**3GPP TSG RAN WG1 #118 R1-2407212**

**Maastricht, NL, August 19th – 23rd, 2024**

Source: Moderator(vivo)

Title: Summary of discussion on FR2-NTN inclusion to specifications

Agenda Item: 8.1

Document for: Discussion and Decision

# Introduction

This feature lead summary (FLS) document aims to collect and align on company views on maintenance issues on FR2-NTN inclusion to specifications, which contains a summary of the contribution and draft CR related to FR2-NTN inclusion to specifications.

R1-2406161 Discussions on FR2-NTN inclusion to specifications vivo

R1-2406161 Draft CR on FR2-NTN inclusion to TS38.213 vivo

**1st round discussion**: please provide your feedback before **Monday 16:30**

# Discussions

## Companies’ contributions summary

[1] found several parts in TS38.213 where the support of the operation of FR2-NTN is ambiguous, for example, the text highlighted yellow or cyan defines different behaviors between FR2-1 and FR2-2, but does not include FR2-NTN for either case. It should be noted that according to TS 38.101-5, the FR1-NTN band is regarded as a FR1 band, while the FR2-NTN is regarded as a **FR2 band,** i.e., indistinguishable between FR2-1 and FR2-2.

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| The frequency ranges in which NTN satellite can operate according to this version of the specification are identified as described in Table 5.1-1.Table 5.1-1: Definition of NTN frequency ranges

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| Frequency range designation | Corresponding frequency range  |
| FR1-NTN1 | 410 MHz – 7125 MHz |
| FR2-NTN2 | 17300 MHz – 30000 MHz |
| NOTE 1: [NTN bands within this frequency range are regarded as a FR1 band when references from other specifications.]NOTE 2: [NTN bands within this frequency range are regarded as a FR2 band when references from other specifications.] |

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| TS38.213 v18.3.010.1 UE procedure for determining physical downlink control channel assignment<<omitted>>The UE may assume that the DM-RS antenna port associated with PDCCH receptions in the CORESET configured by *pdcch-ConfigSIB1* in *MIB*, the DM-RS antenna port associated with corresponding PDSCH receptions, and the corresponding SS/PBCH block are quasi co-located with respect to average gain, quasi co-location 'typeA' and 'typeD' properties, when applicable [6, TS 38.214], if the UE is not provided a TCI state indicating quasi co-location information of the DM-RS antenna port for PDCCH reception in the CORESET. The value for the DM-RS scrambling sequence initialization is the cell ID. For operation without shared spectrum channel access in FR1 and FR2-1, a SCS is provided by *subCarrierSpacingCommon* in *MIB*. For operation with shared spectrum channel access in FR1 and for operation in FR2-2, a SCS is same as the SCS of a corresponding SS/PBCH block.13 UE procedure for monitoring Type0-PDCCH CSS setsIf during cell search a UE determines from *MIB* that a CORESET for Type0-PDCCH CSS set is present, as described in clause 4.1, the UE determines a number of consecutive resource blocks and a number of consecutive symbols for the CORESET of the Type0-PDCCH CSS set from *controlResourceSetZero* in *pdcch-ConfigSIB1*, as described in Tables 13-0 through 13-10, for operation without shared spectrum channel access in FR1 and FR2-1, or as described in Tables 13-1A and 13-4A for operation with shared spectrum channel access in FR1, or as described in Table 13-10A for FR2-2, and determines PDCCH monitoring occasions from *searchSpaceZero* in *pdcch-ConfigSIB1*, included in *MIB*, as described in Tables 13-11 through 13-15A. $SFN\_{c}$ and $n\_{c}$ are the SFN and slot index within a frame of the CORESET based on SCS of the CORESET and $SFN\_{SSB,i}$ and $n\_{SSB,i}$ are the SFN and slot index based on SCS of the CORESET, respectively, where the SS/PBCH block with index $i$ overlaps in time with system frame $SFN\_{SSB,i}$ and slot $n\_{SSB,i}$. The symbols of the CORESET associated with *pdcch-ConfigSIB1* in *MIB* or with *searchSpaceSIB1* in *PDCCH-ConfigCommon* have normal cyclic prefix. In Table 13-0, configurations with index 0 to 9 are applicable when an associated SS/PBCH block is located according to Table 5.4.3.3-2 in [8-1, TS 38.101-1], configurations with index 10 to 11 are applicable when an associated SS/PBCH block is located according to NOTE 12 of Table 5.4.3.3-1 in [8-1, TS 38.101-1], and non-interleaved CCE-to-REG mapping applies for configurations with index 6 to 9. In Table 13-1, the associated SS/PBCH block is not located according to NOTE 12 of Table 5.4.3.3-1 in [8-1, TS 38.101-1].For operation with shared spectrum channel access in FR2-2 and for operation without shared spectrum channel access, a UE assumes that the offset in Tables 13-0 through 13-10A is defined with respect to the SCS of the CORESET for Type0-PDCCH CSS set from the smallest RB index of the CORESET for Type0-PDCCH CSS set to the smallest RB index of the common RB overlapping with the first RB of the corresponding SS/PBCH block, after puncturing if any [4, TS 38.211]. The SCS of the CORESET for Type0-PDCCH CSS set is provided by *subCarrierSpacingCommon* for FR1 and FR2-1, and same as the SCS of the corresponding SS/PBCH block for FR2-2. In Tables 13-7, 13-8, and 13-10, $k\_{SSB}$ is defined in [4, TS 38.211]. <<omitted>>**Table 13-8: Set of resource blocks and slot symbols of CORESET for Type0-PDCCH search space set when {SS/PBCH block, PDCCH} SCS is {120, 120} kHz for FR2-1**<< omitted>>Table 13-12: Parameters for PDCCH monitoring occasions for Type0-PDCCH CSS set - SS/PBCH block and CORESET multiplexing pattern 1 and FR2-1, or SS/PBCH block and CORESET multiplexing pattern 1 and {SS/PBCH block, PDCCH} SCS {120, 120} kHz in FR2-2<< omitted>>If a UE detects a first SS/PBCH block and determines that a CORESET for Type0-PDCCH CSS set is not present, and for $24\leq k\_{SSB}\leq 29$ for FR1 or for $12\leq k\_{SSB}\leq 13$ for FR2, the UE may determine the nearest (in the corresponding frequency direction) global synchronization channel number (GSCN) of a second SS/PBCH block having a CORESET for an associated Type0-PDCCH CSS set as $N\_{GSCN}^{Reference}+N\_{GSCN}^{Size}⋅N\_{GSCN}^{Offset}$. $N\_{GSCN}^{Reference}$ is the GSCN of the first SS/PBCH block, $N\_{GSCN}^{Size}=1$ in FR1 and FR2-1, $N\_{GSCN}^{Size}=$ 3 in FR2-2, and $N\_{GSCN}^{Offset}$ is a GSCN offset provided by Table 13-16 for FR1 and Table 13-17 for FR2. If the UE detects the second SS/PBCH block and the second SS/PBCH block does not provide a CORESET for Type0-PDCCH CSS set, as described in clause 4.1, the UE may ignore the information related to GSCN of SS/PBCH block locations for performing cell search. |

In addition, [1] also observed that there are some legacy parameters and UE capabilities that should be applicable to NTN, but currently they refer only to the FR2-1 bands, e.g., *channelBWs-DL*, *configuredUL-GrantType1-v1650*, i.e., without referring the FR2-NTN band. The following are some examples extracted from the TS 38.331 and TS38.306.

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| TS38.306***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 IAB-MT, to determine whether the IAB-MT supports a channel bandwidth of 100 MHz, the network checks c*hannelBW-DL-IAB-r16*.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 IAB-MT the third / rightmost bit (for 200MHz) is ignored. To determine whether the IAB-MT supports a channel bandwidth of 200 MHz, the network checks *channelBW-DL-IAB-r16*.For FR1, the leading/leftmost bit in *channelBWs-DL-v1590* indicates 70MHz, the second leftmost bit indicates 45MHz, the third leftmost bit indicates 35MHz, the fourth leftmost bit indicates 100MHz and all the remaining bits in *channelBWs-DL-v1590* shall be set to 0. The fourth leftmost bit (for 100MHz) is not applicable for bands n41, n48, n77, n78, n79 and n90 as defined in TS 38.101-1 [2]. For each band, (e)RedCap UEs shall indicate supporting the maximum of those channel bandwidths that are less than or equal to 20 MHz for FR1 and less than or equal to 100 Mhz for FR2, taking restrictions in TS 38.101-1 [2] and TS 38.101-2 [3] into consideration. For each band, NTN capable UEs shall indicate the supported channel bandwidths for FR1, taking restrictions in TS 38.101-5 [34] into consideration.This feature is applicable only for FR1 and FR2-1 band, otherwise it is absent.***configuredUL-GrantType1-v1650***Indicates whether the UE supports Type 1 PUSCH transmissions with configured grant as specified in TS 38.214 [12] with UL-TWG-repK value of one. This applies only to non-shared spectrum channel access. For shared spectrum channel access, *configuredUL-GrantType1-r16* applies. UE shall set the capability value consistently for all FDD-FR1 bands, all TDD-FR1 bands, all TDD-FR2-1 bands and all TDD-FR2-2 bands respectively.The UE only includes *configuredUL-GrantType1-v1650* if *configuredUL-GrantType1* is absent. |

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| TS38.331BWP ::= SEQUENCE { locationAndBandwidth INTEGER (0..37949), subcarrierSpacing SubcarrierSpacing, cyclicPrefix ENUMERATED { extended } OPTIONAL -- Need R}***subcarrierSpacing***Subcarrier spacing to be used in this BWP for all channels and reference signals unless explicitly configured elsewhere. Corresponds to subcarrier spacing according to TS 38.211 [16], table 4.2-1. The value *kHz15* corresponds to µ=0, value *kHz30* corresponds to µ=1, and so on.Only the following values are applicable depending on the used frequency:FR1: 15, 30, or 60 kHzFR2-1: 60 or 120 kHzFR2-2: 120, 480, or 960 kHz |

From another perspective, according to the note2 from Table 5.1-1 in [2], a FR2-NTN band is regarded as FR2 band when referenced from other specifications, which aims to minimize the impacts on RAN1 and RAN2 specifications from FL understanding. Based on the definition of FR1 and FR2 in [3], the frequency range for FR2-NTN only partially overlaps with the frequency range for FR2-1. However, FR2-1 and FR2-2 are clearly distinguished in RAN1 specifications, which would result in unclear UE behavior for FR2-NTN. Instead of going through the specification and revising the descriptions of the parameters/capabilities/behaviors one by one, an alternative solution could be to consider FR2-NTN as a FR2-1 band, allowing it to naturally reuse the specifications defined for FR2-1. In this case, RAN1 can send an LS to RAN4 to confirm this. Thus, [1] provided two options to be considered and made the following proposals:

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| ***Proposal 1: Consider the following options to support the operation of FR2-NTN**** ***Option 1: RAN1 and RAN2 continue to further update the specifications to complete the inclusion of FR2-NTN band. Adopt*** ***Draft CR*** ***R1-2406162 for 38.213.***
* ***Option 2: send a LS to RAN4 to modify note2 in Table 5.1-1 in TS38.101-5 as ‘FR2-NTN should be regarded as a FR2-1 band when references from other specifications’.***
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And the corresponding draft CR is provided in [4] to include FR2-NTN, by adding ‘*and FR2-NTN*’ after ‘*FR2-1*’, listed in Appendix.

## Collection of Companies’ views

According to the analysis above, companies are invited to provide their views on the following questions

**Q1: Do you agree that the highlighted parts in TS38.213 listed above are ambiguous for the support of the operation of FR2-NTN? Please provide the reason.**

Companies are invited to provide their views on the questions in the following table.

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| **Company** | **Y/N** | **Comments** |
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**Q2: If Q1 is yes, which option do you prefer to move forward. Please provide the reason.**

* **Option 1:** **RAN1 and RAN2 continue to further update the specifications to complete the inclusion of FR2-NTN band.**
	+ **If option 1, do you agree the draft CR in R1-2406162 for TS38.213?**
* **Option 2: send a LS to RAN4 to modify note2 in Table 5.1-1 in TS38.101-5 as ‘FR2-NTN should be regarded as a FR2-1 band when references from other specifications’.**
* **Option 3: other solution.**

Companies are invited to provide their views on the questions in the following table.

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| **Company** | **Option** | **Comments** |
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# Proposal for online discussion

TBD.

# Conclusion

TBD

# References

1. R1-2406161, Discussions on FR2-NTN inclusion to specifications, vivo, August 19th – 23rd, 2024.
2. 3GPP TS 38.101-5: "User Equipment (UE) radio transmission and reception; Part 5: Satellite access Radio Frequency (RF) and performance requirements NR".
3. 3GPP TS 38.101-1: "NR; User Equipment (UE) radio transmission and reception; Part 1: Range 1 Standalone".
4. R1-2406162, Draft CR on FR2-NTN inclusion to TS38.213, vivo, August 19th – 23rd, 2024.

# Appendix: Draft CR in R1-2406162

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| 10 UE procedure for receiving control information<<unchanged parts omitted>>10.1 UE procedure for determining physical downlink control channel assignment <<unchanged parts omitted>>The UE may assume that the DM-RS antenna port associated with PDCCH receptions in the CORESET configured by *pdcch-ConfigSIB1* in *MIB*, the DM-RS antenna port associated with corresponding PDSCH receptions, and the corresponding SS/PBCH block are quasi co-located with respect to average gain, quasi co-location 'typeA' and 'typeD' properties, when applicable [6, TS 38.214], if the UE is not provided a TCI state indicating quasi co-location information of the DM-RS antenna port for PDCCH reception in the CORESET. The value for the DM-RS scrambling sequence initialization is the cell ID. For operation without shared spectrum channel access in FR1 and FR2-1 and FR2-NTN, a SCS is provided by *subCarrierSpacingCommon* in *MIB*. For operation with shared spectrum channel access in FR1 and for operation in FR2-2, a SCS is same as the SCS of a corresponding SS/PBCH block.<<unchanged parts omitted>>13 UE procedure for monitoring Type0-PDCCH CSS setsIf during cell search a UE determines from *MIB* that a CORESET for Type0-PDCCH CSS set is present, as described in clause 4.1, the UE determines a number of consecutive resource blocks and a number of consecutive symbols for the CORESET of the Type0-PDCCH CSS set from *controlResourceSetZero* in *pdcch-ConfigSIB1*, as described in Tables 13-0 through 13-10, for operation without shared spectrum channel access in FR1 and FR2-1 and FR2-NTN, or as described in Tables 13-1A and 13-4A for operation with shared spectrum channel access in FR1, or as described in Table 13-10A for FR2-2, and determines PDCCH monitoring occasions from *searchSpaceZero* in *pdcch-ConfigSIB1*, included in *MIB*, as described in Tables 13-11 through 13-15A. $SFN\_{c}$ and $n\_{c}$ are the SFN and slot index within a frame of the CORESET based on SCS of the CORESET and $SFN\_{SSB,i}$ and $n\_{SSB,i}$ are the SFN and slot index based on SCS of the CORESET, respectively, where the SS/PBCH block with index $i$ overlaps in time with system frame $SFN\_{SSB,i}$ and slot $n\_{SSB,i}$. The symbols of the CORESET associated with *pdcch-ConfigSIB1* in *MIB* or with *searchSpaceSIB1* in *PDCCH-ConfigCommon* have normal cyclic prefix. In Table 13-0, configurations with index 0 to 9 are applicable when an associated SS/PBCH block is located according to Table 5.4.3.3-2 in [8-1, TS 38.101-1], configurations with index 10 to 11 are applicable when an associated SS/PBCH block is located according to NOTE 12 of Table 5.4.3.3-1 in [8-1, TS 38.101-1], and non-interleaved CCE-to-REG mapping applies for configurations with index 6 to 9. In Table 13-1, the associated SS/PBCH block is not located according to NOTE 12 of Table 5.4.3.3-1 in [8-1, TS 38.101-1].For operation with shared spectrum channel access in FR2-2 and for operation without shared spectrum channel access, a UE assumes that the offset in Tables 13-0 through 13-10A is defined with respect to the SCS of the CORESET for Type0-PDCCH CSS set from the smallest RB index of the CORESET for Type0-PDCCH CSS set to the smallest RB index of the common RB overlapping with the first RB of the corresponding SS/PBCH block, after puncturing if any [4, TS 38.211]. The SCS of the CORESET for Type0-PDCCH CSS set is provided by *subCarrierSpacingCommon* for FR1 and FR2-1 and FR2-NTN, and same as the SCS of the corresponding SS/PBCH block for FR2-2. In Tables 13-7, 13-8, and 13-10, $k\_{SSB}$ is defined in [4, TS 38.211]. <<unchanged parts omitted>>**Table 13-8: Set of resource blocks and slot symbols of CORESET for Type0-PDCCH search space set when {SS/PBCH block, PDCCH} SCS is {120, 120} kHz for FR2-1 and FR2-NTN**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Index** | **SS/PBCH block and CORESET multiplexing pattern**  | **Number of RBs** $N\_{RB}^{CORESET}$ | **Number of Symbols** $N\_{symb}^{CORESET}$ | **Offset (RBs)**  |
| 0 | 1  | 24 | 2 | 0 |
| 1 | 1  | 24 | 2 | 4 |
| 2 | 1  | 48 | 1 | 14 |
| 3 | 1  | 48 | 2 | 14 |
| 4 | 3  | 24 | 2 | -20 if $k\_{SSB}=0$ -21 if $k\_{SSB}>0$ |
| 5 | 3  | 24 | 2 | 24 |
| 6 | 3  | 48 | 2 | -20 if $k\_{SSB}=0$ -21 if $k\_{SSB}>0$ |
| 7 | 3  | 48 | 2 | 48 |
| 8 | Reserved |
| 9 | Reserved |
| 10 | Reserved |
| 11 | Reserved |
| 12 | Reserved |
| 13 | Reserved |
| 14 | Reserved |
| 15 | Reserved |

<<unchanged parts omitted>>**Table 13-12: Parameters for PDCCH monitoring occasions for Type0-PDCCH CSS set - SS/PBCH block and CORESET multiplexing pattern 1 and FR2-1 and FR2-NTN, or SS/PBCH block and CORESET multiplexing pattern 1 and {SS/PBCH block, PDCCH} SCS {120, 120} kHz in FR2-2**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Index** | $$O$$ | **Number of search space sets per slot** | $$M$$ | **First symbol index** |
| 0 | 0 | 1 | 1 | 0 |
| 1 | 0 | 2 | 1/2 | {0, if $i$ is even}, {7, if $i$ is odd} |
| 2 | 2.5  | 1 | 1 | 0 |
| 3 | 2.5 | 2 | 1/2 | {0, if $i$ is even}, {7, if $i$ is odd} |
| 4 | 5 | 1 | 1 | 0 |
| 5 | 5 | 2 | 1/2 | {0, if $i$ is even}, {7, if $i$ is odd} |
| 6 | 0 | 2 | 1/2 |  {0, if $i$ is even}, {$N\_{symb}^{CORESET}$, if $i$ is odd} |
| 7 | 2.5 | 2 | 1/2 |  {0, if $i$ is even}, {$N\_{symb}^{CORESET}$, if $i$ is odd} |
| 8 | 5 | 2 | 1/2 |  {0, if $i$ is even}, {$N\_{symb}^{CORESET}$, if $i$ is odd} |
| 9 | 7.5 | 1 | 1 |  0 |
| 10 | 7.5 | 2 | 1/2 |  {0, if $i$ is even}, {7, if $i$ is odd} |
| 11 | 7.5 | 2 | 1/2 |  {0, if $i$ is even}, {$N\_{symb}^{CORESET}$, if $i$ is odd} |
| 12 | 0 | 1 | 2 | 0 |
| 13 | 5 | 1 | 2 | 0 |
| 14 | Reserved |
| 15 | Reserved |

<<unchanged parts omitted>>If a UE detects a first SS/PBCH block and determines that a CORESET for Type0-PDCCH CSS set is not present, and for $24\leq k\_{SSB}\leq 29$ for FR1 or for $12\leq k\_{SSB}\leq 13$ for FR2, the UE may determine the nearest (in the corresponding frequency direction) global synchronization channel number (GSCN) of a second SS/PBCH block having a CORESET for an associated Type0-PDCCH CSS set as $N\_{GSCN}^{Reference}+N\_{GSCN}^{Size}⋅N\_{GSCN}^{Offset}$. $N\_{GSCN}^{Reference}$ is the GSCN of the first SS/PBCH block, $N\_{GSCN}^{Size}=1$ in FR1 and FR2-1 and FR2-NTN, $N\_{GSCN}^{Size}=$ 3 in FR2-2, and $N\_{GSCN}^{Offset}$ is a GSCN offset provided by Table 13-16 for FR1 and Table 13-17 for FR2. If the UE detects the second SS/PBCH block and the second SS/PBCH block does not provide a CORESET for Type0-PDCCH CSS set, as described in clause 4.1, the UE may ignore the information related to GSCN of SS/PBCH block locations for performing cell search. |