**3GPP TSG RAN WG1 Meeting #102-e R1-200xxxx**

**e-Meeting, August 17th – 28th, 2020**

**Source: Moderator (ZTE)**

**Title: Email Discussion Summary of [102-e-NR-7.1CRs-07]**

**Agenda item: 7.1**

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

# Introduction

During RAN1#102-e, one contribution was submitted to discuss and clarify the potential ambiguity issue for UE features in case of cross-carrier operation [1]. During the preparation phase, companies agreed to discuss this issue in RAN1#102-e meeting.

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| [102-e-NR-7.1CRs-07] Interpretation of UE Features in Case of Cross-Carrier Operation – Xingguang (ZTE)    For Rel-15, Issue#32 (as described in R1-2006332)    Discussion/Agreements by 8/19, TPs by 8/24 |

Companies had some preliminary discussion of this issue during RAN#88e meeting [2]. Most companies thought we should handle this issue on a case-by-case basis. Thus, the discussion here is carried out in a case-by-case manner.

This summary is trying to collect/summarize companies’ input and draw potential conclusions based on companies’ input. Once RAN1 reaches consensus on how to interpret these UE features in case of cross-carrier operation, we can draft an LS to RAN2 to kindly ask RAN2 to update their spec accordingly.

# Discussion

## Background introduction

During RAN2#107 meeting, RAN2 sent an LS on ambiguity of UE L1 FDD/TDD FR1/FR2 capabilities to RAN1 to seek clarification [3]. In summary, for UE capabilities with xDD/FRx differentiation, RAN2 asked RAN1 to clarify how to interpret the UE capabilities in case of cross-carrier operation. During RAN1#98bis meeting, RAN1 discussed the ambiguity issue and provided the reply LS in [4]. RAN2 updated Annex A.1 and A.2 of TS38.306 accordingly to clarify this issue.

Note that RAN2 only adds clarification for UE capabilities with xDD/FRx differentiation in Annex A.1 and A.2 of TS38.306 fa0. However, for some UE capabilities without xDD/FRx differentiation, the ambiguity issue still needs to be clarified. Take the Rel-15 UE capability *aperiodicTRS* as an example. UE capability *aperiodicTRS* is a “per Band” signaling, which is to indicate the network whether the UE supports DCI triggering aperiodic TRS associated with periodic TRS. It is not clear how to interpret the UE capability in case when only one of the triggering cell and triggered cell supports *aperiodicTRS*. For example, if UE indicates support of *aperiodicTRS* for Band A and NOT support of *aperiodicTRS* for Band B. If UE needs to trigger A-TRS for Band B from Band A, it is not clear whether UE supports this kind of operation.

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| Definitions for parameters | Per | M | FDD-TDD  DIFF | FR1-FR2  DIFF |
| ***aperiodicTRS***  Indicates whether the UE supports DCI triggering aperiodic TRS associated with periodic TRS. | Band | No | N/A | N/A |

It is observed that RAN2 has added clarification for this issue for some of the UE capabilities, e.g., *aperiodicBeamReport* and *beamReportTiming* as shown below. While for other UE capabilities associated with cross-carrier operation, similar clarification is absent in TS38.306.

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| ***aperiodicBeamReport***  Indicates whether the UE supports aperiodic 'CRI/RSRP' or 'SSBRI/RSRP' reporting on PUSCH. The UE provides the capability for the band number for which the report is provided (where the measurement is performed). | Band | Yes | N/A | N/A |

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| ***beamReportTiming***  Indicates the number of OFDM symbols between the last symbol of SSB/CSI-RS and the first symbol of the transmission channel containing beam report. The UE provides the capability for the band number for which the report is provided (where the measurement is performed). The UE includes this field for each supported sub-carrier spacing. | Band | Yes | N/A | N/A |

## Companies’ input

Based on the input for now [1], companies figured out that at least for *aperiodicTRS*, *beamSwitchTiming*, *ue-SpecificUL-DL-Assignment*, *bwp-DiffNumerology / bwp-SameNumerology*, RAN1 needs to clarify how to interpret them in case of cross-carrier operation.

Based on some offline discussion, some companies think that *crossCarrierScheduling-SameSCS* and *crossCarrierScheduling-OtherSCS* also need to be clarified. From moderator’s point of view, as Rel-15 only supports same numerology cross-carrier scheduling, we can clarify *crossCarrierScheduling-SameSCS* in this Rel-15 discussion and leave *crossCarrierScheduling-OtherSCS* to Rel-16 discussion.

Note: The TS38.306 excerpt of the above UE capabilities are copied in the Appendix.

Basically, there are the following three different interpretations to interpret the UE capabilities.

**Interpretation1**: Support of this UE capability is based on the support of this capability for the band of the scheduled/triggered/indicated cell only.

**Interpretation2**: Support of this UE capability is based on the support of this capability for the band of the scheduling/triggering/indicating cell only.

**Interpretation3**: Support of this UE capability is based on the support of this capability for both the band of the scheduled/triggered/indicated cell and the band of the scheduling/triggering/indicating cell.

### **Q1: What’s your view on how to interpret the following UE capability in case of cross-carrier operation?**

*Note1: Please input your company name in the table to show your understanding of each UE capability.*

*Note2: If you figure out* ***any other UE capabilities*** *that may need clarification in case of cross-carrier operation, please input them in the table below.*

Note3:

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| --- | --- | --- | --- | --- |
| UE capability | Interpretation1 | Interpretation2 | Interpretation3 | Any other interpretation? |
| aperiodicTRS | ZTE, Samsung, vivo, Qualcomm, Nokia |  | Huawei | Apple:  We first need to clarify which FG indicates the UE support of cross carrier AP-TRS. We do not think this is the right FG.  Qualcomm:  This is not related to x-CC scheduling |
| beamSwitchTiming | ZTE, Samsung, vivo, Qualcomm, Nokia |  | Huawei | Apple:  For beam reporting, it can involve three cells  Cell A for scheduling DCI  Cell B for scheduled PUSCH  Cell C for measurement  We need to clarify this FG, but agreeing on a particular interpretation is not enough since this time, we can have 3 cells involved |
| ue-SpecificUL-DL-Assignment | ZTE, Samsung, vivo, Apple, Nokia |  | Huawei, Qualcomm | Apple  But this does not mean we support cross carrier dynamic DCI to determine TDD pattern. Cross carrier scheduling should be subject to cross carrier scheduling capability reporting |
| bwp-DiffNumerology /  bwp-SameNumerology | ZTE, Samsung, vivo, Apple, Nokia |  | Huawei, Qualcomm | Apple  Similar comments as above, whether cross carrier scheduling is allowed is subject to other FGs  Qualcomm:  x-CC scheduling with different BWP SCS feature is not applicable in Rel-15 |
| crossCarrierScheduling-SameSCS | ZTE, Samsung, vivo, Nokia |  | Huawei, Qualcomm | Apple  None of the interpretation is clear. Assume extreme case FR1 (60kHz) + FR2 (60kHz)  For interpretation 1: If we want to support FR1 schedules FR2, do we also have to support FR2 scheduled FR2 (assume multiple CCs are configured in the same FR2 band) which is much less useless and we may not even able to do IoDT due to the lack of deployment  For interpretation 3: If we want to support FR1 schedules FR2, do we also have to support FR2 scheduled FR1 and intra-band cross carrier scheduling (assume multiple CCs are configured in the same FR1/FR2 band) |
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For all the UE capabilities mentioned in Q1, moderator’s understanding is that, there is no RAN1 specification impact. The only thing we need to do is to prepare a LS to RAN2 and ask RAN2 to update their specifications accordingly.

### **Q2: Do you agree that there is no RAN1 specification impact and we only need to prepare a LS to RAN2 and ask RAN2 to update their specifications accordingly?**

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| --- | --- |
| Company | Comment |
| ZTE | Yes, based on our understanding, there is no RAN1 specification impact. We need to prepare a LS to RAN2 and ask RAN2 clarify this issue in RAN2 specification. |
| Samsung | Yes, there is no RAN1 impact. |
| vivo | Yes, agree. |
| Apple | The current UE cross carrier scheduling related capability is not enough. |
| Nokia | Agree, no RAN1 impact |

### **Q3: Do you figure out any other issue that needs to be clarified? If yes, please elaborate them in the table below.**

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| Company | Comment |
| Samsung | We do not figure out other issues yet. However, we think it is preferred to apply the same interpretation for the potential issues related to cross-carrier operation once we have reached to a consensus on the interpretation from Q1. |
| Qualcomm | crossCarrierScheduling-SameSCS was designated as Type 3 by RAN1 but RAN2 has changed it to per band. This made the Rel-15 cross carrier scheduling feature hardly useful and we think this makes the need to clarify any of the issues being discussed here lower priority. |
| Nokia | We don’t foresee other issues than the capability interpretation issue. |

# Summary

The following potential conclusion and draft LS will be updated based on the companies’ input.

## Potential conclusion

**Draft conclusion v0**

**Conclusion:**

Regarding the interpretation of UE capabilities in case of cross-carrier operation, RAN1 clarifies that support of the following UE capability is based on the support of this capability for the band of the scheduled/triggered/indicated cell only.

* *aperiodicTRS*
* *beamSwitchTiming*
* *ue-SpecificUL-DL-Assignment*
* *bwp-DiffNumerology / bwp-SameNumerology*
* *crossCarrierScheduling-SameSCS*

**Draft conclusion v1**

TBD

## Draft LS to RAN2

**Draft LS v0**

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| **Overall Description:**  RAN1 discussed the ambiguity issue on how to interpret UE capability in case of cross-carrier operation. For UE capability associated with cross-carrier operation, if UE indicates support of this capability only for the band of the scheduled/triggered/indicated cell or only for the band of the scheduling/triggering/indicating cell, it is not clear whether UE support this kind of cross-carrier operation for this UE capability between these two cells.  [One example of the issue is as following. UE capability *aperiodicTRS* is a “per Band” signaling, which is to indicate the network whether the UE supports DCI triggering aperiodic TRS associated with periodic TRS. It is not clear how to interpret the UE capability in case when only one of the triggering cell in one band and triggered cell in another band supports *aperiodicTRS*. For example, if UE indicates support of *aperiodicTRS* for Band A and NOT support of *aperiodicTRS* for Band B. It is not clear whether UE supports to trigger A-TRS for Band B from Band A.]  After discussion, RAN1 reached the following conclusion.  **Conclusion:**  Regarding the interpretation of UE capabilities in case of cross-carrier operation, RAN1 clarifies that support of the following UE capability is based on the support of this feature for the band of the scheduled/triggered/indicated cell only.   * *aperiodicTRS* * *beamSwitchTiming* * *ue-SpecificUL-DL-Assignment* * *bwp-DiffNumerology / bwp-SameNumerology* * *crossCarrierScheduling-SameSCS*   **Action to RAN2**: RAN1 respectfully requests RAN2 to take the above information into account and update RAN2 specs accordingly. |

**Draft LS v1**

TBD

# Reference

[1] R1-2006332, Interpretation of UE Features in Case of Cross-Carrier Operation, RAN1#102-e, ZTE.

[2] RP‑201284, Summary of email discussion [R15\_R16\_UE\_features], NTT DOCOMO, RAN#88e.

[3] R1-1909953, LS on ambiguity of UE L1 FDD/TDD FR1/FR2 capabilities, RAN2#107

[4] R1-1911741, Reply LS on ambiguity of UE L1 FDD/TDD FR1/FR2 capabilities, RAN1#98bis.

# Appendix

| ***aperiodicTRS***  Indicates whether the UE supports DCI triggering aperiodic TRS associated with periodic TRS. | Band | No | N/A | Yes |
| --- | --- | --- | --- | --- |

| ***beamSwitchTiming***  Indicates the minimum number of OFDM symbols between the DCI triggering of aperiodic CSI-RS and aperiodic CSI-RS transmission. The number of OFDM symbols is measured from the last symbol containing the indication to the first symbol of CSI-RS. The UE includes this field for each supported sub-carrier spacing.  *beamSwitchTiming* of value (*sym224* or *sym336*) indicates the minimum number of required OFDM symbols between the DCI triggering aperiodic CSI-RS and the corresponding aperiodic CSI-RS transmission in a CSI-RS resource set configured with repetition 'ON' | Band | No | N/A | FR2 only |
| --- | --- | --- | --- | --- |

| ***ue-SpecificUL-DL-Assignment***  Indicates whether the UE supports dynamic determination of UL and DL link direction and slot format based on Layer 1 scheduling DCI and higher layer configured parameter UL-DL-configuration-dedicated as specified in TS 38.213 [11]. | FS | No | N/A | N/A |
| --- | --- | --- | --- | --- |

| ***bwp-DiffNumerology***  Indicates whether the UE supports BWP adaptation up to 4 BWPs with the different numerologies, via DCI and timer. For the UE capable of this feature, the bandwidth of a UE-specific RRC configured DL BWP includes the bandwidth of the CORESET#0 (if CORESET#0 is present) and SSB for PCell and PSCell (if configured). For SCell(s), the bandwidth of the UE-specific RRC configured DL BWP includes SSB, if there is SSB on SCell(s). | Band | No | N/A | N/A |
| --- | --- | --- | --- | --- |

| ***bwp-SameNumerology***  Defines type A/B BWP adaptation (up to 2/4 BWPs) with the same numerology, via DCI and timer. For the UE capable of this feature, the bandwidth of a UE-specific RRC configured DL BWP includes the bandwidth of the CORESET#0 (if CORESET#0 is present) and SSB for PCell and PSCell (if configured). For SCell(s), the bandwidth of the UE-specific RRC configured DL BWP includes SSB, if there is SSB on SCell(s). | Band | No | N/A | N/A |
| --- | --- | --- | --- | --- |

| ***crossCarrierScheduling-SameSCS***  Indicates whether the UE supports cross carrier scheduling for the same numerology with carrier indicator field (CIF) in carrier aggregation where numerologies for the scheduling cell and scheduled cell are same. | Band | No | N/A | N/A |
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