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

**Online, January 25th – February 5th 2021**

**Agenda item: 5.4.3**

**Source: Samsung**

**Title: Summary of [011][NR15] UE Capabilites III (Samsung)**

**Document for: Discussion and Decision**

# 1 Brief scope of the contributions

This document contains the summary of documents from agenda item 5.4.3 (“xDD differentiation for SUL”, “Fallback per CC” and “Supported Number of TAG”) as per below excerpt from the session chair minutes:

* [AT113-e][011][NR15] UE Capabilites III (Samsung)

Scope: Treat R2-2100016, R2-2100439, R2-2100440, R2-2101911, R2-2101912, R2-2101432, R2-2101430, R2-2101431, R2-2101660, R2-2101661, R2-2101354,

Phase 1, determine agreeable parts, Phase 2, for agreeable parts Work on CRs.

Intended outcome: Report and Agreed CRs.

Deadline: Schedule A

xDD differentiation for SUL

Related to RP-202911, R2 is tasked to provide CRs.

Moved from 5.1:

[R2-2100016](file:///C:\Users\Docs\R2-2100016.zip) Reply LS on UE capability xDD differentiation for SUL/SDL bands (R1-2009576; contact: Samsung) RAN1 LS in Rel-15 NR\_newRAT-Core To:RAN2 Cc:RAN4

[R2-2100439](file:///C:\Users\Docs\R2-2100439.zip) xDD differentiation of UE capabilities for SUL/SDL bands Samsung CR Rel-15 38.306 15.12.0 0486 - F NR\_newRAT-Core

[R2-2100440](file:///C:\Users\Docs\R2-2100440.zip) xDD differentiation of UE capabilities for SUL/SDL bands Samsung CR Rel-16 38.306 16.3.0 0487 - A NR\_newRAT-Core

[R2-2101911](file:///C:\Users\Docs\R2-2101911.zip) Clarfication on FDD-TDD differentiation for SUL band Huawei, HiSilicon, Intel Corporation CR Rel-15 38.306 15.12.0 0522 - F NR\_newRAT-Core

[R2-2101912](file:///C:\Users\Docs\R2-2101912.zip) Clarfication on FDD-TDD differentiation for SUL band Huawei, HiSilicon CR Rel-16 38.306 16.3.0 0523 - F NR\_newRAT-Core

[R2-2101432](file:///C:\Users\Docs\R2-2101432.zip) Per UE capability differentiation for SUL bands Ericsson CR Rel-15 38.306 15.12.0 0508 - F NR\_newRAT-Core

**Fallback per CC**

Continue last meeting

[R2-2101430](file:///C:\Users\Docs\R2-2101430.zip) Definition of Fallback per CC feature set Ericsson discussion

[R2-2101431](file:///C:\Users\Docs\R2-2101431.zip) Definition of fallback per CC feature set Ericsson CR Rel-15 38.306 15.12.0 0507 - F NR\_newRAT-Core

[R2-2101660](file:///C:\Users\Docs\R2-2101660.zip) Discussion on the definition of fallback per CC feature set Huawei, HiSilicon discussion Rel-15 NR\_newRAT-Core

[R2-2101661](file:///C:\Users\Docs\R2-2101661.zip) CR to clarify the definition of fallback per CC feature set Huawei, HiSilicon CR Rel-15 38.306 15.12.0 0519 - F NR\_newRAT-Core

Supported Number of TAG

Continue last meeting

[R2-2101354](file:///C:\Users\Docs\R2-2101354.zip) Clarification on the capability of supportedNumberTAG Apple discussion Rel-16 NR\_newRAT-Core, TEI16

# 2 Company comments to the contributions

## 2.1 xDD differentiation for SUL

This section deals with **DISC\_S1: xDD differentiation for SUL**.

According to the reply LS (R2-2100016) from RAN1, RAN1 provided the answers for the questions RAN2 requested on xDD differentiation for SUL/SDL bands.

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| “**Question 1:** Could per-UE capabilities for SUL/SDL bands be differentiated on the duplex mode(s) for Rel-15 and Rel-16?”  Regarding Question 1 from RAN2, RAN1 concluded per-UE capabilities for SUL/SDL bands can be differentiated on the duplex mode(s) for Rel-15 and Rel-16.  “**Question 2:** Which duplex mode(s) (i.e. FDD or TDD) for the per-UE capabilities which are differentiated by FDD and TDD are applied for SUL/SDL in both Rel-15 and Rel-16?”  Regarding Question 2 from RAN2, RAN1 concluded Rel-16 per-UE capabilities with xDD differentiation and FRx differentiation can be differentiated for SUL/SDL bands by "per-band” capability signaling for each SUL band and SDL band. On the other hand, RAN1 didn’t make a conclusion on Rel-15 per-UE capability yet and will continue discussing it. |

However, RAN1 didn’t provide clear answers and the discussions had continued in the RAN plenary. In RAN#90-e meeting, following conclusion was made in RP-202911 i.e. how to apply the features can be xDD differentiated for SUL:

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| Conclusion:  - No new signalling will be introduced in Rel-16 to provide a DL/UL configuration for an SUL carrier.  - Per UE Capabilities that are FDD/TDD differentiated when applied to SUL carriers are indicated by the FDD capability (i.e. in effect the capabilities are not FDD/TDD differentiated for this case). Per UE capabilities that are  TDD only are not applicable to SUL. RAN2 is tasked to prepare Rel-15 and 16 CRs to capture this agreement. |

***DISC S1\_1:*** *How to associate the SDL carriers to xDD?*

During the RAN plenary discussion, the conclusion only handles the association of the SDL carriers to FDD was made but how to associate the SDL carriers to xDD was not concluded. In this meeting, RAN1 is now discussing on this issue and the candidate option on the table would be:

1. Capability differentiation of SDL carriers is associated to the capabilities for TDD bands if SDL bands are overlapped with TDD bands, otherwise SDL bands can be associated to the FDD bands.
2. Capability differentiation of SDL carriers is always associated to the capabilities for FDD bands.

R2-2100439/R2-2100440 proposes the approach 1) above but other CRs are not touching this issues.

**Q1: How to associate the SDL carriers to xDD?**

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| **Company** | **Comments** |
| Qualcomm Incorporated | Wait for RAN1. We do not think it is technically correct to associate SDL to TDD purely from the basis of spectrum arrangement. There are many UE capabilities also related to baseband behaviours as well. |
| Huawei, HiSilicon | We need to wait for RAN1’s agreement. Technically we prefer 2). Perhaps it would also be good that in RAN1 discussion it can be confirmed whether the agreement would apply to both Rel-15 and Rel-16 per UE capabilities for SDL, as the current RAN1 discussion seems focusing on Rel-16 only. |
| OPPO (Qianxi) | Better to wait for RAN1 to conclude first. |
| Ericsson | We are fine to wait for RAN1. |
| Nokia | Okay to wait for RAN1 to conclude the details. |
| MediaTek | Also agree to wait RAN1 |
| Apple | We are also ok to wait for RAN1 |
| vivo | Can confirmed by RAN1 which option is used. |
| ZTE | Also agree to wait RAN1 |
| Intel | Wait for RAN1 since RAN plenary only concluded on SUL. |
| CATT | Also we think it is better to wait for R1. |
| Samsung | Agree to wait RAN1. |
| LG | Wait for RAN1 |

***DISC S1\_2:*** *How to capture the SUL differentiation in the specification?*

There are three types of CRs were submitted but the changes are based on what RAN plenary concluded in the above excerption. It is clear that RAN2 need to capture some description to clearly provide how the capability differentiation of SUL bands is achieved. There are two big approaches:

1. Option 1: Update the normative text procedure to describe conclusion of SUL/SDL differentiation.

* Huawei: R2-2101911/R2-2101912
* Ericsson: R2-2101432

1. Option 2: Add “Note” to describe the conclusion of SUL/SDL differentiation.

* Samsung: R2-2100439/R2-2100440

**Q2: How to capture the SUL/SDL differentiation in the specification? Companies provide the preferred way with further comments.**

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| **Company** | **Option?** | **Comments to the CR** |
| Qualcomm Incorporated |  | No strong view. |
| Huawei, HiSilicon | 1 | We prefer to add normative text instead of note as these are clarifications. |
| OPPO (Qianxi) | 2 | A note would be sufficient.  As replied above, for SDL, we tend to wait for RAN1 conclusion first. |
| Ericsson | Option 1 | We think it is safer to clarify in normative text. |
| Nokia |  | Normative text is fine |
| MediaTek | 1 | Normative text is better. Prefer to start with Huawei version. |
| Apple | Op 1 | Prefer in the normative text with Huawei/Intel paper |
| vivo | 1 |  |
| ZTE | 1 | We think both Huawei and E///’s modification are needed. |
| Intel | Option 1 | We basically prefer R2-2101911’s CR capturing the conclusion as it is. However, we do not think there is a need to include the additional sentence on consistency as in R2-2101912 for Rel-16. We only need a Rel-15 CR with a shadow Rel-16 CR. |
| CATT | 1 |  |
| Samsung |  | No strong view but if majority want to option 2 we will follow the decision. |
| LG | 1 | No strong view but slightly prefer to having normative text. We prefer R2-2101911. |

**Conclusions (DISC\_S1):**

All participated companies commented that RAN2 should wait for RAN1 how to How to associate the SDL carriers to xDD because RAN1 is discussing this issue during this meeting. In addition, majority companies prefer to capture the how to signal SUL/SDL differentiation in the normative text, R2-2101911 would be the starting point.

Rapporteur suggests to postpone this CR until RAN1 concludes how to associate the SDL carriers to xDD,RAN2 first apply corrections on the SUL part using normative text in this meeting. R2-2101911/R2-210191 would be the baseline in Phase 2 discussion

Proposal 1a: Wait RAN1 response how to associate the UE capability differentiation for SDL carriers.

Proposal 1b: To agree R2-2101911/R2-2101912 with potential updates based on companies comments in Phase 2.

## 2.2 **Fallback per CC**

This section deals with **DISC\_S2: Fallback per CC**.

In RAN#113-e, it was discussed the definition of fallback in case of feature sets per CC, but the changes related to this were postponed:

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| R2-2010539 Definition of fallback per CC feature set Ericsson CR Rel-15 38.306 15.11.0 0457 - F NR\_newRAT-Core  - [011] Intermediate, Rapporteur: To continue discussing: whether there is any parameter in feature set per CC that may be unclear regarding the definition of fallback of feature set per CC (for both Rel-15 and Rel-16); how to capture any identified parameters into the definition of fallback of feature set per CC  **[011] Postponed**  R2-2010538 Definition of fallback per CC feature set Ericsson CR Rel-16 38.306 16.2.0 0456 - A NR\_newRAT-Core  **[011] Postponed** |

In R2-2101430/R2-2101431, it is proposed that all the Rel-15 parameters present on Feature Set per CC level are applicable to the fallback concept defined in TS 38.306, except for SCS.

In R2-2101660/R2-2101661, it is proposed that Rel-15 fallback per CC feature set is a feature set per CC that has lower value than the reported values (i.e. MIMO layers and BW) while keeping the numerology(SCS) and modulation order the same.

All above contributions observed that the capabilities that are introduced in Rel-16 could be applicable to the fallback concept defined in 38.306. CRs suggest to re-word the definition of fallback per CC feature and fallback per band feature set.

* **Option 1**: Suggest to re-word the definition of fallback per CC feature and fallback per band feature set suggested in R2-3101431.

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| **Fallback per CC feature set:** A feature set per CC that has same or lower values than the values for the reported feature set per CC for a given carrier per band, while keeping the numerology. |

* **Option 2**: Suggest to re-word the definition of fallback per CC feature and fallback per band feature set suggested in R2-3101661.

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| **Fallback per band feature set:** A feature set per band that has lower capabilities than the reported capabilities from the reported feature set per band for a given band.  **Fallback per CC feature set:** A feature set per CC that has lower capabilities of UE supported MIMO layers and BW while keeping the numerology and other parameters the same from the reported feature set per CC for a given carrier per band. |

Q3: Which CR is preferred if the changes are required?

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| **Company** | **Option?** | **Comments to the CR** |
| Qualcomm Incorporated | Option 2 | It is indeed true that lower capability does not necessary means lower value. We think though it is safer to keep the fallback which has the “same” capability to be included there, in order to avoid the UE indicating the same capability (though unlikely). |
| Huawei, HiSilicon | Option 2 | Proponent of R2-2101660/R2-2101661.  Except for the clarification for Rel-15 spec, the IE which is ENUMERATED {supported} is introduced in Rel-16, we need to clarify how to understand the fallback for such capability. Besides, we understand the current wording “lower values” is not always accurate, as “lower values” does not always means “lower capability”. Thus, the re-wording on “lower values” is needed to avoid considering a better capability as the fallback capability. |
| OPPO (Zhongda) | See comment | The way in option1 seems more future proof but the wording “value” should be replaced with “capabilities” so we can have following change:  **Fallback per band feature set:** A feature set per band that has same or lower capabilities than the reported capabilities from the  reported feature set per band for a given band.  **Fallback per CC feature set:** A feature set per CC that has same or lower capabilities than the capability of the reported feature set per CC for a given carrier per  band. |
| Ericsson | Option 1 and Option 2 | Our understanding is that the changes touch upon different aspects.  Option 1 intends to clarify to which capabilities the fallback behaviour concept for feature set per CC applies – in our view, all the capabilities are applicable to such behaviour except the SCS.  Option 2 intends to clarify that lower values in UE capability fields not always mean reduced UE capabilities. Hence, we think also this clarification is needed. But it is safer to not remove the “same or” part. |
| Nokia | Option 2 | Option 2 is safer. Agree with Qualcomm. |
| MediaTek | Option 2 | Similar view. Option 2 is safer. |
| Apple | Op 2 | In addition agree with Huawei’s comments, which also need to be addressed. |
| vivo | Option2 |  |
| ZTE | Option 1 and Option 2 | If the option 1 can be accepted by the UE vendors, we slightly prefer option 1 for that it’s more future proof. |
| Intel | Option 1 | We think Option 1 and 2 are covering different aspects. The main point here is to decide on which specific capabilities can be fallback and hence we agree with the intention of option 1 CR but prefer to add specific capabilities applicable for this fallback definition, instead of making it generic. |
| CATT | Option 2 | But it is better to keep the term “same”. |
| Samsung | Option 2 | Agree that Option 2 is safer. |
| LG | Option 2 | For now we think option2 is sufficient. If more generic definition is to be considered later, we can re-discuss this then. |

**Conclusions (DISC\_S2):**

All companies agree to the intension of Option 2 (R2-3101660/R2-3101661) that “lower values” does not always means “lower capability” (i.e. change “lower values” to “lower capabilities”), but some companies proposed to keep the “same or” in the definition of Fallback per band feature set in order to avoid the UE indicating the same capability.

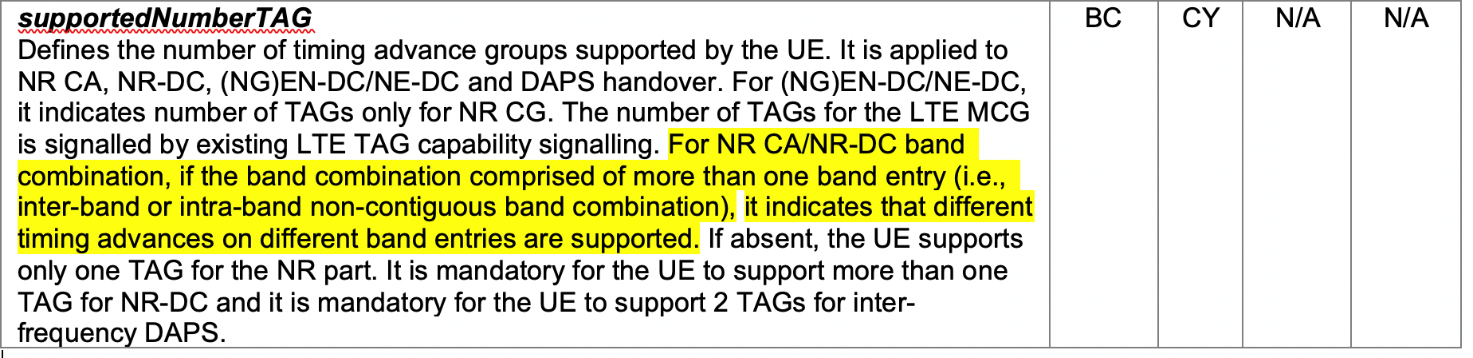
In addition, some companies explained that Option 1 touched different aspect to clarify which capabilities the fallback behaviour concept for feature set per CC applies. There are some supports for the intention of this CR (Option 1). Meanwhile some companies think the Option 2 is sufficient now and more generic definition is to be considered later.

**Proposal 2: Agree CR** **R2-2101660/R2-2101661 with revision i.e.** **keep the “same or” in the definition of Fallback per band feature set.**

## 2.3 **Supported Number of TAG**

This section deals with **DISC\_S3: Supported Number of TAG**.

In last RAN2 meeting, the clarification of *supportedNumberTAG* capability was discussed, and companies wants to have more time to check further.



According to the description marked in yellow, it’s clear that for the BC with two band entries NW can configure the TAG per band entry. But for the BC with more than 2 band entries, especially for the mixed inter-/intra band BC, if UE indicates 2 TAGs, how to interpret the capability is not clear and needs to be clarified.

R2-2101354 explains that the current UE capability signalling will lead the NW misinterpretation on the UE capability when *supportedNumberTAG* < band entries in the BC, so the contribution proposes that the clarification is needed. Below options are suggested:

* **Option 1:** UE is required to support the different TAGs in the different bands if the TAG number < band entry number;

For the mix inter/intra-band BC:

* If UE reports the TAG number = band entry number, UE supports the different TAGs configured in both intra-band non-contiguous CA and inter-band CA;
* If UE reports TAG number < band entry number, UE only supports the different TAG configured in inter-band CA.
* **Option 2:** Introduce the association between the TAG and the band entries, e.g. via the cell grouping;

The cell grouping signaling designed for Async DC capability can be considered to be used to indicate the association between band entry and TAG.

Q4: Which option is preferred if the changes are required?

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| **Company** | **Option?** | **Comments to the CR** |
| Qualcomm Incorporated | Option 1 | We understand typical deployments can still be address with this solution. Option 2 is more flexible, but introduces complexity and overhead. |
| Huawei, HiSilicon | None | We agree there may exist the case that supportedNumberTAG < band entries in the BC. In this case, it means different TAGs are on different band entries (some band entries may belong to the same TAG) according to the current spec. Option 1 is NBC change from NW perspective and Option 2 is too complicated.  We don’t see any issue with current definition, and we prefer not to change the current specification. |
| OPPO (Qianxi) |  | We tend to see option-1 as the preferred starting point.  On the other hand, option-1 may not be exhaustive so worth further clarification: e.g.,   * When the indicated TAG no. < the no. of band (for inter-band case only), whether the association between TAG and band can be arbitrary. * When the indicated TAG no. > the no. of band (for inter-band case only) and the indicated TAG no. < the no. of band entry (considering intra-band non-contiguous case), whether the association between the extra TAG (= no. of TAG – no. of band) and the intra-band band-entries can be arbitrary. |
| Ericsson | None | Option 1 is NBC, a UE setting *supportedNumberTAG* to something larger than 1 must support any set of contiguous carriers in any group. The reasoning in Rel-15 was that UEs would anyway serve each group of contiguous carriers by one RF chain and, if it supports several sets of contiguous UL carriers, it should also be able to handle those with different TAGs. There should be no difference between intra-band non-contiguous and inter-band non-contiguous. Hence, option 2, besides being complex, it is also not needed. |
| Nokia | None | Agree about the NBC nature of Option 1 as this puts a meaning that was not previously understood. Option 2 complexity is not justified enough for the given use case and till there is a real issue we don’t propose to fix anything. |
| MediaTek | Option 1 |  |
| Apple | Both are ok  (proponent of the paper) | Option 2 is perfect, and Option 1 is acceptable.  UE could have different mutli-TA capability for inter-band BC and intra-band non-contigous BC. Therefore, in the mix inter-/intra-band BC, UE should be allowed to use the *supportedNumberTAG* to indicates its inter-band BC capability but not for the intra-band BC capability.  But current defination of the *supportedNumberTAG* capability is not clear in the mixed inter-/intra-band BC case. So how to understand the *supportedNumberTAG* capability needs to be clarified.  Option 1 is the simple solution, which is to interpret *supportedNumberTAG* capability is only applicable for the inter-band CA case if TAG number < band entry number.  There is no inter-operability issue for Option 1, because multi-TA for intra-band CA requires UE having the dual PA capability. In the mix inter-/intra-band BC case, UE cannot indicate its *dualPA-Architecture*  capability for the intra-band case, so NW cannot assume UE can support the multi TA for the intra-band CA case.  Option 2 is more accurate to provide the association between the TAG and the band entries. It can also indicates the case that UE can support multi-TA in some inter-band cases but not in the others in one BC. But it will introduce new signaling for it. |
| vivo | Option1 | Option1 is OK now. more flexibility method can be discussed in later release. |
| ZTE | Option 1 and option 2 | We think the option 1 can be as the start point. |
| Intel | None | Our understanding is that there is no differentiation between intra-band and inter-band combination. If the TAG number < band entry in a band combination, the UE should be able to do any combination that satisfies the TAG number, |
| CATT | Option 1 | For its simplicity. We don’t see much issue with such simple solution. |
| Samsung | None | We also think option 1 is NBC from NW point of view and the current specification seems fine i.e. UE should be support any combination as Intel mentioned. |
| LG | Option 1 | Option1 is simpler and straightforward from UE perspective.  But if this is considered as network NBC, we may consider Intel approach, but wonder if this may result in the UE announcing lower TAG than option 1. |

**Conclusions (DISC\_S3): TBA**

Companies views are divided into two ways: “Option 1” and “None” (i.e. no further clarification is needed).

Some companies agree on problem that UE is required to support the different TAGs in the different bands if the TAG number < band entry number especially for the mix inter/intra-band BC. Option 1 is supported by these companies because of the simple approach.

However, some network vendors expressed concerns on the NBC problem from NW point of view and there is no difference between intra-band and inter-band combination. In that sense, UE should be able to do any combination that satisfies the TAG number if the TAG number < band entry in a band combination.

**Proposal 3: RAN2 further discuss whether UE should be able to do any combination that satisfies the TAG number if the TAG number < band entry in a band combination in the Phase 2.**

# 4 Conclusions

**Conclusions (DISC\_S1):**

**Proposal 1a: Wait RAN1 response how to associate the UE capability differentiation for SDL carriers.**

**Proposal 1b: To agree R2-2101911/R2-2101912 with potential updates based on companies comments in Phase 2.**

**Conclusions (DISC\_S2):**

**Proposal 2: Agree CR** **R2-2101660/R2-2101661 with revision i.e.** **keep the “same or” in the definition of Fallback per band feature set.**

**Conclusions (DISC\_S3):**

**Proposal 3: RAN2 further discuss whether UE should be able to do any combination that satisfies the TAG number if the TAG number < band entry in a band combination in the Phase 2.**