**3GPP TSG-RAN** **WG2 Meeting #110-e R2-200xxxx**

**Electronic, June 1 – 12, 2020**

**Source: Samsung**

**Title: Summary of email discussion [AT110e][022][NR15] UE cap Miscellaneous II**

**Document for: Decision**

**Agenda Item: 5.4.3.1**

# Introduction

This document summarizes the following offline discussion for UE capabilities.

**Miscellaneous II**

* [AT110e][022][NR15] UE cap Miscellaneous II (Samsung)

Scope: Treat R2-2004831, R2-2004458, R2-2004459, R2-2005397, R2-2005398 (proponents are responsible to explain and drive)

Part 1: Decision whether to make corrections or not, identify agreeable corrections. Deadline: June 4, 0700 UTC.

Part 2: For agreeable parts, continuation to agree CRs. Deadline: June 10, 0700 UTC

xDD differentiation SUL/SDL bands

[R2-2004831](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2004831.zip) xDD differentiation of UE capabilities for SUL/SDL bands Samsung discussion Rel-15 NR\_newRAT-Core

BCS and BW

[R2-2004458](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2004458.zip) Clarification on BCS and UE BW capabilities Nokia, Nokia Shanghai Bell discussion Rel-15 NR\_newRAT-Core

[R2-2004459](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2004459.zip) Draft LS to RAN4 on clarification on BCS and UE BW capabilities Nokia, Nokia Shanghai Bell LS out Rel-15 NR\_newRAT-Core To:RAN4

Serving cell number for ENDC power class

[R2-2005397](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2005397.zip) Correction to the serving cell number for ENDC power class Huawei, HiSilicon CR Rel-15 38.306 15.9.0 0287 1 F NR\_newRAT-Core R2-2003461

[R2-2005398](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2005398.zip) Correction to the serving cell number for ENDC power class Huawei, HiSilicon CR Rel-16 38.306 16.0.0 0288 1 A NR\_newRAT-Core R2-2003462

Chair: Can take LS from R4 into account once ready in R4, if it is to be provided

# Discussion: Part 1 (by June 4, 0700 UTC)

It is proposed to try to come to a set of agreeable proposals out of the documents listed above. For each set of CRs, companies are requested provide their views.

## xDD differentiation for SUL/SDL bands ([R2-2004831](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2004831.zip))

This contribution proposes to clarify the xDD differentiation of capabilities for SDL and SUL bands for Rel-15, these SDL and SUL bands follow the xDD differentiation of capabilities for TDD and FDD, respectively

According to clause 5.2 in 38.101-1 v15.90, NR operating bands in FR1 are defined in Table 5.2-1. There are 2 SDL bands (i.e. n75, n76) and 6 SUL bands (i.e. n80, n81, n82, n83, n84, n86) and these bands have corresponding TDD or FDD bands i.e. all SDL/SUL bands have corresponding bands.

1. SDL bands

* n75, n76: have corresponding TDD bands, n50 and n51, respectively.

1. SUL bands

* n80, n81, n82, n83, n84, n86: have corresponding FDD bands, n66, n8, n20, n1, n66, and n5, respectively.

In other words, capabilities for SDL bands follows the TDD-differentiation (i.e. common containers of Phy-ParametersXDD-Diff and MeasAndMobParametersXDD-Diff, tdd-Add-UE-NR/MRDC-Capabilities, etc) and capabilities for SUL bands follows the FDD-differentiation (i.e. common containers of Phy-ParametersXDD-Diff and MeasAndMobParametersXDD-Diff, fdd-Add-UE-NR/MRDC-Capabilities).

**Q1. Do you agree that xDD differentiation of capabilities for SDL and SUL bands for Rel-15 follows the xDD differentiation of capabilities for TDD and FDD bands, respectively?**

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| **Company name** | **Agree / Disagree** | **Comments** |
| Samsung | Agree | It is natural that Rel-15 SUL/SDL bands can be associated with the TDD and FDD bands, respectively. |
| Qualcomm Incorporated | Disagree | This is a good question, but we disagree to the conclusion for the following reasons.  - neither SDL nor SUL has TDD UL-DL-configuration.  - there are also TDD-only and FDD-only capabilities and features that are specific for TDM nature of TDD would not apply to SDL.  So the categorization should not be based merely on how SUL/SDL bands are categorized in RAN4 RF table. We should also consider other aspects, e.g. nature of baseband processing.  We should ask RAN1 as well as RAN4 in more general before RAN2 concludes on anything. |
| Huawei, HiSilicon | Agree | Agree with Samsung. |
| Ericsson | Wait for RAN4 reply | If we are going to anyway ask RAN4 for clarification (see our comments in the question below), better to take a joint decision once we get the reply. |
| Nokia | LS to RAN4 | In our understanding the differentiation follows the corresponding pairing where SDL band would follow TDD band differentiation if paired with some TDD band and SDL band would follow FDD band differentiation if paired with some FDD band and **NOT** based on the fact that SDL band n75 would follow TDD differentiation as it has the same DL frequencies as TDD band n50 and SUL band n82 would follow FDD differentiation as it has the same UL frequencies as FDD band n20.  Is this understanding correct? |
| OPPO |  | We share the view above that essentially this is about whether L1/L2/RAN4 capability which applicable to FDD/TDD is also applicable to SUL/SDL without any difference, so LS to RAN1/4 is necessary. |
| CATT |  | In our understanding, we could first ask RAN4 for guidance. |
| MediaTek |  | Agree with companies that this is better to ask RAN4 before we conclude. |
| ZTE | LS to RAN4 and RAN1 | Agree with above companies to send LS to RAN4 for clarification, and RAN1 should also be informed. |
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RAN4 defined the new SUL/SDL bands in Rel-16. According to clause 5.2 in 38.101-1 v16.30, NR operating bands in FR1 are defined in Table 5.2-1. There are 3 SDL bands (i.e. n29, n75, n76) and 8 SUL bands (i.e. n80, n81, n82, n83, n84, n86, n89, n95) i.e. new bands for n29, n89, n95 are introduced in Rel-16. However, there are no clear rule that mapping SDL/SUL banbs to the corresponding TDD/FDD bands. Each new band have different corresponding band, so it seems that the Proposal 1 above cannot be applied.

1. SDL bands

* n29: no corresponding band

1. SUL bands

* n89: have corresponding FDD band (i.e. n5)
* n95: have corresponding TDD band (i.e. n34)

It is unclear how the capability parameters can be differentiated by xDD for SUL/SDL bands which can be signalled for this problematic bands above. If there are no exception case (n29 and n95), the simplest way would be the xDD differentiation for capabilities for SUL/SDL bands follow the signalling rule of the corresponding bands (i.e. SDL follows the corresponding TDD band, SUL follows the corresponding FDD band).

**Q2. How to differentiate by xDD the UE capabilities for the newly added SUL SDL bands in Rel-16?**

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| **Company name** | **Comments** |
| Samsung | It would be better to ask this aspect to RAN4 because RAN2 cannot solve this issue without further information.  Send LS to RAN4 to ask how capability parameters can be differentiated by xDD for newly added SUL/SDL bands (i.e. n29, n89 and n95) in Rel-16. |
| Qualcomm Incorporated | See our comment to Q1. We should ask RAN1 and RAN4 in more general. |
| Huawei, HiSilicon | Agree to send LS to RAN4. |
| Ericsson | We think we could confirm with RAN4 their understanding on the Rel-15 and Rel-16 bands in general. Once they reply we can decide how to handle it jointly. |
| Nokia | Agree to send LS to RAN4. |
| OPPO | Agree to use LS to consult other WG, but may not limit to RAN4.  The issue is for all capability (L1/L2/RAN4), how the capability attributive of ‘FDD/TDD diff’ is defined for SUL/SDL. While RAN2 has a say on L2 capability, L1/RAN4 capability has to rely on the view from RAN1/RAN4. |
| CATT | Yes we can ask Ran4. |
| MediaTek | Agree to ask RAN4. We need a common understanding on SUL/SDL bands in general and this understanding should be release agnostic. |
| ZTE | Agree to send LS to RAN4 (RAN1 should also be informed). |
|  |  |

*Summary: Majority companies provide the view that this issues, i.e.* *how to differentiate by xDD the UE capabilities for the SUL/ SDL bands in Rel-15 and Rel-16, should be asked to RAN4 and some companies suggest to ask to RAN1 as well. It seems sending LS to ask how per-UE capabilities for SUL/SDL bands be differentiated on the duplex mode(s).*

**Proposal 1: RAN2 send LS to RAN4 to ask how per-UE capabilities for SUL/SDL bands can be differentiated on the duplex mode(s) in Rel-15 and Rel-16.**

## Clarification on BCS and UE BW capabilities ([R2-2004458](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2004458.zip), [R2-2004459](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2004459.zip))

In R2-2004458 [2], it is proposed to clarify the UE behaviour observed in the field on interpretation of BCS and UE BW while reporting UE capabilities:

The UE indicates its supported BCSs for each supported band combination in UE capabilities as shown in below excerpt from TS 38.306:

**supportedBandwidthCombinationSet**

*For NR SA and for inter-band EN-DC, the field defines the bandwidth combinations for the NR part of the band combination. For intra-band EN-DC, the field indicates the supported bandwidth combination set applicable to the NR and LTE band combinations. The first (left-most) bit in the bitmap corresponds to the BCS#0 and so on. If the bit is set to 1, the UE supports the corresponding BCS.*

However, the UE also has an additional capability description in *FeatureSetDownlinkPerCC::supportedBandwidthDL* to indicate the supported BW for a particular band per a band combination configuration, as well as the capabilities for supported channel BWs per band in *BandNR::channelBWs-DL*, as shown below (for downlink only in this case):

| ***supportedBandwidthDL***  Indicates maximum DL channel bandwidth supported for a given SCS that UE supports within a single CC, which is defined in Table 5.3.5-1 in TS 38.101-1 [2] for FR1 and Table 5.3.5-1 in TS 38.101-2 [3] for FR2.  For FR1, all the bandwidths listed in TS38.101-1 Table 5.3.5-1 for each band shall be mandatory with a single CC unless indicated optional. For FR2, the set of mandatory CBW is 50, 100, 200 MHz. When this field is included in a band combination with a single band entry and a single CC entry (i.e. non-CA band combination), the UE shall indicate the maximum channel bandwidth for the band according to TS 38.101-1 [2] and TS 38.101-2 [3].  NOTE: To determine whether the UE supports a channel bandwidth of 90 MHz, the network may ignore this capability for and validate instead the *channelBW-90mhz* and the *supportedBandwidthCombinationSet*. For serving cells with other channel bandwidths the network validates the *channelBWs-DL*, the *supportedBandwidthCombinationSet* and *supportedBandwidthDL*. |
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| ***channelBWs-DL***  Indicates for each subcarrier spacing the UE supported channel bandwidths. Absence of the *channelBWs-DL* (without suffix) for a band or absence of specific scs-XXkHz entry for a supported subcarrier spacing means that the UE supports the channel bandwidths among [5, 10, 15, 20, 25, 30, 40, 50, 60, 80, 100] and [50, 100, 200] that were defined in clause 5.3.5 of TS 38.101-1 version 15.7.0 [2] and TS 38.101-2 version 15.7.0 [3] for the given band or the specific SCS entry.  For FR1, the bits in *channelBWs-DL* (without suffix) starting from the leading / leftmost bit indicate 5, 10, 15, 20, 25, 30, 40, 50, 60 and 80MHz. For FR2, the bits in *channelBWs-DL* (without suffix) starting from the leading / leftmost bit indicate 50, 100 and 200MHz. The third / rightmost bit (for 200MHz) shall be set to 1.  For FR1, the leading/leftmost bit in *channelBWs-DL-v1590* indicates 70MHz, and all the remaining bits in *channelBWs-DL-v1590* shall be set to 0.  NOTE: To determine whether the UE supports a specific SCS for a given band, the network validates the *supportedSubCarrierSpacingDL* and the *scs-60kHz*. To determine whether the UE supports a channel bandwidth of 90 MHz, the network may ignore this capability for and validate instead the *channelBW-90mhz* and the *supportedBandwidthCombinationSet*. For serving cells with other channel bandwidths the network validates the *channelBWs-DL*, the *supportedBandwidthCombinationSet* and *supportedBandwidthDL*. |
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According to the observations and the example in R2-2004458 [2], the specifications seem unclear what exactly means for a UE to support a particular BCS: In LTE, UE was mandated to support all the bandwidths defined for the BCS, but in NR it appears (given that the current description in the specification) that some UEs consider this is not the case. If the UE cannot support all CH BWs belonging to a certain BCS from 3GPP point of view, then it is unclear how to interpret the disparity between the supported channel bandwidths and the BCS.

**Q3. Do you agree that UE shall support all the channel bandwidths for that BCS if a UE indicates support for a BCS defined for a band combination? and if not how should the discrepancy be interpreted?**

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| **Company name** | **Agree / Disagree** | **Comments** |
| Samsung | Agree | UE reported BCS0 and then the UE should support all specified aggregated bandwidths, we can refer to the description in TR-38.817-01, excerpt here:  **Considering NR bands in standalone operation:**   * BCSs are specified for CA configuration in NR bands in standalone operation * UE should support all specified aggregated bandwidths which are smaller than the indicated aggregated bandwidth and are part of same BCS indicated * UE should support all specified lower order CA configurations which have same BCS as indicated * BCS with same number (e.g. BCS0) need to be aligned between lower and higher order fallback configuration |
| Qualcomm Incorporated | Disagree | Our understanding is the following.   * supportedBandwidthDL was meant to cover a way forward from RAN#78 that the maximum channel BW is UE capability. * channelBWs-DL was meant to cover a way forward from RAN#80 that IOT indication should be introduced for channel BWs lower than the maximum channel BW.   BCS defines a set of available channel BWs in the band combination, and supportedBandwidthDL and channelBWs-DL indicate what the UE support or is tested for. So no action is needed. |
| Huawei, HiSilicon | Disagree | In TS 38.306, there is the description “For serving cells with other channel bandwidths the network validates the *channelBWs-DL*, the *supportedBandwidthCombinationSet* and *supportedBandwidthDL*.”  So the BW supported by the UE needs to combine BCS, channelBWs-DL/UL and supportedBandwidthDL/UL. The current spec is clear. |
| Ericsson | Disagree | At least the UE could include some FSD/FSU which allow more MIMO layers when configured with narrower carriers. And if the UE does that, the NW anyway has to check the channel-BW. The UE can indicate different (in-)capabilities in different places, so due to that the gNB has no other choice than crawling through all of those and configure what is allowed by all (BCS tables, supported-BW in FSD/FSU, channel BW in BandNR).  Having said this, we would appreciate if we could just remove the supportedBandwidthCombinationSet signalling as well as the RAN4 tables and configure simply what the UE allows according to its explicit UE capabilities. |
| Nokia | Agree | As proponent of this we would like to check with RAN4 about Ericsson’s point “we would appreciate if we could just remove the supportedBandwidthCombinationSet signalling as well as the RAN4 tables and configure simply what the UE allows according to its explicit UE capabilities” |
| OPPO | Disagree | According to the NOTE below, to judge whether a BW is support for a BC under a BCS, *supportedBandwidthDL*, and *channelBWs-DL* have to be considered as well, i.e., a BW is supported only if it is supported based on all IEs (*supportedBandwidthCombinationSet*, *supportedBandwidthDL*, *channelBWs-DL*).  NOTE: To determine whether the UE supports a specific SCS for a given band, the network validates the *supportedSubCarrierSpacingDL* and the *scs-60kHz*. To determine whether the UE supports a channel bandwidth of 90 MHz, the network may ignore this capability for and validate instead the *channelBW-90mhz* and the *supportedBandwidthCombinationSet*. For serving cells with other channel bandwidths the network validates the *channelBWs-DL*, the *supportedBandwidthCombinationSet* and *supportedBandwidthDL*. |
| CATT | See comment | Currently we think ran2 spec is clear. For BCS we believe if any changes needed that should come from RAN4. |
| MediaTek | Disagree | We also share the understanding that UE capability is defined by BCS, Channel BW, and supportedBandwidth altogether. This was discussed and agreed.  R2 can confirm the understanding again, otherwise, no action is needed. |
| ZTE | Disagree | We also think that both the UE and network side shall take all of the BCS, channelBWs-DL/UL and upportedBandwidthDL/UL in to consideration, when filling/Determine the UE BW capability. |
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*Summary: There are clear majority companies the current specification is clear that UE capability for channel bandwidths is defined by BCS, Channel BW, and supportedBandwidth altogether. So, it seems no need to send LS to RAN4. However, it seems better to capture the RAN2 understanding in the chairman note because this is raised by real IODT issue.*

**Proposal 2: RAN2 confirm that the current specification is clear i.e. UE capability for channel bandwidths is defined by BCS, channel BWs, and supportedBandwidth altogether.**

## Serving cell number for ENDC power class ([R2-2005397](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2005397.zip), [R2-2005398](http://www.3gpp.org/ftp/tsg_ran/WG2_RL2/TSGR2_110-e/Docs/R2-2005398.zip))

These CRs propose to update the field description for *powerClass* in TS 38.306 to support EN-DC combinations with 3 UL CCs.

RAN4 has already specified the EN-DC combinations with 3CC uplink serving cells. The EN-DC combinations with 3 UL CCs are added in TS 38.101-3 and the NOTE4 (Power class 3 is the default power class unless otherwise stated) should also be applied to these EN-DC combinations with 3 UL CCs. To align with RAN4 spec, the description for powerClass needs update, and RAN4 is working on the LS to be sent to RAN2.

See the below proposed change in these CRs.

| ***powerClass***  Indicates power class the UE supports when operating according to this band combination. If the field is absent, the UE supports the default power class. If this power class is higher than the power class that the UE supports on the individual bands of this band combination (*ue-PowerClass* in *BandNR*), the latter determines maximum TX power available in each band. The UE sets the power class parameter only in band combinations with two or more FR1 uplink serving cells. | BC | No | No | FR1 only |
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As chairman commented in the chairman note, these CRs can be confirmed/treated when LS from R4 is received but in this offline discussion RAN2 can provides the view based on internal checking for this issue.

**Q4. Do you agree to update the description for *powerClass* for band combinations with up to three FR1 uplink serving cells?**

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| **Company name** | **Agree / Disagree** | **Comments** |
| Samsung | Agree | It reflects the RAN4 agreements, we are fine for adding further clarification as suggested in these CRs. |
| Qualcomm Incorporated | Agree | This is in line with the current RAN4 status. |
| Huawei, HiSilicon | Proponent |  |
| Ericsson | Agree | We agree with the intention. |
| Nokia | Agree | This is in line with the current RAN4 status. |
| OPPO |  | It is preferred to wait till LS from RAN4 is received. |
| CATT | Agree |  |
| MediaTek | Agree |  |
| ZTE |  | We agree with the motivation. But the wording detail could be further determined based on the RAN4’s final LS. Such as whether it shall be limited to the BC with 2LTE CC UL+ 1NR CC UL or it can be applicable to the both BC with "2LTE CC UL+ 1NR CC UL” and BC with"1LTE CC UL+ 2NR CC UL” |
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*Summary: There is significant majority in support of this CR, but one company suggest that the detail wording should be determined based on the RAN4’s final LS.*

**Proposal 3: RAN2 will agree the CRs (i.e.** **R2-2005397, R2-2005398) when LS from RAN4 is received. Detail wording can be determined based on the RAN4’s final LS.**

# Discussion: Part 2 (by June 10, 0700 UTC)

For the issue number (i.e. xDD differentiation for SUL/SDL bands), further discussion will be continued to draft LS.

# Conclusion

**Proposal 1: RAN2 send LS to RAN4 to ask how per-UE capabilities for SUL/SDL bands can be differentiated on the duplex mode(s) in Rel-15 and Rel-16.**

**Proposal 2: RAN2 confirm that the current specification is clear i.e. UE capability for channel bandwidths is defined by BCS, channel BWs, and supportedBandwidth altogether.**

**Proposal 3: RAN2 will agree the CRs (i.e.** **R2-2005397, R2-2005398) when LS from RAN4 is received. Detail wording can be determined based on the RAN4’s final LS.**

# Reference

1. R2-2004831, xDD differentiation of UE capabilities for SUL/SDL bands, Samsung.
2. R2-2004458 Clarification on BCS and UE BW capabilities, Nokia, Nokia Shanghai Bell.
3. R2-2004459 Draft LS to RAN4 on clarification on BCS and UE BW capabilities, Nokia, Nokia Shanghai Bell.
4. R2-2005397 Correction to the serving cell number for ENDC power class, CR Rel-15, 38.306 15.9.0 0287, Huawei, HiSilicon.
5. R2-2005398 Correction to the serving cell number for ENDC power class, CR Rel-16, 38.306 16.0.0 0288, Huawei, HiSilicon.