirements are minimized. We cannot support to revert the discussion for requirements/features related to the bundling. It will definitely cause compatibility issues if we only change all related requirements, or it is suggested to introduce new capability for each of these requirements? Then why couldn’t have the per-BC indication?  We would also like to invite companies to put your insights on these two directions and provide the potential way forward if you prefer to revert all related requirements case by cases and also about the limitation on the CC combination. |
| **MTK** | We disagree Huawei’s argument “if UE want to support a CC combination with more CCs only within the same FR (e.g. FR1 only), UE has to allocate dedicated resource for FR2 measurement even though it could not be configured with a FR2 CC under this BC.” For per-UE gap case with measurement outside gap (a baseline behavior), UE already has to performance measurement in parallel with data reception/transmission on all CCs. (not just the CCs in one FR)  Regarding overloading issue, we still think a case-by-case discussion is needed. At least from our observation, interruption requirements has nothing to do with baseline resources. We should still assume per-FR-gap capable UE will not create interruption across 2 FRs. (BTW, it is very strange to make this assumption BC-dependent.) Also some requirements that were agreed to be introduced for per-FR-gap capable UE only should not be reverted, either. BWP switch delay on multiple CCs may need to be revisited because it involves some baseband resources arrangement (maybe there are more examples). Of course, we need a RAN4 agreement to revert previous agreement. But this is just a business as usual. |
| **Qualcomm** | **Issue 2-1: New per BC indication of the per-FR gap**  Support Option 1.  **For compatibility issue:**  There is no compatibility issue. And we believe this is a common understanding in the group.  **Implementation constraints:**  In typical UE implementation, many baseband resources are shared between measurements and control/data processing. We should keep in mind that measurement processing is not solely driven by cell searcher, i.e. not just about PSS/SSS correlation. In order for UE to measure an accurate signal strength/quality, in some cases UE may have to perform wideband channel estimation (especially for CSI-RS based measurements), PBCH DMRS channel estimation and/or PBCH demodulation (especially for beam level measurements), etc. In order words, even if UE is equipped with dedicated cell searchers for measurement, there will be more processing units that should be opportunistically available for the measurements. Therefore, if UE is configured with, e.g. the highest order CA combo it can support, per-FR MG capable UE may not be able to process both measurement on one band and control/data processing on the other band concurrently. It should be noted that the likelihood of the highest CA combo being configured/activated is rare.  Another aspect that should be also taken into account is that the number of required cell searchers for gap-less measurement, i.e. cell search engines running in the background to detect/measure/evaluate potential new cells, are not explicitly defined/assumed in RAN4 spec but left to UE implementation. For instance, if UE is configured with the highest CA combo with FR1 and FR2 and the largest BW for each CC, UE may not be always able to process all tasks at the worst because there can be insufficient spare processing resources for gap-less measurement.  **Loss due to per-UE based vs. Benefit of per-BC based per-FR MG capability:**  More importantly the group should objectively evaluate the loss and the benefit by not supporting and supporting per-BC based per-FR MG capability.  We believe there is no different view on the observation that per-FR MG capability brings benefits to both network and UE in terms of resource utilization, interruption, throughput, etc. Therefore, the capability signaling should be defined in such a way that many UEs can support the feature in most likely practical scenarios rather than making it impossible for UE to support it even with reasonable implementation. Unfortunately, however, due to the way it is currently defined and given the unnecessarily overloaded requirements, it is less likely to be supported by many FR2 capable UEs even though they can manage to support it in most of the cases.  **Issue 2-2: Transient period**  The capability should apply to any SCS supported in that band. The transient period should be agnostic of SCS. |
| **Verizon** | **Issue 2-1: New per BC indication of the per-FR gap**  **Support option 1** |

* 1. Summary on 2nd round (if applicable)
     1. Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

**Issue 2-1: New per BC indication of the per-FR gap**

*The WF on new per BC indication of the per-FR gap (R4-2103168) was discussed.*

*The WF need to be revised to remove the following sentence since comments are received after the final Tdoc is submitted.*

*~~•So far, companies have not identified any compatibility issue in RAN4 by combining the original per-UE indication and the per-BC indication~~*

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| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| *R4-2103168* | To be revised to remove the following sentence  *~~•So far, companies have not identified any compatibility issue in RAN4 by combining the original per-UE indication and the per-BC indication~~* |

**Issue 2-2: Transient period**

*Since only 1 company provide comment on issue 2-2 and agree to remove the Note: SCS dependency is FFS. Moderator recommends to remove the note.*

Tentative agreement:

• Remove the Note: SCS dependency is FFS

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| 7-4 | Transient period | Report the shorter transient capability supported by the UE: 2, 4 or 7us  ~~Note: SCS dependency is FFS~~ |  | Yes | N/A | Ue does not support enhanced UL performance | Type 2 | No | FR1 | N/A | No value reported means UE supports the legacy 10us transient period | Optional with capability signalling |

• Update the UE feature list to remove the FFS for feature 7-4