**3GPP TSG-RAN WG4 Meeting #xxx R4-2414287**

**<Meeting Location>, <Date> ‒ <Date>, 2024**

**Title:** WF on Rel-19 FR1 NTN bands

**Agenda Item:** 7.17, 7.18, 7.19

**Source: Moderator (Inmarsat)**

**Document for:** Approval

# Topic #1: NR\_NTN\_Sband

## Sub-topic 1-2: General Aspects

#### Issue 1-2-1: Band Numbering

Agreement: Adopt n252 as the band number for the new NR NTN S-band.

#### Issue 1-2-2: Band Plan

Agreement:

* + Proposed band plan as follows

|  |  |  |  |
| --- | --- | --- | --- |
| Satellite operating band | Uplink (UL) operating band SAN receive / UE transmit  FUL,low – FUL,high | Downlink (DL) operating band SAN transmit / UE receive  FDL,low – FDL,high | Duplex mode |
| [n252] | 2000 MHz - 2020 MHz | 2180 MHz - 2200MHz | FDD |
| NOTE: Satellite bands are numbered in descending order from n256. | | | |

#### Issue 1-2-3: Intended Regions and Countries

Agreement: Clarify that the new NTN S-band is only targeting north America.

#### Issue 1-2-4: Regulatory Background

Agreement:

* + Capture all the applicable regulations in a new section of TR 38.863
  + ATC is not applicable, hence out of scope for this work.

#### Issue 1-2-5: Applicable TN Bands for Coexistence

**Agreement:**

* + Focus on coexistence of S-band UL with B2/n2 and B25/n25 DL.
  + **Capture the clarifications on the co-existence issues with** B70/n70 and B66/n66 **and that there is no 3GPP solution for them** in the TR

#### Issue 1-2-6: TN-NTN UE-to-UE Coexistence

**Offline Agreement:**

* Further study the UE-to-UE coexistence between NTN S-band UL and B2/n2, B25/n25 DL, considering:
  + Realistic usage scenarios
  + consider UE antenna gain for smartphone of -5.5dBi
  + UE-to-UE separations
  + probability of the UE coexistence scenarios occurring
* Companies are encouraged to examine the previous work in TR 38.863 for UE-to-UE coexistence, noting that the solutions might need to be revisited
* Companies are encouraged to investigate the background scenario for applicability of the -50dBm/MHz requirement to assess its applicability to TN-NTN coexistence
* Companies are also encouraged to investigate other prior work in UE-to-UE coexistence where different values from -50 dBm/MHz have been adopted

## Sub-topic 1-3: System Parameters and UE RF

#### Issue 1-3-1: UE Channel Bandwidths

Agreement:

* + For the NTN FDD band with UE transmitting at 2000 - 2020 MHz and SAN transmitting at 2180 - 2200 MHz, the channel bandwidth and SCS should be defined as follows:

| NTN satellite band | SCS  kHz | UE Channel bandwidth (MHz) | | | |
| --- | --- | --- | --- | --- | --- |
| 5 | 10 | 15 | 20 |
|  | 15 | 5 | 10 | 15 | 20 |
| [n252] | 30 |  | 10 | 15 | 20 |
|  | 60 |  | 10 | 15 | 20 |

#### Issue 1-3-2: Channel Raster

Agreement:

* + Support both 100 kHz and 10 kHz channel raster.
  + Agree to mark Enhanced Channel Raster support as Mandatory as agreed in the WID Objectives.

#### Issue 1-3-3: Sync Raster

Agreement:

* Specifying at least Case A for the new NTN S-band GSCN.

#### Issue 1-3-4: TX-RX Separation

Agreement:

* Follow the conclusion of flexible Tx-Rx separation under the maintenance agenda.

#### Issue 1-3-6: General views on Impact to UE Requirements

**Offline Agreement:**

* Use the following merged table with common views on identified specification impact as a starting point.
* Companies to further assess focusing on the missing or TBC sections.

|  |  |  |
| --- | --- | --- |
| **Section** | **Requirement** | **COMMON VIEWS** |
|  |
| **Tx requirements** |  |  |  |
| 6.2.1 | UE maximum output power | Some impact |  |
|  |
| 6.2.2 | UE maximum output power reduction | No impact |  |
| 6.2.3 | UE additional maximum output power reduction | Some impact |  |
|  |
| 6.2.4 | Configured transmitted power | No impact |  |
| 6.3.1 | Minimum output power | No impact |  |
| 6.3.2 | Transmit OFF power | No impact |  |
| 6.3.3 | Transmit ON/OFF time mask | No impact |  |
| 6.3.4 | Power control | No impact |  |
| 6.4.1 | Frequency error | No impact |  |
| 6.4.2 | Transmit modulation quality | No impact |  |
| 6.5.1 | Occupied bandwidth | No impact |  |
| 6.5.2 | Out of band emission (ACLR) | No impact |  |
| 6.5.2.2 | Spectrum emission mask | No impact |  |
| 6.5.2.3 | Additional Spectrum emission mask | Some impact |  |
|  |
| 6.5.2.4.1 | NR ACLR | No impact |  |
| 6.5.2.4.2 | UTRA ACLR | No impact |  |
| 6.5.3.1 | General Spurious emissions | No impact |  |
| 6.5.3.2 | Spurious emissions for UE co-existence | Some impact |  |
|  |
| 6.5.3.3 | Additional spurious emissions | Some impact |  |
|  |
| 6.5.4 | Transmit intermodulation | No impact |  |
| **Rx requirements** |  |  |  |
| 7.3.2 | Reference sensitivity | Some impact |  |
|  |
| 7.4 | Maximum input level | No impact |  |
| 7.5 | Adjacent channel selectivity | No impact |  |
| 7.6.1 | General | No impact |  |
| 7.6.2 | In-band blocking | TBC |  |
| 7.6.3 | Out-of-band blocking | Some impact |  |
| 7.6.4 | Narrow band blocking | Some impact |  |
| 7.7 | Spurious response | No impact |  |
| 7.8 | Intermodulation characteristics | No impact |  |
| 7.9 | Spurious emissions | No impact |  |

## Other Sub-topics/Issues

**Offline Agreement:**

* Other topics and issues are postponed to future meetings

## Work Split/Interest

**Offline Agreement:**

* No formal CR/Spec Work Split agreed in this meeting
* Companies to report areas/topics of interest for contribution or future CR work split
* Following table shall be used

|  |  |  |  |
| --- | --- | --- | --- |
| **TS/TR (if applicable)** | **Clause/Section (if applicable** | **Topic/Requirement** | **Interested contributing companies** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# Topic #2 IoT\_NTN\_FDD\_S\_band

## Sub-topic 2-2: General Aspects

#### Issue 2-2-1: Band Numbering

Agreement: Adopt 252 as the band number for the new IoT NTN S-band.

#### Issue 2-2-2: Band Plan

Agreement:

* + Adopt the proposed band plan as follows

E-UTRA operating bands for satellite access

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating band BS receive UE transmit | | | Downlink (DL) operating band BS transmit  UE receive | | | Duplex Mode |
| FUL\_low – FUL\_high | | | FDL\_low – FDL\_high | | |
| 256 | 1980 MHz | – | 2010 MHz | 2170 MHz | – | 2200 MHz | FDD |
| 255 | 1626.5 MHz | – | 1660.5 MHz | 1525 MHz | – | 1559 MHz | FDD |
| 254 | 1610 MHz | - | 1626.5 MHz | 2483.5 MHz | - | 2500 MHz | FDD |
| 2532 | 1668 MHz | - | 1675 MHz | 1518 MHz | - | 1525 MHz | FDD |
| 252 | 2000 MHz | - | 2020 MHz | 2180 MHz | - | 2200 MHz | FDD |
| NOTE 1: Satellite bands are numbered in descending order from 256  NOTE 2: UE assigned to channels and allocated frequency resources in the lower portion of Band 253 may experience blocking or harmful interference from terrestrial networks in adjacent or nearby frequencies when operating in the proximity with terrestrial base stations. | | | | | | | |

#### Other Issues

Agreement: follow the agreements in Topic #1 for issue 2-2-3, 2-2-4, 2-2-5.

## Sub-topic 2-3: System Parameters and UE RF

#### Issue 2-3-1: Channel Bandwidths

**Tentative Offline Agreement:**

* No impact to existing Cat M1 and Cat NB1, NB2 UE channel bandwidths

#### Issue 2-3-2: EARFCN for CAT M1

**Tentative Offline Agreement:**

* Adopt the following table as a starting point:
* Table 2.2-1: E-UTRA channel numbers

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| E-UTRA Operating  Band | ΔFRaster (kHz) | Downlink | | | Uplink | | |
| FDL\_low (MHz) | NOffs-DL | Range of NDL  (First – <Step size> – Last) | FUL\_low (MHz) | NOffs-UL | Range of NUL  (First – <Step size> – Last) |
| [252] | 100 | 2180 | 228301 | 228301 –<1>- 228500 | 2000 | 261069 | 261069 –<1>- 261268 |

#### Issue 2-3-3: Default TX-RX Separation

**Tentative Offline Agreement:**

* Adopt default TX-RX frequency separation as fixed value as a starting point. Further study whether flexible TX-RX frequency separation can be supported, following conclusions from UE RF maintenance.

#### Issue 2-3-4: General Views on Impact to UE RF Requirements

**Tentative Offline Agreement:**

* Use the following merged table with common views on identified specification impact as a starting point.
* Companies to further assess focusing on the missing or TBC sections.

|  |  |  |
| --- | --- | --- |
| **Clause/Section** | **Requirement** | **COMMON VIEWS** |
| **Clause 6** | **Transmitter Characteristics** |  |
| 6.2A.1 | UE maximum output power | Some impact |
| 6.2B.1 |
| 6.2A.1 | UE maximum output power tolerance | Some impact |
| 6.2B.1 |
| 6.2A.2 | UE maximum output power reduction (MPR) | No Impact |
| 6.2B.2 |
| 6.2A.3 | UE additional maximum output power reduction | Some impact |
| 6.2B.3 |
| 6.2A.4 | Configured transmitted Power for category M1 | No Impact |
| 6.2B.4 | Configured transmitted Power for category NB1 and NB2 | No Impact |
| 6.3: | Output power dynamics | No Impact |
| 6.4: | Transmit signal quality | No Impact |
| 6.4.2 | Transmit modulation quality | No Impact |
| 6.5A.3.2 | Spectrum emission mask | No Impact |
| 6.5B.3.2 |
| 6.5A.2 | Occupied bandwidth for category M1 | No Impact |
| 6.5B.2 | Occupied bandwidth for category NB1 and NB2 | No Impact |
| 6.5A.3.3 | Additional Spectrum Emission Mask for category M1 | TBC |
| 6.5B.3.3 | Additional Spectrum Emission Mask for category NB1 and NB2 |
| 6.5A.3.4 | Adjacent Channel Leakage Ratio | No Impact |
| 6.5B.3.4 |
| 6.5A.4.3 | Spurious emissions for UE co-existence | Some impact |
| 6.5B.4.3 |
| 6.5A.4.4/ | Additional spurious emissions | Some impact |
| 6.5B.4.4 |
| 6.6A | Transmit intermodulation for category M1 | Not applicable. |
| 6.6: | Transmit intermodulation for category NB1 and NB2 | No impact |
| **Clause 7:** | **Receiver characteristics** |  |
| 7.2: | Diversity characteristics | No impact |
| 7.3A | Reference sensitivity power level for UE category M1 | Some Impact |
| 7.3 | Reference sensitivity power level for UE category NB1 and NB2 | Some Impact |
| 7.4: | Maximum input level | No impact |
| 7.5: | Adjacent Channel Selectivity | No impact |
| 7.6A.2 | In-band blocking requirements for category M1 | TBC |
| 7.6B.2 | In-band blocking requirements for category NB1 and NB2 |
| 7.6A.3 | Out-of-band blocking requirements for category M1 | Some impact |
| 7.6B.3 | Out-of-band blocking requirements for category NB1 and NB2 |
| 7.6A.4 | Narrow band blocking for category M1 | TBC |
| 7.6B.4 | Narrow band blocking for category NB1 and NB2 |
| 7.7: | Spurious response | No impact |
| 7.8: | Intermodulation characteristics | No impact |
| 7.9: | RX spurious emission | TBC |

## Other Sub-topics/Issues

**Offline Agreement:**

* Other topics and issues are postponed to future meetings

## Work Split/Interest

**Offline Agreement:**

* No formal CR/Spec Work Split agreed in this meeting
* Companies to report areas/topics of interest for contribution or future CR work split
* Following table shall be used

|  |  |  |  |
| --- | --- | --- | --- |
| **TS/TR (if applicable)** | **Clause/Section (if applicable** | **Topic/Requirement** | **Interested contributing companies** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |

# Topic #3: NR\_NTN\_combinedLband

## Sub-topic 3-1: General Aspects

#### Issue 3-1-1: Band Plan

Agreement:

* + Consider the following three new NR NTN bands as a starting point:

Table 1: NR-NTN satellite bands in FR1-NTN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NTN satellite operating band | Uplink (UL) operating band Satellite Access Node receive / UE transmit  FUL,low – FUL,high | Downlink (DL) operating band Satellite Access Node transmit / UE receive  FDL,low – FDL,high | | Duplex mode |
| [n253] | 1668MHz – 1675MHz | 1518MHz – 1525MHz | | FDD |
| [n251] | 1626.5MHz – 1660.5MHz | | 1518MHz – 1559MHz | FDD |
| [n250] | 1668MHz – 1675MHz | | 1518MHz – 1559MHz | FDD |
| NOTE: NTN satellite bands are numbered in descending order from n256. | | | | |

#### Issue 3-1-2: Band Numbering

**Offline Agreement:**

* Proposed band numbering as follows:

Table 1: NR-NTN satellite bands in FR1-NTN

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NTN satellite operating band | Uplink (UL) operating band Satellite Access Node receive / UE transmit  FUL,low – FUL,high | Downlink (DL) operating band Satellite Access Node transmit / UE receive  FDL,low – FDL,high | | Duplex mode |
| n253 | 1668MHz – 1675MHz | 1518MHz – 1525MHz | | FDD |
| n251 | 1626.5MHz – 1660.5MHz | | 1518MHz – 1559MHz | FDD |
| n250 | 1668MHz – 1675MHz | | 1518MHz – 1559MHz | FDD |
| NOTE: NTN satellite bands are numbered in descending order from n256. | | | | |

#### Issue 3-1-3: Bands in scope for TN-NTN coexistence

**Offline Agreeement:**

* Reuse list of protected bands from Band 253, Band 255 and n255 respectively as a starting point.

## Sub-topic 3-2: System Parameters and UE RF

#### Issue 3-2-2: Asymmetric Channel Bandwidth Support

Agreement: Agree to support for asymmetric channel bandwidths for the new NR NTN combined L-band bands and further discuss which channel bandwidth combinations can be supported.

#### Issue 3-2-3: Channel Raster and NR-ARFCN

Agreement: Consider Option 1 as a starting point for further discussion after correcting the band numbers.

Table 2.4-1: Applicable NR-ARFCN per operating band in FR1-NTN with 100 kHz channel rater

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster  (kHz) | Uplink  range of NREF  (First – <Step size> – Last) | Downlink  range of NREF  (First – <Step size> – Last) |
| [n253] | 100 | 333600– <20> – 335000 | 303600 – <20> – 305000 |
| [n251] | 100 | 325300– <20> – 332100 | 303600 – <20> – 311800 |
| [n250] | 100 | 333600– <20> – 335000 | 303600 – <20> – 311800 |

Table 2.4-2: Applicable NR-ARFCN per operating band in FR1-NTN with 10 kHz channel rater

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| NTN satellite operating band | ΔFRaster  (kHz) | Uplink  Range of NREF  (First – <Step size> – Last) | Downlink  Range of NREF  (First – <Step size> – Last) | Mandatory support |
| [n253] | 10 | 333600– <2> – 335000 | 303600 – <2> – 305000 | Yes |
| [n251] | 10 | 325300– <2> – 332100 | 303600 – <2> – 311800 | Yes |
| [n250] | 10 | 333600– <2> – 335000 | 303600 – <2> – 311800 | Yes |

#### Issue 3-2-4: GSCN and Sync Raster

Agreement: Consider Option 1 as a starting point for further discussion after correcting the band numbers.

Table 2.4-3: Applicable SS raster entries per operating band (FR1-NTN)

|  |  |  |  |
| --- | --- | --- | --- |
| NTN satellite operating band | SS Block SCS | SS Block pattern1 | Range of GSCN  (First – <Step size> – Last) |
| [n253] | 15 kHz | Case A | 3800 – <1> – 3807 |
| [n251] | 15 kHz | Case A | 3800 – <1> – 3892 |
|  | 30 kHz | Case B | 3806 – <1> – 3886 |
| [n250] | 15 kHz | Case A | 3800 – <1> – 3892 |

#### Issue 3-2-5: TX-RX Separation

Agreement:

* The flexible TX-RX frequency separation for for the new NR-NTN bands should be defined
* FFS on how to capture flexible Tx-Rx frequency separation in the spec.

#### Issue 3-2-6: General Views on Impact to UE RF Requirements

**Tentative Offline Agreement:**

* Use the following merged table with common views on identified specification impact as a starting point.
* Companies to further assess focusing on the missing or TBC sections.

|  |  |  |
| --- | --- | --- |
| **Section** | **Requirement** | **COMMON VIEWS** |
|  |
| **Tx requirements** |  |  |  |
| 6.2.1 | UE maximum output power | Some impact |  |
|  |
| 6.2.2 | UE maximum output power reduction | No impact |  |
| 6.2.3 | UE additional maximum output power reduction | Some impact |  |
|  |
| 6.2.4 | Configured transmitted power | No impact |  |
| 6.3.1 | Minimum output power | No impact |  |
| 6.3.2 | Transmit OFF power | No impact |  |
| 6.3.3 | Transmit ON/OFF time mask | No impact |  |
| 6.3.4 | Power control | No impact |  |
| 6.4.1 | Frequency error | No impact |  |
| 6.4.2 | Transmit modulation quality | No impact |  |
| 6.5.1 | Occupied bandwidth | No impact |  |
| 6.5.2 | Out of band emission (ACLR) | No impact |  |
| 6.5.2.2 | Spectrum emission mask | No impact |  |
| 6.5.2.3 | Additional Spectrum emission mask | Some impact |  |
|  |
| 6.5.2.4.1 | NR ACLR | No impact |  |
| 6.5.2.4.2 | UTRA ACLR | No impact |  |
| 6.5.3.1 | General Spurious emissions | No impact |  |
| 6.5.3.2 | Spurious emissions for UE co-existence | Some impact |  |
|  |
| 6.5.3.3 | Additional spurious emissions | Some impact |  |
|  |
| 6.5.4 | Transmit intermodulation | No impact |  |
| **Rx requirements** |  |  |  |
| 7.3.2 | Reference sensitivity | Some impact |  |
|  |
| 7.4 | Maximum input level | No impact |  |
| 7.5 | Adjacent channel selectivity | No impact |  |
| 7.6.1 | General | No impact |  |
| 7.6.2 | In-band blocking | TBC |  |
| 7.6.3 | Out-of-band blocking | Some impact |  |
| 7.6.4 | Narrow band blocking | Some impact |  |
| 7.7 | Spurious response | No impact |  |
| 7.8 | Intermodulation characteristics | No impact |  |
| 7.9 | Spurious emissions | No impact |  |

## Other Sub-topics/Issues

**Offline Agreement:**

* Other topics and issues are postponed to future meetings

## Work Split/Interest

**Offline Agreement:**

* No formal CR/Spec Work Split agreed in this meeting
* Companies to report areas/topics of interest for contribution or future CR work split
* Following table shall be used

|  |  |  |  |
| --- | --- | --- | --- |
| **TS/TR (if applicable)** | **Clause/Section (if applicable** | **Topic/Requirement** | **Interested contributing companies** |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |
|  |  |  |  |