3GPP TSG-RAN WG2 #105 Tdoc R2-19xxxxx

Athens, Greece, 25th February – 1st Mars 2019

Agenda Item: x.x.x

Source: Ericsson

Title: Email discussion summary [104#66][NR] UE NR and E-UTRA capabilities for Late drop (Ericsson)

Document for: Discussion, Decision

# 1 Introduction

This document reports the following e-mail discussion:

[104#66][NR] UE NR and E-UTRA capabilities for Late drop (Ericsson)

      To progress and agree on principles (reuse on existing capabilities, request filtering, etc)

      Intended outcome: Report and agreeable draft CRs to 36.306, 38.306, 36.331, 38.331 (to be included in Running CRs at next meeting)).

      Deadline:  Thursday 2019-02-07

# 2 Discussion

## 2.1 Capability coordination

Signaling and UE behavior for MR-DC may rely on the fact that different RATs are used for MCG and SCG configurations. But in NR-DC, when reusing EN-DC framework for capability coordination, this may generate ambiguity and requires additional discussion. Namely, the FFS below can be derived from [1].

**FFS: How to signal restricted bands, in a band combination, to be used for SN in NR-DC**

In NR-DC, more information is needed into the inter node messages to indicate the share of each band combination that the SN may use. To address this issue, a field could be added with a list of the selected band entries used by the MN. This information, in combination with the *allowedBC-ListMRDC* IE, could be used by the SN to select the bands for the SCG, such that the UE capabilities are not exceeded. Below is a ASN.1 example of this option.

ConfigRestrictInfoSCG ::= SEQUENCE {

allowedBC-ListMRDC BandCombinationInfoList OPTIONAL,

powerCoordination-FR1 SEQUENCE {

p-maxNR-FR1 P-Max OPTIONAL,

p-maxEUTRA P-Max OPTIONAL,

p-maxUE-FR1 P-Max OPTIONAL

} OPTIONAL,

servCellIndexRangeSCG SEQUENCE {

lowBound ServCellIndex,

upBound ServCellIndex

} OPTIONAL, -- Cond SN-Addition

maxMeasFreqsSCG-NR INTEGER(1..maxMeasFreqsMN) OPTIONAL,

maxMeasIdentitiesSCG-NR INTEGER(1..maxMeasIdentitiesMN) OPTIONAL,

... ,

[[

selectedBandEntriesMN SEQUENCE (SIZE (1..maxSimultaneousBands)) OF BandEntryIndex

]]

}

|  |
| --- |
| ***selectedBandEntiesMN***  Indicates the position of a band entry selected by the MN, in the first band combination entry in *allowedBC-ListMRDC* IE. |

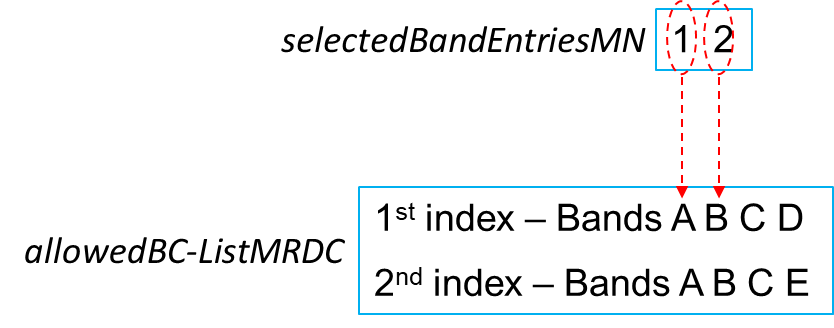
As an example of the behavior above, if the MN indicates in *allowedBC-ListMRDC* IE two indices referring to the following band combinations:

1st index – Bands A B C D

2nd index – Bands A B C E

The MN could, in addition, indicate with *selectedBandEntriesMN* the positions of the MN selected bands corresponding to the first band combination referred in *allowedBC-ListMRDC* IE, i.e. 1st index.

If the MN indicates with *selectedBandEntriesMN* the positions 1 and 2, it would imply that bands A and B are selected by the MN, as depicted below.



**Question 1: For capability coordination in NR-DC, should the MN be able to indicate a list of band entries, on top of the information provided in *allowedBC-ListMRDC* IE? Companies are also encouraged to list more solutions above and provide comments below.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Yes/No?** | **Comments** |
| **Samsung** | Yes | Seems fine |
| **Nokia** | Yes |  |
| **Qualcomm Incorporated** | Yes |  |
| **Ericsson** | Yes |  |
| MediaTek | Yes |  |
| NTT DOCOMO | Yes |  |
| Intel | Yes |  |

In [3], it was also raised for NR-DC an issue concerning the parameter *pdcch-BlindDetectionCA*, copied below from TS 38.306.

| **Definitions for parameters** | **Per** | **M** | **FDDTDD**  **DIFF** | **FR1**  **FR2**  **DIFF** |
| --- | --- | --- | --- | --- |
| ***pdcch-BlindDetectionCA***  Indicates PDCCH blind decoding capabilities supported by the UE for CA with more than 4 CCs as specified in TS 38.213 [11]. The field value is from 4 to 16. | UE | Tbd | No | Yes |

The UE is expected to monitor a total of PDCCH candidates per slot for downlink cells with SCS configuration , where stands for the capability indicated in *pdcch-BlindDetectionCA*, and is given in TS 38.213 for each . This equation can then be divided into 2 cases.

A) A UE (that indicates ) configured with downlink cells where would result in .

B) A UE (that indicates ) configured with downlink cells where would result in .

As it can be seen from the derivation above, different cell groups are not taken into account to define the maximum number of PDCCH candidates the UE can monitor, which leads to unclarity on how this capability should be handled for NR-DC case.

Three solutions were outlined in [3] and listed below:

**Option 1**. MN divides between MN and SN (i.e. have and ) and lets SN and UE know allowed and .

**Option 2**. MN and SN exchange the values of of each cell group for each SCS configuration .

**Option 3**. MN derives maximum allowed number of cells for each SCS configuration and informs it to SN.

Given that options above would require extra signaling and coordination between MN and SN, and that case B already implies in complex handling of *pdcch-BlindDetectionCA*, another option can be to have *pdcch-BlindDetectionCA* as a dummy parameter and limit the availability of UE capabilities retrieved by the network to case A, i.e. the UE only report capabilities for a number of CCs that can comply with .

**Option 4**. The parameter *pdcch-BlindDetectionCA* is set to a dummy value and the UE only report capabilities for a number of CCs that can comply with .

**Question 2: Which option is preferred by companies? Companies are also encouraged to list more solutions above and provide comments below.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option** | **Comments** |
| **Samsung** | 1 | We think option 1 is most optimal (we understand this can be done by existing RRC signalling). We think option 4 is too restrictive and understand that option 2 and 3 will require changes to RAN1 specifications. |
| **Nokia** | 1 | Option 1 is optimal for us too. |
| **Qualcomm Incorporated** |  | We agree that sharing of the UE capability between MN and SN shall be supported. It is not entirely clear though if the existing capability for CA can be reused, especially if we take into account asynchronous DC already. We suggest RAN2 consult RAN1. |
| **Ericsson** | 1, but | We agree with Qualcomm that more RAN1 input is needed. |
| MediaTek | 1/2/3 | From the RAN2 perspective we agree that option 4 is too restrictive, and would be OK with the other options. RAN1 input would be useful. |
| NTT DOCOMO | 1 | 1 is the approach as specified for LTE DC. We also agree that RAN1 input are beneficial, as there are the other capabilities requiring the same handling. |
| Intel | 1/2/3 | We also agree that RAN1 input is needed. |

## 2.2 Inclusion of voice capability

In RAN2#103bis, the following was agreed:

Agreements

1 The parameters included in measAndMobParametersMRDC, measAndMobParametersMRDC-XDD-Diff and measAndMobParametersMRDC-FRX-Diff are reused for NGEN-DC and NE-DC except for sftd-MeasNR-Cell for NE-DC.

1-1 Add clarification in 38.306 sftd-MeasNR-Cell field that this is now only applied to EN-DC and NGEN-DC cases.

2: Reuse Phy-ParametersMRDC for NGEN-DC and NE-DC.

3-1: BandParameters, CA-ParametersEUTRA, CA-ParametersNR and power classes are reused for NGEN-DC and NE-DC.

3-2: FFS for MR-DC parameters and featureset until feedback from RAN1/RAN4.

4: GeneralParametersMRDC-XDD-Diff is in general reused for NGEN-DC and NE-DC except for v2x-EUTRA-v1530, and except for SRB3 for NE-DC

4-1: v2x-EUTRA-v1530 is only applied to EN-DC in Rel-15 and should be clarified in 38.306.

4-2: SRB3 is not applied to NE-DC and should be clarified in 38.306.

5: PDCP-ParametersMRDC is reused for NGEN-DC and NE-DC

6-1: limit the current ims-VoiceOverNR-PDCP-SCG-Bearer and ims-VoiceOverNR-PDCP-MCG-Bearer to EN-DC case only, and add one additional bit for NGEN-DC case for SCG bearer.

6-2: FFS: to introduce VoiceOverSCG-Bearer for NE-DC SCG bearer in either MR-DC capability or NR SA UE capability.

7: NGEN-DC-Add-UE-MRDC-Capabilities and NE-DC-Add-UE-MRDC-Capabilities can be added if RAN1/RAN4 confirms there is a need to differentiate UE capabilities for different options.

**Option 1: In MR-DC UE capability.**

In [2], it was raised that VoiceOverSCG-Bearer for NE-DC should be inserted in *UE-MRDC-Capability* IE since it is a capability related to an MR-DC option.

**Option 2: In NR SA UE capability.**

IMS parameter concerning EN-DC, for instance, is within E-UTRA capability (*IMS-VoiceOverNR-PDCP-SCG-Bearer-15*). Therefore, this capability should not need to be visible for the SN RAT. Similarly, this VoiceOverSCG-Bearer for NE-DC should not need to be visible for the SN in NE-DC case, even though it is related to the NE-DC SCG.

**Question 3: Where the capability of VoiceOverSCG-Bearer for NE-DC SCG bearer should be included?**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1/2** | **Comments** |
| **Samsung** | 2 |  |
| **Nokia** | 2 | Keeping this in NR SA capabilities is fine. |
| **Qualcomm Incorporated** | 2 |  |
| **Ericsson** | 2 |  |
| MediaTek | 1 | We have a slight preference for option 1 on the basis that it is an MR-DC option. But either option will work and we should go with the one that companies feel yields the clearest spec. |
| NTT DOCOMO | 2 | It’s a sort of the modelling issues and so both options work as Mediatek said. We don’t have a strong opinion either and so are fine with the majority view. |
| Intel | 2 | Both options (in MR DC capability or SA NR capability) can work. The only difference should be:  1 option 1, both MN and SN know UE voice capability for SCG;  2 Option 2, only MN knows this.  However, it is MN to decide which flow should be forwarded to SN, so option 2 should be sufficient. |

## 2.3 Capability request filtering

In RAN#103bis, the following was agreed:

Agreements

1 Introduce one per UE capability indication in UE-EUTRA-Capability to indicate support of option 7 and introduce one per UE capability indication in UE-NR-Capability to indicate support of option 4

2 NGEN-DC can reuse all the capabilities parameters of EN-DC.

3 Add ability to request NE-DC capabilities into NR RRC.

It should be discussed, however, details regarding how the network should request capabilities for NG-EN-DC and NE-DC. Two options are captured below, but companies are also encouraged to list more solutions and provide comments to the options below.

**Option 1: When responding to an *UECapabilityEnquiry* message that includes *rat-Type* set to *eutra-nr* and the UE supports EN-DC, NGEN-DC or NE-DC, the UE includes capabilities for EN-DC, NGEN-DC and NE-DC, whichever is supported.**

A capability request with *rat-Type* set to *eutra-nr* will currently result in acquiring EN-DC capabilities (if supported by the UE), in both 36.331 and 38.331. A straightforward approach that would comply with the current handling for EN-DC would be that the UE, when receiving a capability request with *rat-Type* set to *eutra-nr*, would also include capabilities for NG-EN-DC and NE-DC, whichever is supported, as in the 38.331 example below. It should be noted that this option does not imply in more than one MR-DC container, i.e., the UE would still include only one *UE-MRDC-Capability* with the *rat-Type* set to *eutra-nr*, containing capabilities for EN-DC, NGEN-DC and NE-DC, whichever is supported.

A drawback from this approach could be that a gNB may be only interested on e.g. NE-DC capabilities, but while using a *UE-CapabilityRAT-Request* with *rat-Type* set to *eutra-nr*, it will receive also the UE EN-DC capabilities.

5.6.1.3 Reception of the *UECapabilityEnquiry* by the UE

The UE shall set the contents of *UECapabilityInformation* message as follows:

1> if the *ue-CapabilityRAT-RequestList* contains a *UE-CapabilityRAT-Request* with *rat-Type* set to *nr*:

2> include in the *ue-CapabilityRAT-ContainerList* a *UE-CapabilityRAT-Container* of the type *UE-NR-Capability* and with the *rat-Type* set to *nr*;

2> include the *supportedBandCombinationList, featureSets* and *featureSetCombinations* as specified in clause 5.6.1.4;

1> if the *ue-CapabilityRAT-RequestLis*t contains a *UE-CapabilityRAT-Request* with *rat-Type* set to *eutra-nr*:

2> if the UE supports (NG)EN-DC or NE-DC:

3> include in the *ue-CapabilityRAT-ContainerList* a *UE-CapabilityRAT-Container* of the type *UE-MRDC-Capability* and with the *rat-Type* set to *eutra-nr*;

3> include the *supportedBandCombinationList* and *featureSetCombinations* as specified in clause 5.6.1.4;

**Option 2: When responding to an *UECapabilityEnquiry* message, a new indication is used to request for the UE to include capabilities for NGEN-DC and NE-DC, whichever is supported.**

Another option would be to include new indications for the request of NGEN-DC and NE-DC capabilities. This could reduce the size of reported UE capabilities for MR-DC options, while not preventing a further combination, on the network side, of requests for different MR-DC options in a sole container with MR-DC capabilities. A drawback from this approach could be that additional signaling and more complex procedure text should be defined in this case, as in the 38.331 example below (considering that for NGEN-DC and NE-DC capability request, the field must be included).

*UE-CapabilityRequestFilterNR* information element

-- ASN1START

-- TAG-UE-CAPABILITYREQUESTFILTERNR-START

UE-CapabilityRequestFilterNR ::= SEQUENCE {

frequencyBandList FreqBandList OPTIONAL, -- Need N

nonCriticalExtension UE-CapabilityRequestFilterNR-v1540 OPTIONAL

}

UE-CapabilityRequestFilterNR-v1540 ::= SEQUENCE {

srs-SwitchingTimeRequest ENUMERATED {true} OPTIONAL, -- Need N

nonCriticalExtension UE-CapabilityRequestFilterNR-v15xy OPTIONAL

}

UE-CapabilityRequestFilterNR-v15xy ::= SEQUENCE {

mrdc-Request MRDC-Request OPTIONAL, -- Need N

nonCriticalExtension SEQUENCE {} OPTIONAL

}

MRDC-Request ::= SEQUENCE {

en-DC-Request ENUMERATED {true} OPTIONAL, -- Need N

ne-DC-Request ENUMERATED {true} OPTIONAL, -- Need N

ng-EN-DC-Request ENUMERATED {true} OPTIONAL, -- Need N

nonCriticalExtension SEQUENCE {} OPTIONAL

}

-- TAG-UE-CAPABILITYREQUESTFILTERNR-STOP

-- ASN1STOP

*UE-MRDC-Capability* information element

-- ASN1START

-- TAG-UE-MRDC-CAPABILITY-START

UE-MRDC-Capability ::= SEQUENCE {

measAndMobParametersMRDC MeasAndMobParametersMRDC OPTIONAL,

phy-ParametersMRDC-v1530 Phy-ParametersMRDC OPTIONAL,

rf-ParametersMRDC RF-ParametersMRDC,

generalParametersMRDC GeneralParametersMRDC-XDD-Diff OPTIONAL,

fdd-Add-UE-MRDC-Capabilities UE-MRDC-CapabilityAddXDD-Mode OPTIONAL,

tdd-Add-UE-MRDC-Capabilities UE-MRDC-CapabilityAddXDD-Mode OPTIONAL,

fr1-Add-UE-MRDC-Capabilities UE-MRDC-CapabilityAddFRX-Mode OPTIONAL,

fr2-Add-UE-MRDC-Capabilities UE-MRDC-CapabilityAddFRX-Mode OPTIONAL,

featureSetCombinations SEQUENCE (SIZE (1..maxFeatureSetCombinations)) OF FeatureSetCombination OPTIONAL,

pdcp-ParametersMRDC-v1530 PDCP-ParametersMRDC OPTIONAL,

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension UE-MRDC-Capability-v15xy OPTIONAL

}

UE-MRDC-Capability-v15xy ::= SEQUENCE {

appliedMRDC-Request MRDC-Request OPTIONAL,

lateNonCriticalExtension OCTET STRING OPTIONAL,

nonCriticalExtension SEQUENCE {} OPTIONAL

}

UE-MRDC-CapabilityAddXDD-Mode ::= SEQUENCE {

measAndMobParametersMRDC-XDD-Diff MeasAndMobParametersMRDC-XDD-Diff OPTIONAL,

generalParametersMRDC-XDD-Diff GeneralParametersMRDC-XDD-Diff OPTIONAL

}

UE-MRDC-CapabilityAddFRX-Mode ::= SEQUENCE {

measAndMobParametersMRDC-FRX-Diff MeasAndMobParametersMRDC-FRX-Diff

}

GeneralParametersMRDC-XDD-Diff ::= SEQUENCE {

splitSRB-WithOneUL-Path ENUMERATED {supported} OPTIONAL,

splitDRB-withUL-Both-MCG-SCG ENUMERATED {supported} OPTIONAL,

srb3 ENUMERATED {supported} OPTIONAL,

v2x-EUTRA-v1530 ENUMERATED {supported} OPTIONAL,

...

}

-- TAG-UE-MRDC-CAPABILITY-STOP

-- ASN1STOP

5.6.1.3 Reception of the *UECapabilityEnquiry* by the UE

The UE shall set the contents of *UECapabilityInformation* message as follows:

1> if the *ue-CapabilityRAT-RequestList* contains a *UE-CapabilityRAT-Request* with *rat-Type* set to *nr*:

2> include in the *ue-CapabilityRAT-ContainerList* a *UE-CapabilityRAT-Container* of the type *UE-NR-Capability* and with the *rat-Type* set to *nr*;

2> include the *supportedBandCombinationList, featureSets* and *featureSetCombinations* as specified in clause 5.6.1.4;

1> if the *ue-CapabilityRAT-RequestLis*t contains a *UE-CapabilityRAT-Request* with *rat-Type* set to *eutra-nr*:

2> if the UE supports EN-DC and *mrdc-Request* is not received:

3> include in the ue-CapabilityRAT-ContainerList a UE-CapabilityRAT-Container of the type UE-MRDC-Capability and with the rat-Type set to eutra-nr;

3> include the *supportedBandCombinationList* and *featureSetCombinations* as specified in clause 5.6.1.4;

2> else if the UE supports (NG)EN-DC or NE-DC:

3> create a *UE-CapabilityRAT-Container* of the type *UE-MRDC-Capability* and with the *rat-Type* set to *eutra-nr*;

3> include, in the created *UE-CapabilityRAT-Container*, the *supportedBandCombinationList* and *featureSetCombinations* as specified in clause 5.6.1.4;

3> if the UE supports EN-DC and *en-DC-Request* is included in *mrdc-Request*:

4> include EN-DC capabilities in the created *UE-CapabilityRAT-Container*;

3> if the UE supports NE-DC and *ne-DC-Request* is included in *mrdc-Request*:

4> include, in the created *UE-CapabilityRAT-Container*, any remaining capabilities needed for NE-DC;

3> if the UE supports NGEN-DC and *ng-EN-DC-Request* is included in *mrdc-Request*:

4> include, in the created *UE-CapabilityRAT-Container*, any remaining capabilities needed for NGEN-DC;

3> include the received *mrdc-Request* in the field *appliedMRDC-Request*;

3> include in the *ue-CapabilityRAT-ContainerList* the created *UE-CapabilityRAT-Container*;

**Option 3: Limit reporting of MR-DC differences without introducing signaling (at least in REL-15)**

Another option would be to define some rules regarding for what MR-DC cases UE reports capabilities/ capability differences i.e. as follows:

1. In LTE RRC (REL-15): UE only reports capabilities for (NG)-EN-DC
2. In NR RRC (REL-15): UE only reports capabilities for NE-DC

Above rules are possible assuming assume that (see also general starting points/ question 6):

1. For REL-15 we do not support configuration of MR-DC upon IRAT HO between LTE and NR
2. Capability differences between EN-DC and NG EN-DC are marginal (i.e. no real harm if UE also reports NG EN-DC specifics)

**Question 5: Which option is preferred by companies? It is also encouraged to list more solutions above and provide comments below.**

|  |  |  |
| --- | --- | --- |
| **Company** | **Option 1/2...** | **Comments** |
| **Samsung** | 3, but | If UE includes capabilities for all supported MR-DC cases, this will result in some additional signaling. If it is not evident that providing capabilities for all MRDC cases results in marginal additional signaling, it would be good to introduce some means to avoid this. For REL-15 we think option 3 is possible and preferable (given its simplicity).  Regarding option 1: Note that so far there is a 1-to-1 relation between rat-Type and UE capability container. Breaking that principle seems to involve several changes, not just within RAN. We thus assume option 1 involves transferring a UE capability container per RAT. As we assume that most capabilities are same for different MRDC cases, we assume any solution involving a capability container per MRDC case should be avoided.  (Note that previously there were discussions on how to indicate differences between MRDC cases and it seems an XDD approach was selected. We however think that we should avoid duplicating the list of supported BC but rather indicate some minor differences within the supported BC signaling). |
| **Nokia** | 3 | We would also agree with Samsung that in Rel-15, Option 3 has good potential to work. Adding a flavor of rat-type per MR-DC variant seems counterproductive even given the discussions on UE Capability ID. It would be ideal to not duplicate band combinations unnecessarily as well to discriminate minor differences between the different MR-DC variants. |
| **Qualcomm Incorporated** | 2 | We prefer generic approach that works for different combinations of MR-DC options the UE may support in RAT-independent manner.  Overhead with such approach is indeed an issue, but we should ask if it is a realistic scenario that a single operator deploys many MR-DC options simultaneously. Also the network can choose not to request the UE capability for a given MR-DC option depending on the mobility scenario it may support.  Signaling optimization can be considered for MR-DC band combination which is the major contributor to signaling overhead. |
| **Ericsson** | 2 | This option would not imply in more MR-DC containers per rat-Type or multiple rat-types. The intention from procedural text is that a sole container would be sent with supported MR-DC options (among (NG)EN-DC and NE-DC), if requested by the network. Option 1 could also work if RAN4 input is that band combinations from e.g. EN-DC can be reused for NE-DC. |
| MediaTek | 2 | Option 2 saves some overhead over option 1, and we think the impact to spec complexity is acceptable here. We have the same understanding as Ericsson that it does not require separate containers.  Option 3 looks as if it would be sensible for Rel-15 but would run into problems if in a future release we challenged its assumptions. |
| NTT DOCOMO | 1 (but 2 is o.k) | On Option 3, we agree with Mediatek that we should not cherry-pick a solution just addressing the Rel-15 scenarios.  We think Option 1 is simplest from the NW viewpoint. If EN-DC band combinations can be reused for late drops, the drawback analysed in this paper will no longer exist. Nevertheless, we see the benefit of Option 2 and can accept Option 2 if the majority prefers. |
| Intel | 2 | Option 2 seems better if we view from future additions perspective. We also think that there would not be an increase in BCs in general. |

## 2.4 Other

General starting points

It would be good to agree a number of assumptions/ starting points for REL-15, or if not agreeable identify points requiring further discussion. This concerns the following main aspects:

1. Requirement: In REL-15 only support capability retrieval for the following MRDC cases:
2. 36.331: Retrieval of EN-DC and NG EN-DC capabilities
3. 38.331: Retrieval of NE-DC and NN-DC capabilities
4. Requirement: For the band combinations, it should at least be possible indicate differences regarding MRDC support i.e. that:
   1. For the BC UE only supports (or performed IoT) a subset of the MRDC cases
5. Response: Use one UE capability container for all MRDC cases reported by the UE (i.e. mainly concerns bullet a.1)
6. Response: Use a single supported BC field and indicate any differences regarding MRDC support for a particular supported BC within the entry of the concerned BC
7. Response: For other capability parameters (i.e. more top level rather than nested within such list), use the FDD/ TDD mechanism for signaling differences
   1. Such approach may not be used for some cases e.g. a parameter only applicable for one MRDC case
8. Request: Use existing requested band list i.e. do not introduce additional filters for specific MRDC cases

**Question 6: Can companies agree to the above general starting points? Please share your views in the following table. If companies have concerns regarding one or more of the indicated starting points, please clarify concerns and if appropriate a discussion issue may be added after this question.**

|  |  |  |
| --- | --- | --- |
| Company | Item(s) | Comment |
| Qualcomm Incorporated | a)  Agree to other items. | a) We would prefer generic RAT-independent approach that works also in future releases. Being able to request full UE capability and avoiding multiple UE capability enquiry upon inter-RAT mobility would be beneficial for the UE Capability ID solution being discussed. |
| Ericsson | Agree to c), f) | a) e.g. if we agree on filtered capabilities per MR-DC option, the limitation would not be needed.  We think the other points are related to previously agreement to indicate differences between MRDC cases with an XDD approach which, however, are still subject to RAN4 input. |
| MediaTek | Agree to c), f) | Regarding a), we also prefer a more generic approach, and this entrenches assumptions that seem valid for Rel-15 but might not be valid forever. It seems orthogonal to the other assumptions listed.  We understand from b) that it means the UE could signal, for a certain BC, that it supports e.g. EN-DC but not NGEN-DC. Is the intention to add flags to MRDC-Parameters to indicate which cases are supported?  With d) and e) we would like to see more concretely what is actually proposed. |
| NTT DOCOMO | Agree on b) to f) | On a), we share the same views already commented by the other companies. |
| Intel | Agree to c,f, (d?) | In addition we see that some sort of ‘d’ is also needed. Per each BC, the UE can report if it supports which forms of MR-DC (atleast between EN-DC and NE-DC). And in addition, we may need specifc featureset params that are applicable to certain MR-DC configs (although I hope it is not the case). |
| Samsung | Agree all | Some responses to questions:  About b), yes we think that it should be possible to indicate that a particular BC is supported/ IoT tested for a subset of the MRDC cases  About d) We agree this relates to previous agreements on using XDD approach for indicating differences. We however think it seems inefficient to have a supportedBC field for each MRDC case i.e. that it seems more efficient to have one supported BC field and indicate support/ IoT status of the MRDC case within entries of this field. Also given the feedback, we plan to bring a paper with more concrete proposals |

Request: Need for additional filtering parameters

In this section we discuss whether there is a need for any changes regarding filtering of BC reported for specific MRDC cases. Some remarks regarding this:

* Use of a single band list for all MRDC cases is considered the baseline (see starting point)
* Network may not support NR DC. If UE always reports NR DC capabilities, UE may include information not relevant to network (somewhat increasing size of UE capabilities)
* For NR PCell, network may only want to apply a band in FR1. If for BCs only including FR2 UE supports NR DC or NE-DC, UE may information not relevant to network
* ..

If UE capability size increase due to inclusion of information not relevant to network is not marginal, there may be a need to avoid the concerned reporting by the UE. This can be avoided by introducing a new (filter) field i.e. as follows:

Introduce new (filter) field (Option 1): Add a field indicating whether UE should provide the concerned UE capability info. The indication could either be per UE or for a specific MRDC case (e.g. separate for NR DC and NE-DC)

**Question 7: Companies are requested to share their view i.e. whether there is a need to introduce additional filtering parameters for different MRDC cases and if so, what solution to adopt.**

|  |  |  |
| --- | --- | --- |
| Company | Yes/ no, option | Comment |
| Qualcomm Incorporated | No |  |
| Ericsson | No | We think that an indication for a specific MR-DC case would be the same as option 2 in Question 5. But in general we do not think any other filtering parameters would be needed. |
| MediaTek | No (or minimal) | We tend to think it’s enough for the network to request specific MRDC cases.  Considering bullet 3 above which seems like a reasonable use case, we would be OK with a “don’t include FR2-only BCs” flag. But we should avoid filtering mechanisms that introduce significant complexity. |
| NTT DOCOMO | No | The existing filtering mechanism is enough for Rel-15. |
| Intel | No | Other than the additional field which states the NR interested MR-DC types that the NW wants UE to provide, no additional fields are needed. |
| Samsung | Minimal | We think a single band list should be sufficient  We think it some way to stop inclusion in NR capability container of NR-DC capabilities (alike option 2 for question 5) seems useful, and possibly an indication about omitting FR2-only BCs |

Response: Indication of supported/ reported MRDC cases

In this section we discuss how UE indicates capability differences for MRDC cases. We assume the following cases should be considered (given starting points discussed in the previous):

36.331: Retrieval of EN-DC and NG EN-DC capabilities i.e. MRDC container covers 2 cases

38.331: Retrieval of NE-DC and NN-DC capabilities i.e. MRDC container only covers single case (NE-DC)

It seems good to agree the further details of how the UE indicates MRDC differences and/ or to identity points requiring further discussion. We suggest the following approach:

1. Is for the supported BCs, there a need to indicate MRDC differences other than support of the BC (see staring points). E.g. that for a BC the supported features are different for the supported MRDC cases.
   1. Note that we only have one case in which the MRDC container covers multiple MRDC options and that for this case (i.e. EN-DC and NG EN-DC) differences seem unlikely (i.e. other than support/ IoT)
2. How to indicate the MRDC differences precisely:
   1. If for a supported BC the UE indicates no differences, the indicated capabilities apply for all supported/ reported MRDC cases (i.e. common value). This approach is assumed to be consistent with existing procedure
   2. If for a supported BC the UE indicates differences, the UE indicates the common value and for each the MRDC cases for which the common value does not apply, the delta (i.e. XDD approach)
   3. According to a) the only capability difference UE needs to report concerns for which MRDC cases the UE supports the BC. I.e. If UE supports both EN-DC and NG EN-DC, UE would just indicate support in the common branch. Otherwise, the common branch would indicate ‘*no support*’ while e.g. the EN-DC branch indicates *support*
3. Indicating support of MRDC cases
   1. If UE is to provide EN-DC and NG EN-DC capabilities but reports no difference, it may not be clear which MRDC cases the UE supports. A separate indication seems required, unless this can already be inferred from existing capabilities (note that an indication exists for EN-DC i.e. en-DC-r15 in IRAT-ParametersNR-r15. A similar indication may be introduced for NG-EN-DC)

In short, the main points to clarify concern:

1. For supported band combinations, the only difference between MRDC cases to consider in REL-15 concerns support y/n i.e. whether UE supports EN-DC and NG EN-DC for a supported BC
2. The FDD/ TDD approach is used to indicate differences between MRDC cases in supported BC capabilities, as suggested
3. Introduce a field indicating the MRDC cases supported by the UE. In particular, in 36.331 introduce a field indicating support of NG EN-DC

**Question 8: Companies are requested to share their view i.e. whether they agree to the principles regarding how to indicate differences between MRDC cases as indicated in this section (in particular regarding the 3 main points)**

|  |  |  |
| --- | --- | --- |
| Company | Yes/ no, option | Comment |
| Qualcomm Incorporated | Yes, but see the comment | As stated elsewhere, we would prefer generic RAT-independent approach that works also in future releases. |
| Ericsson | No | As we stated in question 6, those points would need further RAN4 input. |
| MediaTek | Generally yes | Agree with Qualcomm that a RAT-independent approach is preferred. These three points as stated seem valid. |
| NTT DOCOMO | Yes in general | If functional support is common to all MR-DC options, those principles can work. If RAN1/4 feedback that it is not always true and there are exceptional capabilities, we need to introduce additional dimensioning as agreed at RAN2 #104. |
| Intel | Yes in general | Agree with comments from DOCOMO. |
| Samsung | Yes | Agree that RAN1/ 4 feedback may result in some add-ons (but should be possible to agree some starting points) |

Companies are welcome to add further FFS:

|  |  |  |
| --- | --- | --- |
| Issue | Company | Comment |
|  |  |  |
|  |  |  |

# 3 Conclusion

# 4 References

1. R2-1818404, Capability coordination for NR-DC, Ericsson, 3GPP TSG-RAN WG2#104, Spokane, USA, 12th – 17th November 2018.
2. R2-1818001 Email discussion report on 103bis#26NR Late drop NE-DC, Huawei, 3GPP TSG-RAN WG2#104, Spokane, USA, 12th – 17th November 2018.
3. R2-1818302, PDCCH blind decoding capability coordination in NR-DC, Samsung, 3GPP TSG-RAN WG2#104, Spokane, USA, 12th – 17th November 2018.