3GPP TSG RAN WG2 Meeting #111-e R2-200xxxx

**Electronic meeting,** **17th – 28th August 2020**

**Agenda item:** x.x.x

**Source:** Intel Corporation, NTT DoCoMo

**Title:** Report of email discussion [Post109bis-e][082] UE Capabilties

**Document for:**  Discussion and decision

# Introduction

This contribution is to progress some of the general open issues that were left over from the previous email discussion from the last meeting as listed in the RILs in [1] and [2] as part of the email discussion below:

* [Post110-e][082][NR16] UE Capabilities (Intel, NTT Docomo)

      Scope: Progress further R1R4 UE capabilities and general items (if needed). Take into account latest R1 feature list. Discuss handling of FFS’es at next meeting. Can consider Reply LSes (to R4 and R1), e.g. on general matters or on specific points/questions from earlier discussion.

      Intended outcome: Report, Agreeable LSs out to be sent first day of next meeting (if applicable), Draft CRs 38306 38331 (agreeable as baseline for next meeting).

      Deadline: Next meeting.

The outcome is to provide proposals on the general open issues discussed and to provide Reply LS to RAN1 or RAN4 (if needed) for some of the open issues based on the proposals from the discussion points.

Also as part of the email discussion, a draft CRs for 38.306 and 38.331 will also be produced for review based on the latest RAN1 feature list [3] once the June version specifications are available and ASN.1 RIL will be used for collecting review comments on the newly added capabilities as well as any miscellaneous corrections on Rel-16 capabilities added in the previous email discussion.

UL capabilities related to LPP (i.e. updates to TS37.355) will not be handled in this email discussion and are assumed to be handled in positioning session.

V2X UE capability issues will all be discussed in email discussion [707], including all the remaining issues from the last email discussion.

The deadline of this email discussion is into the next meeting, however we suggest having 2 phases:

* Phase 1 until 2020-07-31 23:59 PST for companies to provide their views on the discussion points listed and the drafted CRs to 38.306 and 38.331.
* Phase 2 until 2020-08-06 23:59 PST for companies to provide their views on the updated CRs and the draft LSes.

# Discussion

## Handling of FFS’es at next meeting

It is assumed that further update of RAN1/RAN4 feature list will be made available at the end of week 1 of RAN2 meeting. Hence it can be handled in the same way as in the last meeting to include the further updates to the mega CRs. If there are still FFS’es in the further updates from RAN1/4, the same as in last meeting can be follow that they will not be included in the mega CRs.

**Potential Proposal 1:** Upon receiving further update of RAN1/RAN4 feature list at end of week 1 of RAN 2 meeting, Intel/DCM to trigger RAN2 review of the CRs before or by Thursday of August 27th with the deadline for review and RAN2 agreement set to Wednesday of September 2nd

**Potential Proposal 2:** Include the following in a LS to RAN1/4:

* Explain to them that any content that is FFS will NOT be part of the UE capability signalling for the September specification version but could be considered in the next quarter.
* Inform them that further agreements, if any, from email discussions after their meetings cannot be part of September specification version but could be considered in the next quarter.

1. Companies are requested to provide their view on the potential proposals on how to handle FFS’es at next meeting:

|  |  |  |
| --- | --- | --- |
| **Company’s name** | **Agree/Disagree** | **Company’s comments, if any** |
| Apple | Agree | We have one more item to be added to the LS to RAN4. Pls see response to Q4 (discussion point 2.4). |
| OPPO | Agree with comment | For FFS issue if RAN2 can make sure about ASN.1, then such UE capability should be at least captured in 38.331 and leave FFS in the 38.306 just to make progress. |
| Huawei, HiSilicon |  | We understand from RAN plenary discussion, RAN1 and RAN4 should aim to complete the remaining FFSs in August meeting. Thus we think the LS to RAN4 should be written in a more positive way, i.e. to inform them that RAN2 expects RAN1 and RAN4 completes remaining FFSs in August. |
| Qualcomm Incorporated | Agree |  |
| Ericsson | Agree | If there are FFSs on a given feature, we do not see the point of including it in 38.331 without the corresponding 38.306 description. Essentially the capability anyway could not be used yet without its 38.306 description. And with high probability the capability signalling added to 38.331 prematurely will later require changes that are usually not doable in a backwards compatible manner. |
| Intel | Agree with potential Proposal1 and 2 | Agree with Ericsson that a feature should not be implemented if there will be FFS either in 38.306 or 38.331 |
| ZTE | Agree |  |
| NTT DOCOMO | Agree on both proposals | After ASN. freeze, only the stable capabilities should be incorporated into the specs. Otherwise, RAN2 should wait for the other WG decision. |
| CATT | Agree |  |

9 companies responded to the discussion point. 8 companies agree to the potential proposals. One company thinks that we can implement the feature with FFS if they do not have ASN.1 issue. One company thinks that we need to inform RAN1 and RAN4 in a more positive way. Since there are more companies supporting RAN2 follow the potential proposals, it is proposed to include the following sentence in the LS to RAN1 and 4, similar to the LS to RAN1 and 4 in the last meeting:

**Proposal#1:** include in the LS to RAN1 and 4:

RAN2 would also like to provide the timeline of designing the signalling based of the availability of RAN1 and RAN4 UE feature lists as below:

* RAN2 plan to start working on the capability signalling design aspects under the assumption that the UE feature lists from RAN1 and RAN4 are available to RAN2 by the end of week 1 of RAN1 and RAN4 WG meetings (viz., end of August 21st, 2020).
* Any content that is FFS will NOT be considered/discussed as part of the UE capability signalling for the September specification version but could be considered in the next quarter.
* Further agreements, if any, from email discussions after the RAN1 and RAN4 meetings cannot be part of September specification version but could be considered in the next quarter.

## Handling of the Per UE capability with XDD and FRX differentiation

In the previous email discussion, there is the following RIL which was postponed :

**[RIL]**: E010 **[Delegate]**: Ericsson (Lian) **[WI]**: MobEnh **[Class]**:3 **[Status]**: NotAgree **[TDoc]**: None **[Proposed Conclusion]**: Rapporeur thinks this needs to be discussed separately. Pls see comments

**[Description]**: If we keep “Yes” on both xDD and FRX column, we should add such parameters per band instead, i.e. condHandover-r16, condHandoverFailure-r16 and condHandoverTwoTriggerEvents-r16.

**[Proposed Change]**: See above.

**[Comments]**:[Rapporteur] There are quite many cases in this table, that “yes” for both XDD and FRX, but not put under per Band, e.g. ***handoverLTE-5GC, etc.***

Prefer to keep as is, as per endorsed CR, the FRX-XDD differentiation needs to be discussed for other capabilities as well.

Some examples of such Rel-16 capabilities that have these issues are listed below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| ***condHandover-r16***  Indicates whether the UE supports conditional handover including execution condition, candidate cell configuration and maximum 8 candidate cells. | UE | No | Yes | Yes |
| ***condHandoverFailure-r16***  Indicates whether the UE supports conditional handover during re-establishment procedure when the selected cell is configured as candidate cell for condition handover. | UE | No | Yes | Yes |
| ***condHandoverTwoTriggerEvents-r16***  Indicates whether the UE supports 2 trigger events for same execution condition. This feature is mandatory supported if the UE supports *condHandover-r16*. | UE | CY | Yes | Yes |

One proposal is to make these Rel-16 capabilities per band (instead of per UE) to resolve the issue when either XDD or FRX or both is set to ‘Yes’, as per RAN2 intention as in the LS to RAN1 [R2-2006367]:

*For release-16 UE capabilities for which both xDD and FRx differentiations are allowed, RAN2 intends to use “per band” capability signalling.*

Based on the above, the solution could be: Make those Rel-16 UE capabilities which have both XDD and FRX = ‘Yes’ to per band, if they are not already so.

1. Companies are requested to provide their view on the above solution or provide other suggestions:

|  |  |  |
| --- | --- | --- |
| **Company’s name** | **Agree/Disagree** | **Company’s comments, if any** |
| Apple | Agree | Per-band approach seems reasonable. |
| OPPO | Agree with comment | If an UE capability could be different for either XDD or FRX, then there is no any controversial issue. Therefore for those UE capability, they should still be per UE capability instead of per band. |
| Huawei, HiSilicon | Partly Agree | According to the LS sent to RAN1, the “per band” solution only applies to R16 UE capabilities for which both xDD and FRx differentiations are allowed. So those R16 UE capabilities which have either XDD or FRX = ‘Yes’ are not included.  And we still suggest to analyse these UE capabilities case by case. Regarding CHO UE capabilities, it perhaps good to keep them in *MeasAndMobParameters* field. If this capability is indicated per band, the meaning is a bit unclear, does it mean the source band supports CHO for any other target band? Originally the capability is differed between FR1 and FR2, this means the UE should have the same capability for FR1 bands and FR2 bands respectively, by indicating now per band would this original requirement be fulfilled? |
| Qualcomm Incorporated | Agree and additional comments | ***condHandover-r16*:**  Given other related capabilities we have defined, *condHandoverFDD-TDD-r16* and *condHandoverFR1-FR2-r16*, our understanding is that this capability covers the following cases.   * Intra-frequency CHO * Inter-frequency CHO   + Intra-DD/Intra-FR/Intra-band   + Intra-DD/Intra-FR/Inter-band   This capability should be changed to per band capability according to the previous RAN2 agreement. Additional restriction can be added to indicate that the UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR2 bands and all TDD-FR2 bands respectively.  ***condHandoverFailure-r16*:**  It is not clear how this capability applies to different conditional handover cases.  We think this should be per UE capability without xDD or FRx split.  That is, the UE capability indicates that the UE supports the failure handling in CHO scenarios the UE supports according to *condHandoverFDD-TDD-r16, condHandoverFR1-FR2-r16* and *condHandover-r16***.**  ***condHandoverTwoTriggerEvents-r16*:**  It is not clear how this capability applies to different conditional handover cases.  We think this should be per UE capability without xDD or FRx split.  That is, the UE capability indicates that the UE supports the 2 trigger events in CHO scenarios the UE supports according to *condHandoverFDD-TDD-r16, condHandoverFR1-FR2-r16* and *condHandover-r16***.**  We think the same issues apply to the following CPC capabilities.   * **condPSCellChange-r16** * **condPSCellChangeFDD-TDD-r16** * **condPSCellChangeFR1-FR2-r16** * **condPSCellChangeTwoTriggerEvents-r16** |
| Ericsson | Partially agree | The per band approach is needed only for Rel-16 UE capabilities for which both xDD and FRx differentiation is allowed. For the simpler cases i.e. only xDD differentiation **or** FRx differentiation, the signalling in the corresponding xDD or FRx branch should be used.  Generally, we wonder why those capabilities require any distinction by frequency range or duplex mode. It does not seem to impose any additional radio or measurement requirements. Shouldn’t this be a pure “per UE” feature? |
| Intel | Agree with additional comments | For the CHO capabilities, *condHandover-r16* and *condHandoverFailure-r16* requires xDD-Diff and FRx diff as agreed in RAN2#109 based on [R2-2001727](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_109_e/Docs/R2-2001727.zip), while *condHandoverTwoTriggerEvents-r16* is IOT bit (as it is conditioned to condHandover-r16 which requires xDD-Diff and FRx diff) as agreed in RAN2#110 based on [R2-2004663](https://www.3gpp.org/ftp/TSG_RAN/WG2_RL2/TSGR2_110-e/Docs/R2-2004663.zip)  It would be good to stick to RAN2 agreements instead of discussing them again. The only change we see to keep it per UE when the capabilities are updated to per band is to add the condition that the UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR2 bands and all TDD-FR2 bands respectively. |
| ZTE | Partially agree | We understand there was a tentative conclusion to use per-band signalling for capabilities that need both XDD and FRX differentiation. But since we already defined the following structure for condHandoverFDD-TDD-r16 and cond-HandoverFR1-FR2-r16, we can also consider to put condHandover-r16 within the same structure (by adding suffix). From signalling point of view, this is much more efficient than per-band signalling.  condHandoverParametersCommon-r16 SEQUENCE {  condHandoverFDD-TDD-r16 ENUMERATED {supported} OPTIONAL,  condHandoverFR1-FR2-r16 ENUMERATED {supported} OPTIONAL,  condHandoverFDD-FR1-r16 ENUMERATED {supported} OPTIONAL,  condHandoverTDD-FR1-r16 ENUMERATED {supported} OPTIONAL,  condHandoverTDD-FR2-r16 ENUMERATED {supported} OPTIONAL  } OPTIONAL,    If majority companies insist to use per-band signalling, we agree with Qualcomm and Intel to add condition that UE shall set consistent value for all FDD-FR1bands, TDD-FR1 bands and TDD-FR2 bands respectively.  Regarding capability condHandoverFailure-r16 and condHandoverTwoTriggerEvents-r16, we share the same view with Qualcomm that per-UE capability is sufficient, which specific scenario(s) are supported can be derived from other *condHandover-XX* capabilities. |
| NTT DOCOMO | Agree on additional comments | We also agree on Qualcomm analysis that condHandoverFailure-r16 and condHandoverTwoTriggerEvents-r16 require neither xDD split nor FRx split. condHandover-r16 should be defined as per-band, in accordance with the agreement made at the last meeting. |
| CATT | Agree | There is no problem with the general principle ‘For release-16 UE capabilities for which both xDD and FRx differentiations are allowed, ‎RAN2 intends to use “per band” capability signalling.‎’  Then it can be discussed case by case whether a capability/feature need to be differentiated for both xDD and FRx. |

Majority of companies are fine to follow the RAN2 agreement to make per band for Rel-16 capabilities with per UE capability requiring xDD-Diff and FRx-Diff. However, 1 company thinks for CHO capabilities, by adding additional capabilities (condHandoverFDD-FR1-r16, condHandoverTDD-FR1-r16 and condHandoverTDD-FR2-r1 in condHandoverParametersCommon-r16), this can avoid making the CHO capabilities per band. 1 company questioned the need for xDD-Diff or FRx-Diff for all of CHO capabilities, 3 companies questioned the need of some of the CHO capabilities (condHandoverFailure-r16 and condHandoverTwoTriggerEvents-r16) requiring both xDD-Diff and FRX-Diff and 1 company thinks that some ambiguities (e.g. the consistency over all FR1 bands etc.) may arise if the CHO capabilities are changed from per UE to per band. 2 companies proposed to discuss these capabilities requiring xDD and FRx Diff on a case by case.

On the questioning for all or some of the CHO capabilities requiring both xDD-Diff and FRx-Diff, A few companies (3 out of 8) think that at least condHandoverFailure-r16 and condHandoverTwoTriggerEvents-r16 require neither xDD split nor FRx split.

On the ambiguity that may arise when a CHO capabilities are changed from per UE to per band, this can be solved by adding a new condition that “the UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively.” We have added in the Annex a table on how the FDD-FR1 bands, TDD-FR1 bands and TDD-FR2 bands work with *condHandoverFDD-TDD-r16* and *condHandoverFR1-FR2-r16*

**Proposal#2:** Discuss how to handle the CHO capabilities (i.e. condHandoverFailure-r16 and condHandoverTwoTriggerEvents-r16) requiring both xDD Diff and FRx-Diff. If any change is made on CHO, the corresponding CPC capabilities need to change as well.

**Proposal#3:** For UE capabilities that are changed from per UE requiring xDD-Diff and FRx-Diff to per band, a new condition needs to be added (i.e. UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively). This will apply to (parameters so far implemented for Rel-16 that have both xDD-DIFF and FRx-DIFF):

MeasAndMobParameters:

* condHandover-r16
* pcellT312-r16
* handoverIntraF-IAB-r16

MeasAndMobParametersMRDC:

* condPScellChange-r16
* pcellT312-r16

Autonomous gap capabilities are discussed separately in a separate contribution.

## Intra-frequencies DAPS related issues

RAN4 feature list has left FFS on per FS or per BC on the following capabilities. HoweverRAN2 had agreed that they are to be made per band per band combination from the RAN2 WI session in the last meeting.

| ***intraFreqAsyncDAPS-r16***  Indicates whether the UE supports asynchronous DAPS handover. | Band | No | No | No |
| --- | --- | --- | --- | --- |
| ***intraFreqDAPS-r16***  Indicates whether UE supports DAPS handover in source PCell and intra-frequency target PCell, e.g support of simultaneous DL reception of PDCCH and PDSCH from source and target cell. | Band | No | No | No |
| ***intraFreqDiffSCS-DAPS-r16***  Indicates whether UE supports different SCS in source PCell and intra-frequency target PCell in DPAS handover. The UE can include this field only if *intraFreqDAPS-r16* is present. Otherwise, the UE does not include this field. | Band | No | No | No |
| ***intraFreqDynamicPowersharingDAPS-r16***  Indicates the value of T offset (short or long) for the UE supports dynamic UL power sharing during DAPS handover between source and target cells of same FR. It is only applicable to DAPS HO in synchronous scenarios. The UE can include this field only if *intraFreqSemiStaticPowerSharingDAPS-Mode 1-r16* is present. Otherwise, the UE does not include this field. | Band | No | No | No |
| ***intraFreqMultiUL-TransmissionDAPS-r16***  Indicates that the UE supports simultaneous UL transmission in source PCell and target PCell. The UE can include this field only if *intraFreqDAPS-r16* is present, and if any of *intraFreqSemiStaticPowerSharingDAPS-Mode1-r16, intraFreqSemiStaticPowerSharingDAPS-Mode2-r16* or *intraFreqDynamicPowersharingDAPS-r16* are present. Otherwise, the UE does not include this field. | Band | No | No | No |

During the email discussion, it was proposed to check with RAN4 by sending a LS to confirm that they are ok with RAN2 decision, while RAN2 keeps RAN2 agreement.

From the rapporteur point of view, it is reasonable to send a LS to RAN1/RAN4 to inform them of RAN2 decision and check their view.

1. Companies are requested to provide their view on including the above in the LS to RAN 1/4 to check their view on the RAN2 decision

|  |  |  |
| --- | --- | --- |
| **Company’s name** | **Agree/Disagree** | **Company’s comments, if any** |
| Apple | Agree | Ok to send an LS to RAN4 to inform them. |
| OPPO | Agree |  |
| Huawei, HiSilicon | Agree | ***DynamicPowersharingDAPS-r16*** is from RAN1 feature list, in which it is per BC. But in current spec, we specify ***intraFreqDynamicPowersharingDAPS-r16*** as per band, and ***DynamicPowersharingDAPS-r16*** as per BC for inter-frequency case. We also need to inform RAN1 about this change, as in RAN1 feature list it is per BC and if this capability is also applied to intra-frequency DAPS is not clear. The same clarifications also apply to other power sharing related UE capabilities in RAN1 feature list.  RAN2 also need to mention that regarding the granularity of intra-frequency DAPS UE capability, there is a misalignment between RAN1 and RAN4, i.e. per band in RAN1 and [per FS or per BC] in RAN4. |
| Qualcomm Incorporated | Disagree | We strongly believe that the RAN2 agreement should be kept as it is. We do not see strong need of sending an LS just informing RAN2 agreement. |
| Ericsson | Agree to send the LS, but | 38.306 lists these capabilities as “per band”, whereas 38.331 implements them as “per-band-per-BC”.  Capability signalling “per-band-per-BC” is not only the most heavy in terms of overhead and validation – it also seems unnecessary for this feature: –When initiating the DAPS HO, the UE anyway first deconfigures all SCells and then tunes to target PCell while holding the connection to the source PCell; only after completing the HO to the target side it sets up the SCells again. In other words, while performing a DAPS HO the UE does not use carrier aggregation. We don’t see why DAPS support would depend on whether and how carrier aggregation is configured prior or after the DAPS HO. Therefore, giving this misalignment between 38.331 and 38.306, it seems one could make this a “per-band” capability instead. |
| Intel | No strong opinion. | Agree with Qualcomm, we do not see the problem to stick to RAN2 agreements. But would be fine to send LS if majority companies want this.  On the IntraFreq and InterFreq DAPS, RAN1 only had one set of power sharing capability. But based on RAN4 requirements, i.e. separate capabilities for intraFreq and inter Freq, RAN2 agreed to have separate powering sharing capabilities for intra and inter Freq. And then followed the signalling structure for intra and inter frequency, both intra/interfreq DAPS are actually per BC and hence aligned with RAN1 guidance.  If LS is needed, we can inform RAN1, based on RAN4 requirements, RAN2 introduced separate power sharing capabilities for intra/inter freq.  To Ericsson, the TS38.331 is correct since RAN2 agreed that the intraFreq capabilities are per band per BC explicitly since it can give more flexible to the UE implementation, e.g. the UE can have different capabilities under different BC for the same Band. So TS38.306 should be updated to move the intraFreqDAPS parameters from BandNR parameters section to BandCombinationList parameters section (which we have raised in our RIL). |
| ZTE | No strong opinion | Agree with Qualcomm and Intel, we do not see big issue to stick to RAN2 agreements, but would be fine to send LS if majority companies want it. |
| NTT DOCOMO | No strong view | We’re O.K to send an LS to RAN1/4 and seek for their feedback, in order to make progress. |
| CATT | Agree | We are OK to send LS if that helps to progress |

9 companies responded to the discussion point. 5 companies are fine to send a LS to RAN1 and 4, though one company question the need of intraFreqDAPS parameters per band per BC. 1 company does not agree to send a LS. 3 company have no strong opinion/view if majority wants to send. Based on simple majority, RAN2 can include the capability agreements for intraFreqDAPS and interFreqDAPS to RAN1 and 4.

**Proposal#5:** Include the following 2 RAN2 agreements on intraFreqDAPS and interFreqDAPS in the LS to RAN1 and 4:

* 4: For inter freq DAPS, the capability inter-FreqDAPS is specified per BC (for intra band, inter band cases). It is put under existing CA bandcombination, and same as CA, the CCs in the bandcombination with UL can all be source or target PCell.
* 7: Per Band per BC capability (intraBandDiffSCS, intraFreq-DAPS) is put in BandParameters.

## Co-location indication for band combination

In the last email discussion, the following RAN4 feature is removed from the draft CRs as checking is needed on whether it is non-backward compatible:

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 2-20 | support co-located scenario only for inter-band EN-DC | Indicates the inter-band EN-DC combination supported by the UE can only work at co-located scenario, and in this scenario the PSD difference between DL carriers and MRTD can be guaranteed.  candidate values set: {type1, type2}  type 1 UE: performance guaranteed with PSD difference between DL carriers < 6dB, and MRTD=3us (current only DC\_20\_n28 has this limitation)  type 2 UE: performance guaranteed without limitation on PSD difference between DL carriers and MRTD=33us |  | Yes | N/A | If UE does not reports this capability, the performance cannot be guaranteed under inter-band non-collocated scenario. | Per band combination | N/A | FR1 only | NA | Optional |

The related RIL is also provided:

**[RIL]**: E009 **[Delegate]**: Ericsson (Lian) **[WI]**: Gen **[Class]**:3 **[Status]**: Proposal to remove this field in this version **[TDoc]**: None **[Proposed Conclusion]**: Rapporteur [Intel] proposes to handle this capability after discussion in RAN2, as the NBC as proposed by Ericsson is valid and we also cannot have BCs that are only from Rel-16 as RAN4 treats BCs as release independant.

**[Description]**: We assume that this field would be applicable to band combinations added in Rel-16, otherwise it would be non-backwards compatible. We would like to confirm this aspect.

**[Proposed Change]**:

**[Comments]**:

Such a Rel-16 extension of an inter-band EN-DC combination will not be release independent as Rel-15 gNBs and UEs will not be able use it to indicate whether the EN-DC inter-band combination is for only co-located or not.

As suggested in the RIL, one possibility is to make clear that such band combination with co-located indication can only be possible from Rel-16 (i.e. Rel-15 gNB and UE does not support/operate in such band combination with UE type indication). However, this would mean that band combination type indication can be not release independent. Use of magic sentence allowing UE and network to implement this signaling early without being fully Rel-16 compliant could also be considered.

Alternative is to introduce late critical extension for Rel-15. This will make the signaling release independent. However, it will still not be fully backward compatible since legacy gNBs will not be able to comprehend the UE type indication signaling.

If backward compatibility towards legacy gNBs is required, an alternative is to use a gNB “request”. If the UE only supports the co-located scenario for a certain inter-band EN-DC Band Combination, the UE will include these Band Combinations with co-located scenario in the reported capability only if gNB indicates it can comprehend type signalling i.e. UE will not include these Band Combinations in the list of supported band combinations when gNB cannot understand the UE type indication.

1. Companies are requested to provide their view on how to handle UE Type indication of the support of co-located only scenario for inter-band EN-DC combination

|  |  |
| --- | --- |
| **Company’s name** | **Company’s comments, if any** |
| Apple | We think we can have the UE signal only type-2 and absence of this capability for inter-band EN-DC combinations would mean the UE supports type-1.  Our approach is that any new restriction to be introduced, should be considered as baseline operation without signaling capability, and is associated with that feature. And UEs and NWs implementing that feature should support the baseline operation. Capability signaling is for extra options of the feature (or relaxation of restrictions).  In this case, we request that RAN4 capture the type-1 restriction (of MRTD and PSD) is expected by the UEs and NWs for any inter-band EN-DC combination that gets added, and this is without any signaling support. Only for the UEs which can handle relaxed MRTD/PSD, can report this “additional” capability by signaling {type-2}. This can ensure backward compatibility as any UE or NW implementing the new combination already knows the minimum expected operation requirements.  Our view is to add to the LS that is being prepared the below points:   1. Explain to them that RAN2 will only add signaling for type-2 and expect type-1 as the default behaviour. 2. Request RAN4 to capture the type-1 requirement in RAN4 spec as default behaviour, and also follow this general principle for an future additions like these. |
| OPPO | To add a new filter is a valid approach and can resolve the backwards compatibility issue. Another alternative is to introduce a separate EN-DC band combination list. UE will report this new band combination list if it can only support co-located case, or report them in legacy band combination list otherwise. Legacy gNB will ignore them and hence no backward compatibility issue will be caused. |
| Huawei, HiSilicon | Based on RAN4 feature list, only DC\_20\_n28 has the limitation of working at co-located scenario. Only “type1” (co-located) is supported for DC\_20\_n28 in Rel-15 (TS 38.101-3), so there is no backward compatibility issue for DC\_20\_n28. For other band combinations except for DC\_20\_n28, it seems that this UE type indication is not needed and the backward compatibility issue can be avoided.  If the above understanding can be confirmed, RAN2 needs to send LS to inform RAN4 explicitly that if this new capability 2-20 is introduced, there is no backward compatibility issue for DC\_20\_n28, but backward compatibility issue exists if this UE type indication is extended to other band combinations already specified in Rel-15 (a better capability “type2” is by default supported for these band combinations). |
| Qualcomm Incorporated | We suggest RAN2 seek further guidance from RAN4.  At least it should be clear what the baseline implementation of release-15 UEs is when the UE capability is not signalled (e.g. are all UEs considered type 1, type 2 or something else). |
| Ericsson | In the RAN4 feature table shown above it says “*current only DC\_20\_n28 has this limitation*”. This means that for all other existing BCs and for all future BCs for which RAN4 does not explicitly allow “type 1”, the UEs must support “type 2”, i.e., cope with any PSD and with 33µs MRTD.  Since legacy networks do not have the BCS tables for the newly defined BCs (e.g. *DC\_20\_n28*), they would anyway not configure a UE accordingly. Hence, it would actually be backwards compatible to define “type 1” as incapability in the band combination. Of course, it requires a network to implement the new “type 1” incapability signalling when adding support for one of the new BCs allowing this type. A new filter suggested by OPPO can in general not ensure backwards compatibility since a new source gNB may forward such UE capabilities to a non-upgraded target gNB.  Defining a new band combination list allows indeed to introduce “incapabilities” for existing band combinations. But since it increases specification and implementation complexity significantly, it should only be used as a very last resort. In this case it is not necessary. |
| Intel | Our understanding is that band combination DC\_20\_n28 is already specified in Rel-15. As mentioned in FG2\_20 (‘If UE does not reports this capability, the performance cannot be guaranteed under inter-band non-collocated scenario.’), without such indication for DC\_20\_n28 from the UE, it is unclear legacy gNB can support DC\_20\_n28. Hence it is worth checking with RAN4 whether it is expected of legacy gNB supporting DC\_20\_n28. If the response from RAN4 is No, then there is no need to handle backward compatibility issue (i.e. the indication just needs to be from Rel-16).  Based also on the FG2\_20, the only Rel-15 band combination that Type1 is possible is DC\_20\_n28. This is based on the wording (‘type 1 UE: performance guaranteed with PSD difference between DL carriers < 6dB, and MRTD=3us (current only DC\_20\_n28 has this limitation)’). The other Rel-15 band combinations in our view should only support Type 2 UE. Assuming that legacy gNB does not support DC\_20\_n28, our view is that only DC\_20\_n28 and future BCs that are allowed to support Type 1 can signal either Type 1 or Type 2. Other existing BCs and future BCs (i.e. future BCs not allowed to support Type1) are assumed as Type 2 and UE type indication is not applicable (i.e. explicitly specified in RAN4 spec). However, we think that it is also good to check our view with RAN4. |
| ZTE | We prefer to check further with RAN4.  At least it is unclear to us what is the default capability when UE does not signal this capability.  The RAN4 feature list says “If UE does not reports this capability, the performance cannot be guaranteed under inter-band non-collocated scenario.” Does it imply network must treat it as “Type1”? |
| NTT DOCOMO | We also agree to seek for more input and guidance from RAN4. As a last resort, a new band combination list used only for this particular case could be considered to ensure the explicit backward compatibility, as suggested by Ericsson. |
| CATT | Seems further checking with R4 is useful. |

9 companies responded to the DP.

1 company (Apple) thinks that Type 1 is the default behavior for all the inter-band ENDC band combinations and UE only signals the indication only if it supports Type 2 for an inter-band ENDC band combination. [Rapporteur’s view] This does not seem to be aligned to FG2-20 where RAN4 states that ‘current only DC\_20\_n28 has this limitation’.

1 company (OPPO) proposes solutions to solve the backward compatibility, including introducing a separate band combination list for the band combination of UE Type 1. 2 companies (DCM, E///) think this should only be used as a last resort.

1 company (HW) thinks that there is no backward compatibility issue for Rel-15 DC\_20\_n28 and other Rel-15 band combination since by default the UE type for Rel-15 DC\_20\_n28 is Type1 while other Rel-15 band combination is Type2, unless the UE Type indication is extended to Rel-15 inter-band ENDC band combination other than DC\_20\_n28.

2 companies (QC, ZTE) want to find out from what the baseline implementation of release-15 UEs is when the UE Type Indication is not signalled.

1 company (E///) states that no legacy network supports the newly defined BCs (e.g. DC\_20\_n28) and thus would not configure a UE with the band combination. Also only DC\_20\_n28 supports FG2-20, other existing or future band combinations for which RAN4 does not explicitly allow “type 1”, the UEs must support “type 2”,

1 company (Intel) states that no legacy network supports Rel-15 DC\_20\_n28 since RAN4 specified in FG2-20 that (‘If UE does not report this capability, the performance cannot be guaranteed under inter-band non-collocated scenario.’) implies that. Also the limitation is only for DC\_20\_n28 means the only DC\_20\_n28 can use Type 1 and other band combinations should be Type 2 for Rel-15.

Majority of companies (7 out of 9) think there is a need to seek for further guidance from RAN4. It is thus proposed to seek RAN4 guidance with the following questions:

**Proposal#6**: Include in the LS to RAN4 the following questions to seek guidance from RAN4 related to the co-location indication for inter-band ENDC combination:

1. Whether legacy gNB supports Rel-15 DC\_20\_n28?

Even though DC\_20\_n28 is specified in Rel-15, without the UE Type indication for DC\_20\_n28 (which is the only BC allowing Type 1), legacy gNB will not be able to configure DC\_20\_n28 confidently. Hence RAN2 assume that DC\_20\_n28 is not supported by legacy gNB.

1. Is there a default UE Type for DC\_20\_n28 and existing inter-band EN-DC band combinations?

If the UE Type indication is introduced from Rel-16, it is unclear what the UE Type for DC\_20\_n28 and existing inter-band EN-DC band combinations are for the UE and gNB. Hence RAN2 think RAN4 needs to define a default Type for the existing inter-band EN-DC band combinations. Based also on the FG2\_20 (‘type 1 UE: performance guaranteed with PSD difference between DL carriers < 6dB, and MRTD=3us (current only DC\_20\_n28 has this limitation)’), the only inter-band EN-DC band combination that Type1 is possible is DC\_20\_n28.  The other existing band combinations should only support Type 2 UE. Is this the correct understanding?

1. Is it the correct understanding that the UE Type indication is only allowed for limited EN-DC band combination that RAN4 specification defines? As of now, RAN2 understands that DC\_20\_n28 is the only EN-DC band combination that can apply the UE type indication. If it is correct, RAN2 think that it is desirable that the UE Type indication should not be applied for existing inter-band EN-DC band Combination to ensure there is no backward compatibility issue.

## Others

Any other open issues that was left opened from the last email discussion and would need to be discussed (i.e. Class 3) can be included here

Note that any new miscellaneous or WI specific correction should be provided as RIL on the new updated mega CRs when they are sent out.

|  |  |
| --- | --- |
| **Company’s name** | **Company’s comments, if any** |
| Apple | The support of async NR-DC is not part of the UE feature list from RAN1 and so it is not captured in the spec. However, RAN1 has asked for this separately in the same LS. We request that this capability be added. |
|  | 1. On Async DC and Cell Grouping for NR-DC:   We do not think it is correct understanding that this is FFS item from RAN1. RAN2 should capture LTE style cell grouping capability signalling with restriction to 5 bands.  Specifically, RAN1 has requested RAN2 to introduce an FG that indicates support of asynchronous operation in RAN1 LS (R1-2003072). Meanwhile in reply LS to RAN1 (R2-2006030), RAN2 indicated it has agreed to use LTE style cell grouping capability signaling with restriction to 5 bands. And RAN1 response that “There is no additional suggestion from RAN1 for now.” in R1-2005096.   1. Need clarification of the terminology “infra-FR NR-DC” in NR-DC power sharing capabilities (i.e*. intraFR-NR-DC-PwrSharingMode1-r16, intraFR-NR-DC-PwrSharingMode2-r16, intraFR-NR-DC-DynamicPwrSharing-r16* )   It may be misunderstood that only all SCells in MCG and SCG are in same FR. However according to latest 38.213, we think it also includes the case that part of SCells in MCG and SCG are from same FR (e.g. MCG has FR1 and FR2 SCell, SCG has FR1 SCells, where the power sharing can be applied to all FR1 SCells in both MCG and SCG):   |  | | --- | | TS38.213 Section 7.6.2  […]  If a UE is configured with an MCG and a SCG using NR radio access in FR1 and/or in FR2, the UE is configured a maximum power for transmissions on the MCG by *p-NR-FR1* and/or by *p-NR-FR2* and a maximum power for transmissions on the SCG by *p-NR-FR1* and/or by *p-NR-FR2* and with an inter-CG power sharing mode by *NR-DC-PC-mode* for FR1 and/or by *NR-DC-PC-mode* for FR2. The UE determines a transmission power on the MCG and a transmission power on the SCG per frequency range. |   We suggest the following text : “infra-FR NR-DC” also includes the case that a subset of SCells of MCG and SCG are of the same frequency range”   1. Dormancy capabilities, *scellDormancyWithinActiveTime-r16* and *scellDormancyOutsideActiveTime-r16*   RAN1 added the following notes to FG18-4. We propose to capture it in 38.306.   |  | | --- | | One dormant BWP and one non-dormant BWP is supported per carrier.  More than one non-dormant BWP per carrier is supported only if UE feature 6-3/6-4 is also supported. | |
| ZTE | For autonomous gap related capabilities (9-6 and 9-7 of RAN4 feature list), the current signalling has some remaining issues:   1. The RAN4 feature list gives the impression that XDD, FRX differentiation corresponds to the duplex mode of FR mode of serving cell (e.g. FR1/FR2 differentiation column is set to Yes for 9-7), but this is not inline with RAN2’s previous discussion. So it can be clarified whether companies have the same understanding (e.g. the UE signals the capability based on the duplex mode/FR mode of target measured cell, not serving cell). 2. The current capabilities use different FDD/TDD and FR1/FR2 differentiation metrics for different scenarios (NR SA, NE-DC, NR-DC).   We will provide corresponding RIL soon. |
|  |  |

Async NR-DC and autonomous gap related capabilities need to be discussed. Rapporteur understanding is that there are separately contributions to handle them.

**Proposal#7:** Handle async NR-DC and autonomous gap related capabilities separately with their respective discussion paper and CRs.

# Conclusion

The proposals captured are the following:

**Proposal#1:** include in the LS to RAN1 and 4:

RAN2 would also like to provide the timeline of designing the signalling based of the availability of RAN1 and RAN4 UE feature lists as below:

* RAN2 plan to start working on the capability signalling design aspects under the assumption that the UE feature lists from RAN1 and RAN4 are available to RAN2 by the end of week 1 of RAN1 and RAN4 WG meetings (viz., end of August 21st, 2020).
* Any content that is FFS will NOT be considered/discussed as part of the UE capability signalling for the September specification version but could be considered in the next quarter.
* Further agreements, if any, from email discussions after the RAN1 and RAN4 meetings cannot be part of September specification version but could be considered in the next quarter.

**Proposal#2:** Discuss how to handle the CHO capabilities (i.e. condHandoverFailure-r16 and condHandoverTwoTriggerEvents-r16) requiring both xDD Diff and FRx-Diff. If any change is made on CHO, the corresponding CPC capabilities need to change as well.

**Proposal#3:** For UE capabilities that are changed from per UE requiring xDD-Diff and FRx-Diff to per band, a new condition needs to be added (i.e. UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands and all TDD-FR2 bands respectively). This will apply to (parameters so far implemented for Rel-16 that have both xDD-DIFF and FRx-DIFF):

MeasAndMobParameters:

* condHandover-r16
* pcellT312-r16
* handoverIntraF-IAB-r16

MeasAndMobParametersMRDC:

* condPScellChange-r16
* pcellT312-r16

Autonomous gap capabilities are discussed separately in a separate contribution

**Proposal#5:** Include the following 2 RAN2 agreements on intraFreqDAPS and interFreqDAPS in the LS to RAN1 and 4:

* 4: For inter freq DAPS, the capability inter-FreqDAPS is specified per BC (for intra band, inter band cases). It is put under existing CA bandcombination, and same as CA, the CCs in the bandcombination with UL can all be source or target PCell.
* 7: Per Band per BC capability (intraBandDiffSCS, intraFreq-DAPS) is put in BandParameters.

**Proposal#6**: Include in the LS to RAN4 the following questions to seek guidance from RAN4 related to the co-location indication for inter-band ENDC combination:

1. Whether legacy gNB supports Rel-15 DC\_20\_n28?

Even though DC\_20\_n28 is specified in Rel-15, without the UE Type indication for DC\_20\_n28 (which is the only BC allowing Type 1), legacy gNB will not be able to configure DC\_20\_n28 confidently. Hence RAN2 assume that DC\_20\_n28 is not supported by legacy gNB.

1. Is there a default UE Type for DC\_20\_n28 and existing inter-band EN-DC band combinations?

If the UE Type indication is introduced from Rel-16, it is unclear what the UE Type for DC\_20\_n28 and existing inter-band EN-DC band combinations are for the UE and gNB. Hence RAN2 think RAN4 needs to define a default Type for the existing inter-band EN-DC band combinations. Based also on the FG2\_20 (‘type 1 UE: performance guaranteed with PSD difference between DL carriers < 6dB, and MRTD=3us (current only DC\_20\_n28 has this limitation)’), the only inter-band EN-DC band combination that Type1 is possible is DC\_20\_n28.  The other existing band combinations should only support Type 2 UE. Is this the correct understanding?

1. Is it the correct understanding that the UE Type indication is only allowed for limited EN-DC band combination that RAN4 specification defines? As of now, RAN2 understands that DC\_20\_n28 is the only EN-DC band combination that can apply the UE type indication. If it is correct, RAN2 think that it is desirable that the UE Type indication should not be applied for existing inter-band EN-DC band Combination to ensure there is no backward compatibility issue.

**Proposal#7:** Handle async NR-DC and autonomous gap related capabilities separately with their respective discussion paper and CRs.

# References

1. R2-2005818 Release-16 UE capabilities based on RAN1, RAN4 feature lists and RAN2, CR to TS38.331
2. R2-2005817 Release-16 UE capabilities based on RAN1, RAN4 feature lists and RAN2, CR to TS38.306
3. R1-2005110 RAN1 UE features list for Rel-16 NR updated after RAN1#101-e

# Annex

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Support of condHandover-r16 for FR1 FDD bands | Support of condHandover-r16 for FR1 TDD bands | Support of condHandover-r16 for FR2 TDD bands | condHandoverFR1-FR2-r16 | condHandoverFDD-TDD-r16 | Comment |
| Y | Y | N | N | Y | UE supports CHO  Within FR1 FDD;  Within FR1 TDD;  condHandoverFR1-FR2-r16 should not be set to true since the UE cannot support CHO within FR2)  condHandoverFDD-TDD-r16 could be set since UE support FR1\_FDD and FR1\_TDD |
| Y | N | Y | Y | Y | UE supports CHO  Within FR1 FDD;  Within FR2 TDD;  condHandoverFR1-FR2-r16 and condHandoverFDD-TDD-r16 could be set, and if set, should be set simultaneously for this case; |
| N | Y | Y | Y | N | UE supports CHO  Within FR1 TDD;  Within FR2 TDD;  condHandoverFR1-FR2-r16 could be set since UE support FR1\_FDD and FR1\_TDD |
| N | N | Y | N | N | UE supports CHO  Within FR2 TDD;  UE cannot support condHandoverFR1-FR2-r16 and condHandoverFDD-TDD-r16 since the UE only supports FR2 TDD |
| N | Y | N | N | N | UE supports CHO  Within FR1 TDD;  UE cannot support condHandoverFR1-FR2-r16 and condHandoverFDD-TDD-r16 since the UE only supports FR1 TDD |
| Y | N | N | N | N | UE supports CHO  Within FR1 FDD;  UE cannot support condHandoverFR1-FR2-r16 and condHandoverFDD-TDD-r16 since the UE only supports FR1 FDD |
| Y | Y | Y | Y | Y | UE supports CHO  Within FR1 FDD;  Within FR1 TDD;  Within FR2 TDD;  condHandoverFR1-FR2-r16 and condHandoverFDD-TDD-r16 could be set. If set, could be set simultaneously or only one of them. |