**3GPP T****SG-RAN WG2 Meeting #117-e R2-2203640**

**E-Meeting, Feb 21th – Mar 3rd, 2022**

**Agenda item:**  **8.2.5**

**Source: Intel Corporation**

**Title: Report of [AT117-e][225][DCCA] DCCA UE capabilities (Intel)**

**Document for: Discussion**

# Introduction

This is the report of the following email discussion:

* [AT117-e][225][DCCA] DCCA UE capabilities (Intel)

 Scope: Finalize RAN2 parts of UE capabilities of the DCCA WI based on contributions to 8.2.5.

 Intended outcome: Discussion report in [R2-2203640](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2203640.zip).

 Deadline: Deadline 4

**Deadline 4 (discussions for 2nd week Wed online):**

* **Comment deadline:** ~~Monday~~~~W2, 1200 UTC~~ Tuesday W2, 1200 UTC (for collecting views)
* **Rapporteur proposals:** Tuesday W2, ~~1200~~ 1400 UTC (proposed resolution of issues)
* **Document deadline:** Tuesday W2, 1600 UTC (report or agreed CRs)
	+ No extensions to this deadline for regular discussions. Discussions handling CRs may continue to short post-meeting email (based on chair decision).

To allow at least 24h for all delegates to join this offline discussion, rapporteur suggests setting the comment deadline to Tuesday W2, 1000 UTC.

# Discussion

In RAN2#116e meeting, initial discussion on DCCA UE capabilities was made, and the following agreements were achieved:

* 1: consider the following UE capabilities and corresponding descriptions as baseline (can still discuss exact details in the next meeting):

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| **Index** | **Feature group** | **Components** | **Prerequisite feature groups** | **Need of FDD/TDD differentiation** | **Need of FR1/FR2 differentiation** | **Type****(the ‘type’ definition from UE features should be based on the granularity of 1) Per UE or 2) Per Band or 3) Per BC or 4) Per FS or 5) Per FSPC)** | **Mandatory/Optional** |
| x-1 | Activation/Deactivation of SCG | Support of activation/deactivation of SCG. |  | No | Yes | Per UE | Optional with capability signalling |
| x-2 | Activation/Deactivation of SCG | RACH-less SCG activation. | FFS | No | Yes | Per UE | Optional with capability signalling |
| x-3 | CPAC | CPA for NR-DC |  | No | No | Per UE | Optional with capability signalling |
| x-4 | CPAC | CPA for (NG)EN-DC |  | No | No | Per UE | Optional with capability signalling |
| x-5 | CPAC | MN initiated CPC in NR-DC | FFS | No | No | Per UE | Optional with capability signalling |
| x-6 | CPAC | MN initiated CPC in (NG)EN-DC | FFS | No | No | Per UE | Optional with capability signalling |

In RAN2#116bis-e meeting, two more agreements were achieved as below:

* 1: condPSCellChange-r16 is not the Prerequisite for R17 MN initiated CPC.
* 5: RAN2 confirms that per UE CPAC capabilities follow the same approach as for Rel-16 CPC capabilities (granularity etc.)

Meanwhile in the main session, a general agreement on FRX/XDD differentiation was made as follows:

* From Rel-17 onwards, at least for new capabilities, if a UE capability requires at least FRx or at least xDD differentiation, it is defined with both FRx and xDD differentiation in per band signaling, i.e. no new UE capabilities will be defined in the FRX and XDD capability signaling branches.

In this offline discussion, we further discuss how to finalize RAN2 parts of UE capabilities of the DCCA WI based on contributions to 8.2.5.

##  UE capabilities for SCG activation/deactivation

### Granularity

According to the baseline design, UE capabilities for SCG activation/deactivation are per UE capabilities with FRX differentiation. But if we follow the agreement made in main session, we should define them in per band signalling.

To implement the new agreements, the approach suggested in [1] is as below:

**Option 1**: UE capabilities for SCG activation/deactivation are defined in per band signalling.

For NR-DC case, we can put them in IE *BandNR.* For (NG)EN-DC case, define per band UE capabilities for SCG activation/deactivation in extended *supportedBandListEN-DC* of IE *UE-EUTRA-Capability*. It also means new running CRs for 36.331 and 36.306 are needed. The exemplary spec changes are shown in [4-7].

In [2], another option is proposed as follows:

**Option 2**: The Rel-17 SCG (de)activation UE capability is reported per-BC in MRDC-Parameters for EN-DC and CA-ParametersNRDC for NR-DC.

The reasoning for option 2 is “For SCG (de)activation, we understand the granularity could be per-UE or per-BC. From signalling point of view, both ways are easy to signal. Per-BC is more flexible and friendly to UE implement/test on per-BC basis.” [2]

**Question 1: Regarding the granularity of UE capabilities for SCG activation/deactivation, which option is agreeable?**

**Option 1: per band.** Originally it is per UE with FRX differentiation, but it has to be changed to per band according to the latest agreement made in main session.

**Option 2: per BC as proposed in [2].**

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| **Company** | **option 1 or 2** | **Additional comments** |
| OPPO | Option 2 |  |
| Qualcomm | Option 1 or Option 2 | Per-band is preferable for simplicity, but we are fine with Option 2 also, which gives more flexibility. |
| Samsung  | Opt 2 | Per BS is safe and flexible to the UE test case. |
| Nokia | Option 1 | Just for clarification – intention is the allow signaling per band /band combination but UE needs to set value unimously for whole FRX? Why would SCello bands matter for PSCell deactivation? So option 2 seems quite odd choice all together. |
| Ericsson | Option 1 | We agree per band is needed due to agreement on FRX/XDD differentiation in last meeting. There is however no need for per BC signalling, which is more costly from signalling overhead perspective. Moreover, even if the signaling is per band, we understand the UE has to set it consistently for FR1 TDD, FR1 FDD and FR2 TDD bands. |
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If option 1 is agreed, one issue which still needs to be resolved is that UE can only support SCG activation/deactivation when UE supports SCG activation/deactivation in all bands of this SCG. The reason is that when one SCG is activated or deactivated, PSCell and all SCells are supposed to be activated or deactivated together, so UE should support SCG activation/deactivation in every band of this SCG.

**Question 2: If option 1 in Q1 is adopted, do you further agree to the following proposal:**

**RAN2 to confirm that UE can only support activation/deactivation of one SCG when UE supports SCG activation/deactivation in all bands of this SCG.**

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| **Company** | **Y or N** | **Additional comments** |
| Qualcomm | Y |  |
| Nokia | N | Deactivation only concerns PSCell – why would scell band affect PSCell deactivation status? |
| Ericsson | N | Since SCG deactivation is different from SCell deactivation, we think it is sufficient to say that the UE can support activation/deactivation of one SCG when UE supports SCG activation/deactivation in PSCell of this SCG. |
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### Resume and Reconfiguration

Regarding whether to have separate UE capabilities for SCG (de)activation in Resume and Reconfiguration cases, companies’ views are as below:

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| [1] **Proposal 3: For both (NG)EN-DC and NR-DC, have separate capabilities for Activation/Deactivation of SCG in Resume and Reconfiguration cases.**[2] **P4: define separate bits for SCG (de)activation in RRCResume and RRCReconfiguration message.**[3] **Proposal 3 If the UE indicates support of SCG activation/deactivation, it implies support of the feature for both RRC Resume (if the according Rel-16 capabilities for SCG resume are supported) and RRC Reconfiguration.** |

And besides the reason why to define separate UE capabilities, more description is provided on why they can be combined into one UE capability in [3] as follows:

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| Another aspect to be considered is whether to introduce separate capabilities for activation/deactivation of SCG in RRC Resume and RRC Reconfiguration cases. It has been raised in RAN2#116 that this discussion would be similar to the discussion held on SCell activation in Rel-16 (where it was decided to have separate UE capabilities for RRC Resume and RRC Reconfiguration), and thus we should do the same for SCG activation/deactivation. It should be noted, however, that for SCell activation upon resume (compared to SCell activation upon RRC reconfiguration), there is a clear new feature being triggered i.e. the UE must be able to activate SCells upon receiving an *RRCResume* message. However, for SCG case, from the legacy Rel-16 behaviour, the UE should already be able to have the SCG activated upon resuming, i.e. if it indicates support for resumeWithStoredSCG-r16.Note that the term “activate SCG” only makes sense if the SCG was previously deactivated, otherwise, an activated SCG is essentially just a regular SCG. Therefore, we cannot follow the same approach as done for SCell activation, considering that the UE should already be able to support SCG activation upon resuming. We could at most cover with a new feature on resume “the UE support for keeping the SCG deactivated upon resuming”; but the activation is already given by resumeWithStoredSCG-r16. Hence, it is simpler to just follow one capability for RRC configuration and RRC resume in general. The support for resume would further depend on whether the UE reported the Rel-16 capabilities for SCG resume. |

**Question 3: Whether to define separate capabilities for SCG (de)activation in RRC Resume and RRC Reconfiguration cases?**

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| **Company** | **Y or N** | **Additional comments** |
| OPPO | no strong opinion |  |
| Qualcomm | Y | Resume with stored SCG is a different concept where SCG configuration is restored upon RRC resume. It seems not to be relevant here. |
| Samsung  | No  | We think that it can be configured by either RRCResume or RRCReconfiguration if UE supports SCG (de)activation. |
| Nokia | N | It would be quite odd to e.g. only support RRC\_INACTIVE deactivation but not RRC\_IDLE. What is the real difference here? |
| Ericsson | N | As we mentioned in our paper (R2-2203392), if we define separate capabilities we cannot have the full feature of SCG activation/deactivation captured for the Resume case. |
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### RACH-less SCG activation

In the baseline design, we have a separate UE capability for RACH-less SCG activation, and we still have an FFS on whether to specify UE capability for RLM/BFD on deactivated SCG is the prerequisite for the support of RACH-less SCG activation.

In this aspect, companies’ proposals are as below:

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| [2] **Proposal 5: In addition to the basic capability, define the optional capability for the following components:**1. **RACH-less SCG activation;**
2. **RLM/BFD on deactivated SCG, which is not the prerequisite of RACH-less SCG activation.**

[3] **Proposal 1 RACH-less SCG activation is part of the basic support of the feature for Activation/Deactivation of SCG.****Proposal 2 For both FR1 and FR2, the UE support of Activation/Deactivation of SCG depends on the UE support of Rel-15 RLM/BFD capabilities.** |

Also we need to consider the following agreements made in RAN2#116bis and RAN2#117.

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| RAN2#116bis* 5: Upon reception of a network SCG activation command, the UE shall perform RACH towards the SCG if any of the following condition is true:

- reconfigurationWithSync is included in the SCG activation command- TA timer for the PSCell is expired- RLF is declared- BF is declared* 7: When the UE is configured to perform RLM/BFD when the SCG is deactivated, upon reception of a network activation command not including reconfigurationWithSync while the TA timer associated with the PSCell is running and BF/RLF is not declared, the UE shall activate the SCG without performing RACH towards the SCG.

RAN2#117* 5: If the UE is not configured to perform RLM/BFD while the SCG is deactivated, the UE always performs RACH upon receiving an SCG activation command.
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**Question 4: Which option can be agreeable regarding RACH-less SCG activation:**

**Option 1: Define the optional capability for RACH-less SCG activation.**

**Option 2: RACH-less SCG activation is part of the basic support of the feature for Activation/Deactivation of SCG.**

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| **Company** | **Option 1 or 2** | **Additional comments** |
| OPPO | Option 1 |  |
| Qualcomm | Option 2 |  |
| Samsung  | Option 2 | RACH-less SCG activation shows the benefit of activation/deactivation of SCG. Without RACH-less SCG activation, it would be almost the same as legacy addition/release of SCG. |
| Nokia | Option 2 |  |
| Ericsson | Option 2 |  |
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**Question 5: Whether to specify “RLM/BFD on deactivated SCG is the prerequisite of RACH-less SCG activation”?**

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| **Company** | **Y or N** | **Additional comments** |
| OPPO | Yes  |  |
| Qualcomm | Y |  |
| Samsung  | Yes  |  |
| Nokia | Y | It seems agreement “If the UE is not configured to perform RLM/BFD while the SCG is deactivated, the UE always performs RACH upon receiving an SCG activation command” already made the decision? |
| Ericsson | Yes |  |
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**Question 6: Regarding the UE capability for RLM/BFD on deactivated SCG, which option can be agreeable:**

**Option 1: Define separate UE capabilities for RLM/BFD on deactivated SCG.**

**Option 2: Reuse Rel-15 RLM/BFD capabilities.**

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| **Company** | **Option 1 or 2** | **Additional comments** |
| OPPO | Option 2 |  |
| Qualcomm | Option 2, for simplicity |  |
| Samsung  | Opt 2 |  |
| Nokia | Option 1 (ok with option 2 as well) | RLM/BFD on deactivated SCG seems quite different compared to R15 – Alhtough we would be fine to mandate support as well i.e. option 2 is OK as well |
| Ericsson | Option 2 |  |
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##  UE capabilities for CPAC

### Granularity

In RAN2#116bis-e meeting, one agreement was achieved as below:

* 5: RAN2 confirms that per UE CPAC capabilities follow the same approach as for Rel-16 CPC capabilities (granularity etc.)

Considering R16 CPC UE capabilities are defined in per band signalling, to implement the new agreements, the approach suggested in [1] is as below:

**Option 1**: UE capabilities for R17 CPC are defined in per band signalling.

For NR-DC case, we can put them in IE *BandNR.* For (NG)EN-DC case, define per band UE capabilities for R17 CPC, i.e., MN initiated CPC and SN Initiated inter-SN CPC, in extended *supportedBandListEN-DC* of IE *UE-EUTRA-Capability*. It also means new running CRs for 36.331 and 36.306 are needed. The exemplary spec changes are shown in [4-7].

And in [2], a per UE CPC UE capability is proposed as below:

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| For CPC, considering there is no *BandNR* or similar per-band parameter in MR-DC container, we prefer to report the Rel-17 capability in *MeasAndMobParametersMRDC* which can be reported in *UE-MRDC-Capability* container for EN-DC and in *UE-NR-Capability* (i.e. in *NRDC-Parameters*) for NR-DC, to enable a unified reporting signalling for EN-DC and NR-DC.**Proposal 2: Include the Rel-17 CPC UE capability in *MeasAndMobParametersMRDC* (reported separately for EN-DC and NR-DC. Separate bits indicate the UE capability of MN-initiated/SN-initiated CPC within FDD-FR1 bands/TDD-FR1 bands/TDD-FR2, between FDD-TDD, between FR1 and FR2.**MeasAndMobParametersMRDC-Common-v17xx ::= SEQUENCE { condPSCellAdditionChangeParameters-r17 SEQUENCE { condPSCellChangeMNInvolved-r17 ENUMERATED {mnInitiated, snInitiated, both} OPTIONAL, condPSCellChangeMNInvolved-FDDFR1-r17 ENUMERATED {supported} OPTIONAL, condPSCellChangeMNInvolved-TDDFR1-r17 ENUMERATED {supported} OPTIONAL, condPSCellChangeMNInvolved-TDDFR2-r17 ENUMERATED {supported} OPTIONAL <omitted part> } |

**Option 2**: UE capabilities for R17 CPC are defined in per UE signalling.

Include the Rel-17 CPC UE capability in *MeasAndMobParametersMRDC* (reported separately for EN-DC and NR-DC. Separate bits indicate the UE capability of MN-initiated/SN-initiated CPC within FDD-FR1 bands/TDD-FR1 bands/TDD-FR2, between FDD-TDD, between FR1 and FR2.

**Question 7: Regarding the granularity of UE capabilities for R17 CPC, which option is agreeable?**

**Option 1: per band.** Follow the same approach as for R16 CPC.

**Option 2: per UE as proposed by [2].**

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| **Company** | **Option 1 or 2** | **Additional comments** |
| Qualcomm | Option 1 | This is in line with the RAN2 #116-bis-e agreement. |
| Samsung  | Opt 1 | We think per band as legacy seems ok.  |
| Nokia | Option 1 | This is in line with R16 approach (agreed in the last RAN2 meeting). |
| ZTE | Option 1 | This is in line with the RAN2 #116-bis-e agreement. |
| Ericsson | Option 1, but | First of all, it should be noted that whatever we agree for this case should be followed in general when adding capabilities of this same granularity in the MR-DC container. For NR-DC, we should not use the old MeasAndMobParameters since we agreed already that we will make this signaling per band instead. For EN-DC, we can use MeasAndMobParametersMRDC but include the plain bits there, i.e. one for each FRx-XDD, since the whole point of our agreement in Rel-16 to use per band signaling for cases that required both FRx and xDD differentiation was that our xDD/FRx diff structure was complex and ambiguous. |
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As for the granularity of UE capabilities for R17 CPA, we also have the following options to consider:

**Option 1: per band.** Follow the same approach as for R16 CPC, which is in line with the agreement “RAN2 confirms that per UE CPAC capabilities follow the same approach as for Rel-16 CPC capabilities (granularity etc.).”

**Option 2: per BC as proposed by [1].** The corresponding description is as below:

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| For CPA, it should be based on the UE capability of (NG)EN-DC and NR-DC. Since DC related UE capabilities are usually defined as per BC, the CPA UE capabilities should also be defined as per BC. **Proposal 6: CPA UE capabilities are defined in per BC signaling.** |

**Option 3: per UE as proposed by [2].** The corresponding description is as below:

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| For CPA, as the supported band combination already differentiates different band types, one bit of per-UE capability of CPA can be reported in *MeasAndMobParametersMRDC*.**Proposal 3: The Rel-17 CPA UE capability is reported in *MeasAndMobParametersMRDC*, using one bit to indicate the UE supports CPA on all the supported MR-DC band combinations.** |

**Question 8: Regarding the granularity of UE capabilities for R17 CPA, which option is agreeable?**

**Option 1: per band.** Follow the same approach as for R16 CPC.

**Option 2: per BC as proposed by [1].**

**Option 3: per UE as proposed by [2].**

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| **Company** | **Option 1/2/3** | **Additional comments** |
| Qualcomm | Option 1 | This is in line with the RAN2 #116-bis-e agreement. |
| Samsung  | Opt 2 | We think to have per-BC is safer way for indicating the capability, but no strong view. |
| Nokia | 2 | Reasonable to align it with DC-like UE capability signalling design. |
| ZTE | Option 2 | We think it is fine to follow DC related UE capabilities design, but no strong view. |
| Ericsson | Option 3, but | it should be included in the MR-DC container for EN-DC and NR container for NR-DC |
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### Additional CPAC related UE capabilities

The following CPAC related UE capabilities are proposed in companies’ papers:

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| [1] **Proposal 4: Add new capability for SN Initiated inter-SN CPC in (NG)EN-DC and NR-DC respectively.**[3] **Proposal 6: The following separate UE capabilities for CPAC should be introduced:- SN-initiated CPC for NR-DC- SN-initiated CPC for (NG)EN-DC- CPA for NR-DC- CPA for (NG)EN-DC- MN-initiated CPC for NR-DC- MN-initiated CPC for (NG)EN-DC- Inter-SN PSCell change between FDD and TDD (for NR-DC and (NG)EN-DC)- Inter-SN PSCell change between FR1 and FR2 (for NR-DC and (NG)EN-DC)** |

Since CPA for NR-DC and (NG)EN-DC, MN-initiated CPC for NR-DC, and MN-initiated CPC for (NG)EN-DC have been included in baseline design, companies are invited to provide views on whether to add the following separate UE capabilities:

- SN-initiated CPC for NR-DC
- SN-initiated CPC for (NG)EN-DC
- Inter-SN PSCell change between FDD and TDD (for NR-DC and (NG)EN-DC)
- Inter-SN PSCell change between FR1 and FR2 (for NR-DC and (NG)EN-DC)

**Question 9: Whether to define the following separate UE capabilities:**

**- SN-initiated CPC for NR-DC
- SN-initiated CPC for (NG)EN-DC
- Inter-SN PSCell change between FDD and TDD (for NR-DC and (NG)EN-DC)
- Inter-SN PSCell change between FR1 and FR2 (for NR-DC and (NG)EN-DC)**

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| **Company** | **Y or N** | **Additional comments** |
| Qualcomm | Y |  |
| Samsung  | Y  |  |
| Nokia | No | We do not see a justification for this kind of increased UE capability granularity. i.e. from UE point of view there are not many differences (if any) between MN- and SN-initiated CPAC, so what would be the reason for such separation?  |
| ZTE | Y |  |
| Ericsson | Y |  |
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Another issue raised in [3] is as below:

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| The *condPSCellChangeTwoTriggerEvents-r16* is then mandatory supported if the UE supports *condPSCellChange-r16* so the UE thus needs to support the two trigger events if it supports the feature. We therefore think that the two trigger events should be considered as part of the basic support of the corresponding feature and that there is no need for a separate capability indication for this.Proposal 5: Support for two trigger events is part of the basic support of the Rel-17 features CPA, MN-initiated CPC and SN-initiated CPC. |

**Question 10: Whether the following proposal is agreeable?**

**Support for two trigger events is part of the basic support of the Rel-17 features CPA, MN-initiated CPC and SN-initiated CPC.**

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| **Company** | **Y or N** | **Additional comments** |
| Qualcomm | Y |  |
| Samsung  | Y |  |
| Nokia | Yes | We agree that this does not deserve to have a separate capability.  |
| ZTE | Y |  |
| Ericsson | Y |  |
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# Conclusion

Based on this offline discussion on UE capabilities, the following proposals are made:

# References

1. [R2-2202480](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_117-e/Docs/R2-2202480.zip) Discussion on remaining issues on DCCA UE capabilities Intel Corporation
2. [R2-2203380](file:///C%3A%5CRAN2%20work%5CRAN2-117%202202%5Ctdoc%5CR2-2203380.docx) UE capability for CPAC and SCG (de)activation Huawei, HiSilicon
3. [R2-2203392](file:///C%3A%5CRAN2%20work%5CRAN2-117%202202%5Ctdoc%5CR2-2203392---UE-capabilities-for-Rel-17-MR-DC-enhancements.docx) UE capabilities for Rel-17 MR-DC enhancements Ericsson
4. R2-2202483 CR TP for 38.331 on DCCA UE capabilities Intel Corporation
5. R2-2202484 CR TP for 38.306 on DCCA UE capabilities Intel Corporation
6. R2-2202485 CR TP for 36.331 on DCCA UE capabilities Intel Corporation
7. R2-2202486 CR TP for 36.306 on DCCA UE capabilities Intel Corporation