**3GPP TSG-RAN WG4 Meeting #112bis R4-2417081**

**Hefei, China, 14th – 18th October 2024**

**Title:** WF on NTN and IoT-NTN bands

**Agenda Item:** 5.17, 5.18, 5.19

**Source: Moderator (Inmarsat)**

**Document for:** Approval

# Topic #1: NR-NTN S-band

### Sub-topic 1-1: General Requirements and Coexistence Aspects

#### Issue 1-1-1: Regional Applicability

* Proposals
	+ Option 1: For the NTN FDD band with UE transmitting at 2000 - 2020 MHz and SAN transmitting at 2180 - 2200 MHz, RAN4 should discuss how to reflect the regional requirements of the new S-band, e.g. by adding note in clause 5.2 operating band (CATT)
	+ Option 2: Other
* **Recommended WF**
	+ Add a note in clause 5.2 operating band to clarify regional applicability of band n252

#### Issue 1-1-2: General Methodology for UE to UE Coexistence between n252 UL and n2/b2/n25/b25 DL

Summary of companies’ observations and results:

* 9 companies propose to continue investigating defining new coexistence requirements and mechanisms by further studying UE separation and probability of interference
	+ 1 company simulated the UE to UE interference based on the deployment footprint, with a method similar to the TR 38.863 method, but with different TN-NTN separations below 1.5km, and with NTN UE Power Classes ranging from PC3 up to PC1, and reports that with TN-NTN coverage separations ranging from 1500m to -300m (i.e. partial overlap), there is almost no NTN interference from NTN UE UL to TN UE DL
	+ 1 company analysed the possible NTN UE power back-off or RB restrictions in n252 UL to satisfy the existing -50dBm/MHz requirement and reports that, while smaller allocations either do not need any power back-off or that the back-off stays within the limits of 0.5dB, large allocation and/or small(-er) allocations at the edge of the band will require noticeable power back-off
	+ 3 companies simulated the probability of NTN and TN UE being very close to each other
		- 1 company reports that the probability of interference is very low (1.10% worst case with randomized UE densities)
		- The same company points out that by taking into account the maximum NTN UE density for LEO600 with R19 UL Capacity Enhancements, the probability drops to 0.008%
		- 2 companies report that the probability of NTN and TN UE being at 5m separation or less is lower than 0.000665 (0.0665%)
* 5 companies propose to reuse -50dBm/MHz requirement
* 3 Companies think 1m separation is a realistic usage scenario
* 3 companies propose to consider possible scheduling restrictions
* Proposals
	+ **Option 1**: For the NTN FDD band with UE transmitting at 2000 - 2020 MHz and SAN transmitting at 2180 - 2200 MHz, the -50 dBm / MHz UE coexistence requirement could be considered (CATT)
	+ **Option 2:** RAN4 to agree on the proposed methodology of Monte Carlo simulation according to step 1 followed by step 2a or 2b. (EchoStar, Dish Network, Terrestar, Thales)

**Step 1:** Evaluate whether reliable NTN service is possible within the coverage of a TN network operating on the adjacent band. (Scenario 1 in TR 38.863 with NTN UEs dropped within the coverage area of the TN cluster instead of at isolation distance of 1.5 km with varying elevation angle between the NTN UEs and the satellite).
If reliable NTN service in the TN cluster is not possible, estimate the isolation distance at which NTN service is possible. This estimation will serve as input to the execution of procedure specified for Scenario 5 in TR 38.863 (Step 2a) or Step 2b.

**Step 2a:**  Re-run simulation of Scenario 5 in the TR 38.863, using preferred approach specified in TR 25.942, and using the parameters specified in TR 38.863, ITU-R M.2292 and R4-080710 (antenna gain+body loss parameters).

* Identify the outdoor TN UE densities using ITU-R M.2292
(Urban cell: 3 TN UEs / 5 MHz / sq. km, outdoor % = 30%; Rural cell; 0.17 TN UEs / 5 MHz / sq. km, outdoor % = 50%)
* Identify NTN UE density per spot beam assuming a 20 MHz channel and PRB allocation per UE agreed to in TR 38.863. (NTN UEs/spot beam = 106/2 = 53)
* Identify the ACIR that would result in 5% loss to TN DL throughput
* Using the estimated ACIR, calculate the required NTN UE ACLR (TN UE ACS = 33 dB)
* Find the required SEM by adding the delta of the required NTN UE ACLR and 3GPP specified NTN UE ACLR.
* Determine the A-MPR based on the updated emission limit computed in the previous step utilizing the Tx duplexer filter rejection (if any)

**Step 2b:** (As alternative of step 2a)
If RAN4 instead agrees to utilize the distance-based approach for UE–UE coexistence (instead of the method agreed to in TR 38.863 and as proposed in Step 2a), after the evaluation proposed in step 1, estimate an appropriate distance value based on probability of interference of 2% (as recommended by 3GPP TR 25.942) (or 1% as per FCC 99% probability rule).

* Identify the outdoor TN UE densities using ITU-R M.2292
(Urban cell: 3 TN UEs / 5 MHz / sq. km, outdoor % = 30%; Rural cell: 0.17 TN UEs / 5 MHz / sq. km, outdoor % = 50%)
* Identify NTN UE density per spot beam assuming a 20 MHz channel and PRB allocation per UE agreed to in TR 38.863. (NTN UEs/spot beam = 106/2 = 53)
* Perform a Monte Carlo simulation to determine the histogram of UE-UE distance
* Identify the distance exceeded by 98% (or 99% per FCC) of the samples
* Use the identified distance along with appropriate antenna gain, body loss from R4-080710 to compute the UE-UE coexistence spurious emission limit
* Determine the A-MPR, based on the computed UE-UE coexistence spurious emission limit, utilizing Tx duplexer filter rejection (if any)
	+ Option 3: (Ericsson) Proposal: Continue investigating possible UE coexistence requirement with the bands n2 and n25 by:
		- Evaluate the minimum isolation distance for NTN and TN to coexist assuming an NTN UE ACS of 33 dBc.
		- Collect inputs from filter performance to determine an achievable attenuation at 1990 MHz and 1995 MHz for such new S-band (2000-2020 MHz) filter.
		- Consider possible scheduling restriction in the new NTN S-band to facilitate coexistence.
	+ Option 4: (Inmarsat, Viasat) An NTN UE density of 100/km^2 with an active rate of 1.5% shall be used for the coexistence study for scenarios in which TN-NTN UE separation distance will be less than the TR 38.863 2\*ISD separation.
	+ Option 5:
		- Proposal 1: There are realistic usage scenarios with both B252/n252 aggressors and B2/n2/B25/n25 victims in close proximity.
		- Proposal 2: Rather than choose a specific antenna gain value, RAN4 should re-use the 9 dB per UE antenna plus body loss used in R4-080710 [2] for frequencies above 1 GHz.
		- Proposal 3: Use 1m separation distance for UE-UE coexistence. For both NTN->TN and NTN-> SCS/NTN.
		- Proposal 4: UE-UE coexistence is an issue everywhere because B2/n2/B25/n25 can be used for terrestrial coverage, as well as supplemental coverage from space.
		- Proposal 5: The Rural and Urban macro scenarios are applicable for S-Band NTN coexistence.
		- Proposal 6: Consider Scenario 1 and Scenario 2 in Table 6.1-2a.
		- Proposal 7: In 2024, the -50 dBm/MHz coexistence requirement is applicable for UE-UE coexistence between B252/n25 and B25/n25.
		- Proposal 8: Band 252/n252 should meet -50 dBm/MHz spurious emission limit into the legacy Band 25/n25 downlink, including “NOTE 15.”
		- Proposal 9: RAN4 should consider restricting RB uplink allocations and/or uplink channel bandwidths to enable UE-UE coexistence while minimizing the impact on the uplink link budget compared to the use of A-MPR.
		- Proposal 10: Consider the use of the B70/n70 bandplan to enhance coexistence between satellite and terrestrial networks.
	+ Option 6: other

* **New Recommended WF**
	+ Observations:
		- The scenario of a TN and NTN-UE being close does exist in a case where e.g., n70/n66 TN coverage does not exist, but n252 NTN coverage exists, and n2/n25 TN coverage exists. This may be encountered in rural (e.g., mountainous) area with specific use cases such as people hiking together. This makes the case less typical compared to normal usage.
		- Using the Rel-17 TR 38.863 parameters and methodology of random UE dropping, simulation results show that probability of TN and NTN users falling within 20m or less of each other is extremely low, even with a very high NTN UE density. However, some operators are of the opinion that the Rel-17 methodology can not be used to depict the UE to UE coexistence scenario in the above case.
		- The -50 dBm/MHz spurious emission requirement drives an A-MPR such that the link budget of the NTN system may not close at all. This is different compared to the TN scenario, where the probability of UE operating at max power is very low and can easily accommodate power reduction without degrading the service.
		- 3GPP has existing protection requirements that are more relaxed compared to -50dBm/MHz for TN UE coexistence scenarios.
	+ Way Forward:
		- Define a new more relaxed spurious emission requirement for TN-NTN UE to UE coexistence with a more relaxed value compared to -50dBm/MHz, that allows the NTN service to work effectively, across the full n252 band, whilst still protecting the TN UE at least in the majority of cases
			* Further discuss the actual value and methodology for the requirement (e.g. corresponding separation assumption)
			* Companies are requested to propose what emission level in dBm/MHz could be achieved for frequencies below 1995 MHz, considering the UE RF implementation, different uplink channel bandwidths and RB allocations
			* Further discuss how to capture the solutions in the specification

#### Issue 1-1-3: TN-NTN Isolation Distance

MODERATOR NOTE: It was not possible to directly convert the companies contributions in proposals for agreement. The moderator has derived some options, based on the general direction of company contributions, in order to progress the work.

* Proposals
	+ Option 1: Re-evaluate TN-NTN isolation distance based on feasibility of NTN service near the TN cluster and general TN-NTN coexistence aspects
	+ Option 2: Reuse TR 38.863 isolation of 1.5 km
	+ Option 3: No TN-NTN isolation, with:
		1. Partial overlap
		2. Full overlap
* **Recommended WF**
	+ Consider a new TN-NTN separation distance lower than 1.5 km and further study the appropriate separation based on coexistence analysis. At least partial overlap should also be considered.

#### Issue 1-1-5: Protection of n70

* Proposals
	+ Option 1: (Huawei, HiSilicon) the similar solution for band n256 protecting band n2/n25/70 can be reused for new NTN S-band protecting the NR band n70.
	+ Option 2: Other
* **Recommended WF**
	+ Continue focusing on n2/b2/n25/b25 as previously agreed.

MODERATOR NOTE: RAN4#112 Agreement is as follows:

***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 1-1-6: Protection of n66

* Proposals
	+ Option 1: (Huawei, HiSilicon) since band 23 can protect the DL frequency range of band 66 with -50dBm/MHz, similarly the new NTN S-band can protect the DL frequency range of band 66 with -50dBm/MHz as well.
	+ Option 2: Other
* **Recommended WF**
	+ Continue focusing on n2/b2/n25/b25 as previously agreed.

MODERATOR NOTE: RAN4#112 Agreement is as follows:

***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*

### Sub-topic 1-2: UE RF

*Sub-topic description: General UE RF Requirements*

#### Issue 1-2-1: SS Raster

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 5.4.3.3-1: 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) |
| n256 | 15 kHz | Case A | 5429 – <1> – 5494 |
| n255 | 15 kHz | Case A | 3818 – <1> – 3892 |
|  | 30 kHz | Case B | 3824 – <1> – 3886 |
| n254 | 15 kHz | Case A | 6215 – <1> – 6244 |
|  | 30 kHz | Case C | 6218 – <1> – 6241 |
| n252 | 15 kHz | Case A | 5456 – <1> – 5494 |
|  | 30 kHz | Case B | 5460 – <1> – 5488 |
| NOTE : SS Block pattern is defined in clause 4.1 in 3GPP TS 38.213 [7]. |

* + Option 2: Other
* Recommended WF
	+ Specify both Case A and Case B as follows

|  |  |  |  |
| --- | --- | --- | --- |
| NTN satellite operating band | SS Block SCS | SS Block pattern1 | Range of GSCN(First – <Step size> – Last) |
| n252 | 15 kHz | Case A | 5456 – <1> – 5494 |
|  | 30 kHz | Case B | 5460 – <1> – 5488 |
| NOTE : SS Block pattern is defined in clause 4.1 in 3GPP TS 38.213 [7]. |

#### Issue 1-2-3: UE Maximum Output Power

* Proposals
	+ Option 1: For the NTN FDD band with UE transmitting at 2000 - 2020 MHz and SAN transmitting at 2180 - 2200 MHz, the maximum output power should be defined as Table 2.2-1. (CATT)

Table 2.2-1: UE Power Class

|  |  |  |
| --- | --- | --- |
| NR satellite band | Class 3 (dBm) | Tolerance (dB) |
| [n252] | 23 | ±2 |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the toleranceNOTE 2: Powerclass 3 is default power class unless otherwise stated |

* + Option 2: (ZTE Corporation, Sanechips)

Table 6.2.1-1: UE Power Class

|  |  |  |
| --- | --- | --- |
| NR satellite band | Class 3 (dBm) | Tolerance (dB) |
| n256 | 23 | ±2 |
| n255 | 23 | ±2 |
| n254 | 23 | ±2 |
| n252 | 23 | ±2 |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the toleranceNOTE 2: Powerclass 3 is default power class unless otherwise stated |

* + Option 3: Other
* Recommended WF
	+ Specify PC3 maximum output power for band n252 as follows:

|  |  |  |
| --- | --- | --- |
| NR satellite band | Class 3 (dBm) | Tolerance (dB) |
| n252 | 23 | ±2 |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the toleranceNOTE 2: Powerclass 3 is default power class unless otherwise stated |

#### Issue 1-2-3: Two antenna port PREFSENS

* Proposals
	+ Option 1: For the NTN FDD band with UE transmitting at 2000 - 2020 MHz and SAN transmitting at 2180 - 2200 MHz, the A-MPR, additional spurious emissions, additional spectrum emission mask and REFSENS requirements could consider to follow the similar approach of the requirements from LTE band 23, correspondingly. (CATT)
	+ Option 2: (ZTE Corporation, Sanechips)

Table 7.3.2-1: Two antenna port reference sensitivity QPSK PREFSENS for FDD bands

| Operating band / SCS / Channel bandwidth |
| --- |
| Operating Band | SCS kHz | 5MHz(dBm) | 10MHz(dBm) | 15MHz(dBm) | 20MHz(dBm) | 25MHz(dBm) | 30 MHz (dBm) | 35 MHz (dBm) | 40MHz(dBm) | 45 MHz (dBm) | 50MHz(dBm) |
|  | 15 | -99.5 | -96.3 | -94.5 | -93.3 |  |  |  |  |  |  |
| n256 | 30 |  | -96.6 | -94.6 | -93.5 |  |  |  |  |  |  |
|  | 60 |  | -97.0 | -94.9 | -93.7 |  |  |  |  |  |  |
|  | 15 | -100.0 | -96.8 | -95.0 | -93.8 |  |  |  |  |  |  |
| n255 | 30 |  | -97.1 | -95.1 | -94.0 |  |  |  |  |  |  |
|  | 60 |  | -97.5 | -95.4 | -94.2 |  |  |  |  |  |  |
|  | 15 | -99.5 | -96.3 | -94.5 |  |  |  |  |  |  |  |
| n254 | 30 |  | -96.6 | -94.6 |  |  |  |  |  |  |  |
|  | 60 |  | -97.0 | -94.9 |  |  |  |  |  |  |  |
|  | 15 | -100 | -96.8 | -95.0 | -93.8 |  |  |  |  |  |  |
| n252 | 30 |  | -97.1 | -95.1 | -94.0 |  |  |  |  |  |  |
|  | 60 |  | -97.5 | -95.4 | -94.2 |  |  |  |  |  |  |
| NOTE：The transmitter shall be set to PUMAX as defined in clause 6.2.4 of 3GPP TS 38.101-1 [5]. |

* + Option 3: Other
* Recommended WF
	+ TBA
		- MODERATOR NOTE: these numbers look to be copied from n255? Shouldn’t n252 align with n256?

#### Issue 1-2-4: UL Configuration for REFSENS

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 7.3.2-2: Uplink configuration for reference sensitivity

| Operating band / SCS (kHz) / Channel bandwidth (MHz) / Duplex mode |
| --- |
| Operating Band | SCS | 5 | 10 | 15 | 20 | Duplex Mode |
|  | 15 | 25 | 50 | 75 | 100 |  |
| n256 | 30 |  | 24 | 36 | 50 | FDD |
|  | 60 |  | 10 | 18 | 24 |  |
|  | 15 | 25 | 50 | 75 | 752503 |  |
| n255 | 30 |  | 24 | 36 | 362243 | FDD |
|  | 60 |  | 10 | 18 | 182103 |  |
|  | 15 | 25 | 50 | 75 |  |  |
| n254 | 30 |  | 24 | 36 |  | FDD |
|  | 60 |  | 10 | 18 |  |  |
|  | 15 | 25 | 50 | 75 | 100 |  |
| n252 | 30 |  | 24 | 36 | 50 | FDD |
|  | 60 |  | 10 | 18 | 24 |  |
| NOTE: UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth in Table 5.3.2-1. |

* + Option 2: Other
* Recommended WF
	+ Agree Option 1

#### Issue 1-2-5: In-band blocking

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 7.6.2-2: In-band blocking for NR satellite bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Operating Band | Parameter | Unit | Case 1 | Case 2 |
|  | Pinterferer | dBm | -56 | -44 |
| n252, n254,n255,n256 | Finterferer (offset) | MHz | -BWChannel/2 – FIoffset, case 1andBWChannel/2 + FIoffset, case 1 | ≤ -BWChannel/2 – FIoffset, case 2and≥ BWChannel/2 + FIoffset, case 2 |
|  | Finterferer | MHz | NOTE 2 | FDL\_low – 15toFDL\_high + 15 |
| NOTE 1: The absolute value of the interferer offset Finterferer (offset) shall be further adjusted to MHz with SCS the sub-carrier spacing of the wanted signal in MHz. The interferer is an NR signal with 15 kHz SCS.NOTE 2: For each carrier frequency, the requirement applies for two interferer carrier frequencies: a: -BWChannel/2 – FIoffset, case 1; b: BWChannel/2 + FIoffset, case 1 |

* + Option 2: Other
* Recommended WF
	+ Agree Option 1

#### Issue 1-2-6: Out-of-band Blocking

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 7.6.3-2: Out of-band blocking for NR satellite bands with FDL\_high < 2700 MHz and FUL\_high < 2700 MHz

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Operating Band | Parameter | Unit | Range 1 | Range 2 | Range 3 |
|  | Pinterferer | dBm | -44 | -30 | -15 |
| n252 | Finterferer (CW) | MHz | -60 < f – FDL\_low < -15or15 < f – FDL\_high < 60 | -85 < f – FDL\_low ≤ -60or60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 85orFDL\_high + 85 ≤ f≤ 12750 |
| n2542 | Finterferer (CW) | MHz | -60 < f – FDL\_low < -15or15 < f – FDL\_high < 60 | -85 < f – FDL\_low ≤ -60or60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 85orFDL\_high + 85 ≤ f≤ 12750 |
| n255 | Finterferer (CW) | MHz | -60 < f – FDL\_low < -15or15 < f – FDL\_high < 60 | -85 < f – FDL\_low ≤ -60or60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 85orFDL\_high + 85 ≤ f≤ 12750 |
| n2561 | Finterferer (CW) | MHz | -100 < f – FDL\_low < -15or15 < f – FDL\_high < 60 | -145 < f – FDL\_low ≤ -100or60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 145orFDL\_high + 85 ≤ f≤ 12750 |
| NOTE 1: Band n256 lower frequency ranges are modified to enable specific implementationsNOTE 2: Band n254 power level of the interferer (Pinterferer) for Range 3 shall be modified to -20 dBm for Finterferer > 2585 MHz and FInterferer < 2775 MHz.NOTE 3: voidNOTE 4: void |

* + Option 2: Other
* Recommended WF
	+ Agree to Option 1

#### Issue 1-2-7: Narrow Band Blocking

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 7.6.4-1: Narrow Band Blocking

|  |  |  |  |
| --- | --- | --- | --- |
| Operating Band | Parameter | Unit | Channel Bandwidth (MHz) |
|  |  |  | 5 | 10 | 15 | 20 |
| n252, n254,n255,n256 | Pw | dBm | PREFSENS + channel-bandwidth specific value below |
|  |  |  | 16 | 13 | 14 | 16 |
|  | Puw (CW) | dBm | -55 |
|  | Fuw (offset SCS= 15 kHz) 3 | MHz | $$\left(\left⌊\frac{\frac{BW\_{Channel}}{2}+0.2}{SCS}+0.5\right⌋+0.5\right)SCS$$ |
|  | Fuw (offset SCS= 30 kHz)3 | MHz | NA |
| NOTE 1: The transmitter shall be set a 4 dB below PCMAX\_L,f,c at the minimum UL configuration specified in clause 7.3.2 with PCMAX\_L,f,c defined in clause 6.2.4NOTE 2: The PREFSENS power level is specified in clause 7.3.2. NOTE 3: Fuw shall be rounded to half of SCS. |

* + Option 2: Other
* Recommended WF
	+ Agree to Option 1

### Sub-topic 1-3: SAN RF

*Sub-topic description: SAN RF requirements for band n252*

#### Issue 1-3-1: SAN Operating Band

* Proposals
	+ Option 1: (CATT)
* Table 2.1-1: Satellite *operating bands* in FR1

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

* + Option 2: (ZTE Corporation, Sanechips)

Table 5.2-1: Satellite *operating bands* in FR1-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| Satellite *operating band* | Uplink (UL) *operating band*SAN receive / UE transmitFUL,low – FUL,high | Downlink (DL) *operating band*SAN transmit / UE receiveFDL,low – FDL,high | Duplex mode |
| n256 | 1980 MHz – 2010 MHz | 2170 MHz – 2200 MHz | FDD |
| n255 | 1626.5 MHz – 1660.5 MHz | 1525 MHz – 1559 MHz | FDD |
| n254 | 1610 MHz – 1626.5 MHz  | 2483.5 MHz – 2500 MHz | FDD |
| n252 | 2000 MHz - 2020 MHz | 2180 MHz - 2200 MHz | FDD |
| NOTE: Satellite bands are numbered in descending order from n256. |

* + Option 3: Other
* Recommended WF
	+ Specify the following SAN operating band for band n252:

|  |  |  |  |
| --- | --- | --- | --- |
| Satellite *operating band* | Uplink (UL) *operating band*SAN receive / UE transmitFUL,low – FUL,high | Downlink (DL) *operating band*SAN transmit / UE receiveFDL,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 1-3-2: SAN Channel Bandwidths and SCS

* Proposals
	+ Option 1: (CATT)

Table 2.2-1: *SAN channel bandwidths* and SCS per *operating band* in FR1

| SAN Operating Band | SCS (kHz) | *SAN channel bandwidth* (MHz) |
| --- | --- | --- |
| 5 | 10 | 15 | 20 |
|  | 15 | 5 | 10 | 15 | 20 |
| [n252] | 30 |  | 10 | 15 | 20 |
|  | 60 |  | 10 | 15 | 20 |

* + Option 2: (ZTE Corporation, Sanechips)

Table 5.3.5-1: *SAN channel bandwidths* and SCS per *operating band* in FR1-NTN

| SAN Operating Band | SCS (kHz) | *SAN channel bandwidth* (MHz) |
| --- | --- | --- |
| 5 | 10 | 15 | 20 | 30(NOTE) |
|  | 15 | 5 | 10 | 15 | 20 |  |
| n256 | 30 |  | 10 | 15 | 20 |  |
|  | 60 |  | 10 | 15 | 20 |  |
|  | 15 | 5 | 10 | 15 | 20 |  |
| n255 | 30 |  | 10 | 15 | 20 |  |
|  | 60 |  | 10 | 15 | 20 |  |
|  | 15 | 5 | 10 | 15 |  |  |
| n254 | 30 |  | 10 | 15 |  |  |
|  | 60 |  | 10 | 15 |  |  |
|  | 15 | 5 | 10 | 15 | 20 |  |
| n252 | 30 |  | 10 | 15 | 20 |  |
|  | 60 |  | 10 | 15 | 20 |  |
| NOTE: Deployment of 30 MHz channel bandwidth for NTN SAN needs to be preceded by introduction of all applicable Tx RF, Rx RF, and demodulation requirements. |

* + Option 3: Other
* Recommended WF
	+ Specify the following SAN channel bandwidths and SCS for band n252

| SAN Operating Band | SCS (kHz) | *SAN channel bandwidth* (MHz) |
| --- | --- | --- |
| 5 | 10 | 15 | 20 |
|  | 15 | 5 | 10 | 15 | 20 |
| n252 | 30 |  | 10 | 15 | 20 |
|  | 60 |  | 10 | 15 | 20 |

#### Issue 1-3-3: SAN NR-ARFCN with 100 kHz channel raster

* Proposals
	+ Option 1 (CATT):

Table 2.3-1: Applicable NR-ARFCN per *operating band* in FR1-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| [n252] | 100 | 400000 – <20> – 404000 | 436000 – <20> – 440000 |

* + Option 2: (ZTE Corporation, Sanechips)

Table 5.4.2.3-1: Applicable NR-ARFCN per *operating band* in FR1-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| n256 | 100 | 396000 – <20> – 402000 | 434000 – <20> – 440000 |
| n255 | 100 | 325300 – <20> – 332100 | 305000 – <20> – 311800 |
| n254 | 100 | 322000 – <20> – 325300 | 496700 – <20> – 500000 |
| n252 | 100 | 400000 – <20> – 404000 | 436000 – <20> – 440000 |

* + Option 3: Other
* Recommended WF
	+ Specify the following SAN NR-ARFCN for band n252

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| n252 | 100 | 400000 – <20> – 404000 | 436000 – <20> – 440000 |

#### Issue 1-3-4: SAN NR-ARFCN with enhanced channel raster

* Proposals
	+ Option 1: (CATT)

Table 2.3-2: Applicable NR-ARFCN per *operating band* for enhanced channel raster

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| [n252] | 10 | 400000 – <2> – 404000 | 436000 – <2> – 440000 |

* + Option 2: (ZTE Corporation, Sanechips)

Table 5.4.2.3-2: Applicable NR-ARFCN per *operating band* for enhanced channel raster

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| n256 | 10 | 396000 – <2> – 402000 | 434000 – <2> – 440000 |
| n255 | 10 | 325300 – <2> – 332100 | 305000 – <2> – 311800 |
| n254 | 10 | 322000 – <2> – 325300 | 496700 – <2> – 500000 |
| n252 | 10 | 400000 – <2> – 404000 | 436000 – <2> – 440000 |

* + Option 3: Other
* Recommended WF
	+ Specify the following SAN NR-ARFCN for enhanced channel raster for band n252:

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| n252 | 10 | 400000 – <2> – 404000 | 436000 – <2> – 440000 |

#### Issue 1-3-5: SAN SS Raster

* Proposals
	+ Option 1: Case A only (CATT)
* Table 2.4-1: Applicable SS raster entries per *operating band* (FR1-NTN)

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | SS Block SCS | SS Block pattern(NOTE) | Range of GSCN(First – <Step size> – Last) |
| n256 | 15 kHz | Case A | 5429 – <1> – 5494 |
| n255 | 15 kHz | Case A | 3818 – <1> – 3892 |
|  | 30 kHz | Case B | 3824 – <1> – 3886 |
| n254 | 15 kHz | Case A | 6215 – <1> – 6244 |
|  | 30kHz | Case C | 6218 – <1> – 6241 |
| [n252] | 15 kHz | Case A | 5456 – <1> – 5494 |
| NOTE: SS Block pattern is defined in clause 4.1 in TS 38.213 [7]. |

* + Option 2: Case A and B (ZTE Corporation, Sanechips)

Table 5.4.3.3-1: Applicable SS raster entries per *operating band* (FR1-NTN)

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | SS Block SCS | SS Block pattern(NOTE) | Range of GSCN(First – <Step size> – Last) |
| n256 | 15 kHz | Case A | 5429 – <1> – 5494 |
| n255 | 15 kHz | Case A | 3818 – <1> – 3892 |
|  | 30 kHz | Case B | 3824 – <1> – 3886 |
| n254 | 15 kHz | Case A | 6215 – <1> – 6244 |
|  | 30 kHz | Case C | 6218 – <1> – 6241 |
| n252 | 15 kHz | Case A | 5456 – <1> – 5494 |
|  | 30 kHz | Case B | 5460 – <1> – 5488 |
| NOTE: SS Block pattern is defined in clause 4.1 in TS 38.213 [7]. |

* + Option 3: Other
* Recommended WF
	+ Agree Option 2 with both Case A and Case B

#### Issue 1-3-5: Other SAN RF Requirements

* Proposals
	+ Option 1: For TS 38.108, no RF requirements impact by introducing the NTN FDD band with UE transmitting at 2000 - 2020 MHz and SAN transmitting at 2180 - 2200 MHz. The existing SAN type 1-H and 1-O RF requirements are applicable to new band. (CATT)
	+ Option 2: Other
* Recommended WF
	+ Reuse existing SAN 1-H and 1-O RF requirements for band n252

### Sub-topic 1-4: RRM Requirements

*Sub-topic description: RRM requirements for band n252*

*Open issues and candidate options before meeting:*

#### Issue 1-4-1: Band Grouping

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 3.5.2A-1: NR frequency band groups for satellite access in FR1

|  |  |
| --- | --- |
| Group | NR FDD |
|  | Band group notation | Operating bands |
| A | NR\_FDD\_SAB\_FR1\_A | n254, n255, n256, n252 |
| B | NR\_FDD\_SAB\_FR1\_B |  |
| C | NR\_FDD\_SAB\_FR1\_C |  |
| D | NR\_FDD\_SAB\_FR1\_D |  |
| E | NR\_FDD\_SAB\_FR1\_E |  |
| F | NR\_FDD\_SAB\_FR1\_F |  |
| G | NR\_FDD\_SAB\_FR1\_G |  |
| H | NR\_FDD\_SAB\_FR1\_H |  |
| I | NR\_FDD\_SAB\_FR1\_I |  |
| J | NR\_FDD\_SAB\_FR1\_J |  |

* + Option 2: Other
* Recommended WF
	+ Agree Option 1 as follows

Table 3.5.2A-1: NR frequency band groups for satellite access in FR1

|  |  |
| --- | --- |
| Group | NR FDD |
|  | Band group notation | Operating bands |
| A | NR\_FDD\_SAB\_FR1\_A | n254, n255, n256, n252 |
| B | NR\_FDD\_SAB\_FR1\_B |  |
| C | NR\_FDD\_SAB\_FR1\_C |  |
| D | NR\_FDD\_SAB\_FR1\_D |  |
| E | NR\_FDD\_SAB\_FR1\_E |  |
| F | NR\_FDD\_SAB\_FR1\_F |  |
| G | NR\_FDD\_SAB\_FR1\_G |  |
| H | NR\_FDD\_SAB\_FR1\_H |  |
| I | NR\_FDD\_SAB\_FR1\_I |  |
| J | NR\_FDD\_SAB\_FR1\_J |  |

## Other Sub-topics/Issues

**Offline Agreement:**

* Other topics and issues are postponed to future meetings

# Topic #2 IoT-NTN S-band

### Sub-topic 2-1: UE RF

*Sub-topic description: UE RF requirements*

#### Issue 2-1-1: UE operating bands

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 5.2-1 E-UTRA operating bands for satellite access

|  |  |  |  |
| --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating bandBS receiveUE transmit | Downlink (DL) operating bandBS 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 256NOTE 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. |

* + Option 2: TBD
* Recommended WF
	+ Specify UE operating band as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 252 | 2000 MHz | - | 2020 MHz | 2180 MHz | - | 2200 MHz | FDD |
| NOTE 1: Satellite bands are numbered in descending order from 256NOTE 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. |

#### Issue 2-1-2: E-UTRA Channel Numbers

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 5.4A.2-1: E-UTRA channel numbers

|  |  |  |  |
| --- | --- | --- | --- |
| E-UTRA OperatingBand | 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) |
| 256 | 100 | 2170 | 229076 | 229076 –<1>- 229375 | 1980 | 261844 | 261844 –<1>- 262143 |
| 255 | 100 | 1525 | 228736 | 228736 –<1>- 229075 | 1626.5 | 261504 | 261504 –<1>- 261843 |
| 254 | 100 | 2483.5 | 228571 | 228571 –<1>- 228735 | 1610 | 261339 | 261339 –<1>- 261503 |
| 253 | 100 | 1518 | 228501 | 228501-<1>-228570 | 1668 | 261269 | 261269-<1>-261338 |
| 252 | 100 | 2180 | 228301 | 228301 –<1>- 228500 | 2000 | 261069 | 261069 –<1>- 261268 |
| NOTE 1: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7 channel numbers at the lower operating band edge and the last 6 channel numbers at the upper operating band edge shall not be used for channel bandwidth of 1.4 MHz. |

* + Option 2: Other
* Recommended WF
	+ Specify E-UTRA channel numbers as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| E-UTRA OperatingBand | 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 |
| NOTE 1: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7 channel numbers at the lower operating band edge and the last 6 channel numbers at the upper operating band edge shall not be used for channel bandwidth of 1.4 MHz. |

#### Issue 2-1-2: UE TX-RX Separation

* Proposals
	+ Option 1: (Mediatek) Based on the evaluation and experience of NR-NTN bands supporting the variable Tx-Rx frequency, regarding IoT-NTN B252, to support variable Tx-Rx frequency separation is feasible.
	+ Option 2: (ZTE Corporation, Sanechips)

Table 5.4A.3-1: Default UE TX-RX frequency separation

| E-UTRA Operating Band | TX – RX carrier centre frequencyseparation |
| --- | --- |
| 256 | 190 MHz |
| 255 | -101.5 MHz |
| 254 | 873.5 MHz |
| 253 | -150 MHz |
| 252 | 180 MHz |

* Recommended WF
	+ Consider if Option 1 can be agreed and B252 can use 180MHz as default setting.
		- This approach should be applicable to other IoT NTN bands at least from R19

Background:

MTK: after discussion with ZTE and Dish, B252 can support variable Tx-Rx frequency separation and use 180MHz as default setting. Just additional information is that LTE RAN2 SIB1 does not support separately controlling UL and DL ARFCN. In next meeting, MTK will draft Tdoc and LS with feasible method. The LS to RAN1 and RAN2 would be sent if possible. One easiest way would be to copy NR UL- and DL-ARFCN framework in SIB1 for LTE and update it in RAN2 spec if possible.

#### Issue 2-1-3: UE TX Regulatory

* Proposals
	+ Option 1: (Mediatek) Because NTN UE antenna gain for smartphone of -5.5dBi is considered for evaluating NTN A-MPR, the NTN antenna gain of -5.5dBi is also used when evaluating IoT-NTN UE TX MOP regulatory requirements
	+ Option 2: Other
* Proposed WF:
	+ Further discuss whether NTN antenna gain could be considered when evaluating other IoT-NTN UE TX requirements related to regulatory requirement.

#### Issue 2-1-4: UE Maximum Output Power for Cat M1 and NB1/NB2

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 6.2A.1-1: UE Power Class

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| EUTRA band | Class 2(dBm) | Tolerance(dB) | Class 3 (dBm) | Tolerance (dB) | Class 5 (dBm) | Tolerance (dB) |
| 256 |  |  | 23 | +/-2 | 20 | +/-2 |
| 255 |  |  | 23 | +/-2 | 20 | +/-2 |
| 254 |  |  | 23 | +/-2 | 20 | +/-2 |
| 253 |  |  | 23 | +/-2 | 20 | +/-2 |
| 252 |  |  | 23 | +/-2 | 20 | +/-2 |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the tolerance. |

Table 6.2B.1-1: UE Power Class

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EUTRA band | Class 3 (dBm) | Tolerance (dB) | Class 5 (dBm) | Tolerance (dB) |
| 256 | 23 | +/-2 | 20 | +/-2 |
| 255 | 23 | +/-2 | 20 | +/-2 |
| 254 | 23 | +/-2 | 20 | +/-2 |
| 253 | 23 | +/-2 | 20 | +/-2 |
| 252 | 23 | +/-2 | 20 | +/-2 |

* + Option 2: (Mediatek) To increase IoT-NTN HD-FDD PC3 nominal power (e.g., change 23dBm to 23.8dBm) or tolerance (e.g., change +2dB to +2.8dB) because HD-FDD TX nominal output power is expected to be higher (e.g., 23.8dBm) and therefore there is less margin to meet the upper bound (i.e., 23 dBm + 2 dB) over PVT
	+ Option 3: other
* Proposed WF:
	+ Option 1: Specify the UE power class and tolerance as follows and add additional UE capability and BS signalling to control NTN HD-FDD power increment.
		- This approach shall be applicable also to other IoT NTN bands at least from R19

Table 6.2A.1-1: UE Power Class

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| EUTRA band | Class 2(dBm) | Tolerance(dB) | Class 3 (dBm) | Tolerance (dB) | Class 5 (dBm) | Tolerance (dB) |
| 252 |  |  | 23 | +/-2, +2.7/-22 | 20 | +/-2, +2.7/-22 |
| NOTE 1: PPowerClass is the maximum UE power specified without taking into account the tolerance.NOTE 2: [Applicable for IoT-NTN UE operating in HD-FDD indicating support for UE optional capability *x1-r19* and if IE x2-r19 is set to 1. The reference power or MOP upper tolerance is increased by [ΔPNtnHdFdd].] |

Table 6.2B.1-1: UE Power Class

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| EUTRA band | Class 3 (dBm) | Tolerance (dB) | Class 5 (dBm) | Tolerance (dB) |
| 252 | 23 | +/-2,+2.7/-22 | 20 | +/-2, +2.7/-22 |

* + Option 2: New power class (e.g., PC2.5\_NTN-HD-FDD)
		- This new power class shall be applicable also to other IoT NTN bands at least from R19

#### Issue 2-1-6: UE Cat-M1 Reference Sensitivity

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)
* Table 7.3A-1: Reference sensitivity for FDD UE category M1 QPSK PREFSENS

|  |  |  |
| --- | --- | --- |
| NTN Band | REFSENS (dBm) | Duplex Mode |
| 252 | -102.2 | FDD |
| 253 | -102.7 | FDD |
| 254 | -102.2 | FDD |
| 255 | -102.7 | FDD |
| 256 | -102.2 | FDD |
| NOTE 1: The transmitter shall be set to PUMAX as defined in subclause 6.2.5- in TS 36.101 [7]. |

Table 7.3A-2: Reference sensitivity for HD-FDD UE category M1 QPSK PREFSENS

|  |  |  |
| --- | --- | --- |
| NTN Band | REFSENS (dBm) | Duplex Mode |
| 252 | -103 | HD-FDD |
| 253 | -103.5 | HD-FDD |
| 254 | -103.1 | HD-FDD |
| 255 | -103.5 | HD-FDD |
| 256 | -103 | HD-FDD |
| NOTE 1: The transmitter shall be set to PUMAX as defined in subclause 6.2.5 in TS 36.101 [7]. |

* + Option 2: (Mediatek) Regarding B252 Cat-M1 UE REFSENS, to specify -102.2dBm/CBW and -103dBm/CBW for FD-FDD and HD-FDD modes, respectively

Table: Reference sensitivity for FDD UE category M1 QPSK PREFSENS

|  |  |  |
| --- | --- | --- |
| NTN Band | REFSENS (dBm) | Duplex Mode |
| 252 | -102.2 | FDD |

Table: Reference sensitivity for HD-FDD UE category M1 QPSK PREFSENS

|  |  |  |
| --- | --- | --- |
| NTN Band | REFSENS (dBm) | Duplex Mode |
| 252 | -103 | HD-FDD |

* + Option 3: Other
* Recommended WF
	+ Agree to either Option 1/Option 2 (they are equal)

#### Issue 2-1-7: UE Cat-NB1/NB2 REFSENS

* Proposals
	+ Option 1: (Mediatek) Regarding B252 Cat-NB1/NB2 REFSENS, to specify REFSENS of -108.2dBm/CBW because IoT-NTN UE RF REFSENS for Cat-NB1/NB2 is band agnostic

|  |  |
| --- | --- |
| Operating band | REFSENS [dBm] |
| According to subclause 5.2B | - 108.2 |

* + Option 2: Other
* Recommended WF
	+ Agree to Option 1

#### Issue 2-1-8: UL Configuration for REFSENS for Cat-M1

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 7.3A-3: FDD UE category M1 Uplink configuration for reference sensitivity

|  |  |  |
| --- | --- | --- |
| E-UTRA Band | NRB | Duplex Mode |
| 252 | 61 | FDD and HD-FDD |
| 253 | 61 | FDD and HD-FDD |
| 254 | 61 | FDD and HD-FDD |
| 255 | 61 | FDD and HD-FDD |
| 256 | 61 | FDD and HD-FDD |
| NOTE 1: 1 refers to the UL resource blocks shall be located as close as possible to the downlink operating band but confined within the transmission bandwidth configuration for the channel bandwidth (Table 5.3A-1).  |

* + Option 2: Other
* Recommended WF
	+ Agree to Option 1

#### Issue 2-1-9: In-band blocking for Cat-M1

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)
* Table 7.6A.2-2: In-band blocking

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| E-UTRA band | Parameter | Unit | Case 1 | Case 2 |
| PInterferer | dBm | -56 | -44 |
| FInterferer (offset) | MHz | =-BW/2 – FIoffset,case 1&=+BW/2 + FIoffset,case 1 | ≤-BW/2 – FIoffset,case 2&≥+BW/2 + FIoffset,case 2 |
| 256, 255, 254, 253, 252 | FInterferer | MHz | (NOTE 2) | FDL\_low – 15toFDL\_high + 15 |
| NOTE 1: For certain bands, the unwanted modulated interfering signal may not fall inside the UE receive band, but within the first 15 MHz below or above the UE receive bandNOTE 2: For each carrier frequency the requirement is valid for two frequencies:a. the carrier frequency -BW/2 - FIoffset, case 1 andb. the carrier frequency +BW/2 + FIoffset, case 1NOTE 3: FInterferer range values for unwanted modulated interfering signal are interferer center frequencies  |

* + Option 2: Other
* Recommended WF
	+ Agree to Option 1

#### Issue 2-1-10: Out-of-band blocking for Cat-M1

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)
* Table 7.6A.3-2: Out of-band blocking for category M1 UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Operating Band | Parameter | Unit | Range 1 | Range 2 | Range 3 |
|  | Pinterferer | dBm | -44 | -30 | -15 |
| 252, 253, 2542, 255 | Finterferer (C`W) | MHz | -60 < f – FDL\_low < -15or15 < f – FDL\_high < 60 | -85 < f – FDL\_low ≤ -60or60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 85orFDL\_high + 85 ≤ f≤ 12750 |
| 2561 | Finterferer (CW) | MHz | -100 < f – FDL\_low < -15or15 < f – FDL\_high < 60 | -145 < f – FDL\_low ≤ -100or60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 145orFDL\_high + 85 ≤ f≤ 12750 |
| NOTE 1: Band 256 lower frequency ranges are modified to enable specific implementations.NOTE 2: The power level of the interferer (Pinterferer) for Range 3 shall be modified to -20 dBm for Finterferer > 2585 MHz and FInterferer < 2775 MHz. |

* + Option 2: Other
* Recommended WF
	+ Agree to Option 1

#### Issue 2-1-11: Out-of-band blocking for Cat-NB1/NB2

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)
* Table 7.6B.3-1: Out-of-band blocking parameters for category NB1 and NB2 UE

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Operating Band | Parameter | Unit | Range 1 | Range 2 | Range 3 |
| Pw | dBm | REFSENS + 6 dB |
| Pinterferer | dBm | -44 | -30 | -153 |
| 252, 253, 2545, 255 | Finterferer (CW) | MHz | -60 < f – FDL\_low < -15or15 < f – FDL\_high < 60 | -85 < f – FDL\_low ≤ -60or60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 85orFDL\_high + 85 ≤ f≤ 12750 |
| 2562 | Finterferer (CW) | MHz | -100 < f – FDL\_low < -15or15 < f – FDL\_high < 60 | -145 < f – FDL\_low ≤ -100or60 ≤ f – FDL\_high < 85 | 1 ≤ f ≤ FDL\_low – 145orFDL\_high + 85 ≤ f≤ 12750 |
| NOTE 1: Void.NOTE 2: Band 256 lower frequency ranges are modified to enable specific implementations.NOTE 3: For operating bands which downlink band frequency range is between 1475.9 MHz < f < 2690 MHz the power level of the interferer (PInterferer) for Range 3 shall be modified to: -20 dBm for the frequency range which is bounded by FDL\_low- 200 MHz of the lowest band that UE supports in frequency range 1475.9 MHz < f < 2690 MHz and FDL\_high + 200 MHz of the highest band that UE supports in frequency range 1475.9 MHz < f < 2690 MHz.”NOTE 4: The power level of the interferer (PInterferer) for Range 3 shall be modified to -20 dBm for FInterferer > 2800 MHz and FInterferer < 4400 MHz.NOTE 5: The power level of the interferer (Pinterferer) for Range 3 shall be modified to -20 dBm for Finterferer > 2585 MHz and FInterferer < 2775 MHz. |

* + Option 2: Other
* Recommended WF
	+ Further study whether same issue as B256 applies

### Sub-topic 2-2: SAN RF

*Sub-topic description: SAN RF Requirements*

#### Issue 2-2-1: SAN Operating Bands

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 5.2-1 E-UTRA operating bands for satellite access

|  |  |  |  |
| --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating bandBS receiveUE transmit | Downlink (DL) operating bandBS 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 256NOTE 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. |

* + Option 2: Other
* Recommended WF
	+ Specify SAN operating band for band 252 as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| E‑UTRA Operating Band | Uplink (UL) operating bandBS receiveUE transmit | Downlink (DL) operating bandBS transmit UE receive | Duplex Mode |
| FUL\_low – FUL\_high | FDL\_low – FDL\_high |
| 252 | 2000 MHz | - | 2020 MHz | 2180 MHz | - | 2200 MHz | FDD |
| NOTE 1: Satellite bands are numbered in descending order from 256NOTE 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. |

#### Issue 2-2-2: E-UTRA Channel Numbers

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 5.4A.2-1: E-UTRA channel numbers

|  |  |  |  |
| --- | --- | --- | --- |
| E-UTRA OperatingBand | 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) |
| 256 | 100 | 2170 | 229076 | 229076 –<1>- 229375 | 1980 | 261844 | 261844 –<1>- 262143 |
| 255 | 100 | 1525 | 228736 | 228736 –<1>- 229075 | 1626.5 | 261504 | 261504 –<1>- 261843 |
| 254 | 100 | 2483.5 | 228571 | 228571 –<1>- 228735 | 1610 | 261339 | 261339 –<1>- 261503 |
| 253 | 100 | 1518 | 228501 | 228501 –<1>- 228570 | 1668 | 261269 | 261269 –<1>- 261338 |
| 252 | 100 | 2180 | 228301 | 228301 –<1>- 228500 | 2000 | 261069 | 261069 –<1>- 261268 |
| NOTE: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7 channel numbers at the lower operating band edge and the last 6 channel numbers at the upper operating band edge shall not be used for channel bandwidth of 1.4 MHz. |

* + Option 2: Other
* Recommended WF
	+ Specify SAN E-UTRA Channel Numbers for band 252 as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| E-UTRA OperatingBand | 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 |
| NOTE: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. This implies that the first 7 channel numbers at the lower operating band edge and the last 6 channel numbers at the upper operating band edge shall not be used for channel bandwidth of 1.4 MHz. |

### Sub-topic 2-3: RRM Requirements

*Sub-topic description: RRM requirements*

#### Issue 2-3-1: Band grouping for Cat NB1/NB2

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 3.5.1A-1: Band groups for NB-IoT for satellite access

|  |  |
| --- | --- |
| Group | E-UTRA FDD |
|  | Band group notation | Operating bands |
| A | NFDD\_SAB\_A |  |
| B | NFDD\_SAB\_B |  |
| C | NFDD\_SAB\_C |  |
| D | NFDD\_SAB\_D |  |
| E | NFDD\_SAB\_E |  |
| F | NFDD\_SAB\_F |  |
| G | NFDD\_SAB\_G | 253, 254, 255, 256, n252 |
| H | NFDD\_SAB\_H |  |
| I | NFDD\_SAB\_I |  |
| J | NFDD\_SAB\_J |  |
| K | NFDD\_SAB\_K |  |
| L | NFDD\_SAB\_L |  |
| M | NFDD\_SAB\_M |  |
| N | NFDD\_SAB\_N |  |

* + Option 2: Other
* Proposed WF:
	+ Agree to Option 1

#### Issue 2-3-2: Band grouping for Cat M1

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 3.5.1A-2: Band groups for category M1 for satellite access

|  |  |
| --- | --- |
| Group | E-UTRA FDD |
|  | Band group notation | Operating bands |
| A | FDD-M1\_SAB\_A | 253, 255 |
| B | FDD-M1\_SAB\_B | 254, 256, n252 |
| C | FDD-M1\_SAB\_C |  |
| D | FDD-M1\_SAB\_D |  |
| E | FDD-M1\_SAB\_E |  |
| F | FDD-M1\_SAB\_F |  |
| G | FDD-M1\_SAB\_G |  |
| H | FDD-M1\_SAB\_H |  |
| I | FDD-M1\_SAB\_I |  |
| J | FDD-M1\_SAB\_J |  |
| K | FDD-M1\_SAB\_K |  |
| L | FDD-M1\_SAB\_L |  |
| M | FDD-M1\_SAB\_M |  |
| N | FDD-M1\_SAB\_N |  |

* + Option 2: Other
* Proposed WF:
	+ Agree to Option 1

## Other Sub-topics/Issues

**Offline Agreement:**

* Other topics and issues are postponed to future meetings

# Topic #3: NR-NTN L-bands

### Sub-topic 3-1: General Aspects and Regulatory Input

*Sub-topic description: Regulatory aspects*

#### Issue 3-1-1: ETSI additional blocking Requirements

* Proposals
	+ Option 1: Proposal 1: For two new NR NTN L bands, referring to the conclusions in Rel-18 for band 253, do not define the additional in-band / out-of-band blocking requirements in Rel-19 until RAN4 gets clear information from ETSI.
	+ Option 2: Other
* Recommended WF
	+ Further discuss how the additional ETSI requirements for in-band/out-of-band blocking should be captured.

### Sub-topic 3-2: UE RF

*Sub-topic description: System parameters and UE RF aspects*

#### Issue 3-2-1: UE Duplexer

* Proposals
	+ Option 1: (Huawei, HiSilicon) When RAN4 discuss the RF requirements for the new introduced NR NTN L-bands, the implementation should be considered with only one duplexer (DL: 1518 – 1559 MHz, UL: 1626.5 – 1675 MHz) to cover all four L-bands, i.e. n255, n253, n251 and n250.
	+ Option 2: Other
* Recommended WF
	+ Further discuss whether implementation with one duplexer is feasible, considering the requirements to protect Radio Astronomy in the 1660-1668MHz range between the two UL.

### Sub-topic 3-3: SAN RF

*Sub-topic description: SAN RF requirements*

#### Issue 3-3-1: SAN Operating Bands

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 5.2-1: Satellite *operating bands* in FR1-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| Satellite *operating band* | Uplink (UL) *operating band*SAN receive / UE transmitFUL,low – FUL,high | Downlink (DL) *operating band*SAN transmit / UE receiveFDL,low – FDL,high | Duplex mode |
| n256 | 1980 MHz – 2010 MHz | 2170 MHz – 2200 MHz | FDD |
| n255 | 1626.5 MHz – 1660.5 MHz | 1525 MHz – 1559 MHz | FDD |
| n254 | 1610 MHz – 1626.5 MHz  | 2483.5 MHz – 2500 MHz | FDD |
| n253 | 1668 MHz - 1675 MHz | 1518 MHz - 1525 MHz | FDD |
| n251 | 1626.5 MHz - 1660.5 MHz | 1518 MHz - 1559 MHz | FDD |
| n250 | 1668 MHz - 1675 MHz | 1518 MHz - 1559 MHz | FDD |
| NOTE: Satellite bands are numbered in descending order from n256. |

* + Option 2: Other
* Recommended WF
	+ Specify the following SAN operating bands for bands n253, n251 and n250:

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

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

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 5.3.5-1: *SAN channel bandwidths* and SCS per *operating band* in FR1-NTN

| SAN Operating Band | SCS (kHz) | *SAN channel bandwidth* (MHz) |
| --- | --- | --- |
| 5 | 10 | 15 | 20 | 30(NOTE) |
|  | 15 | 5 | 10 | 15 | 20 |  |
| n256 | 30 |  | 10 | 15 | 20 |  |
|  | 60 |  | 10 | 15 | 20 |  |
|  | 15 | 5 | 10 | 15 | 20 |  |
| n255 | 30 |  | 10 | 15 | 20 |  |
|  | 60 |  | 10 | 15 | 20 |  |
|  | 15 | 5 | 10 | 15 |  |  |
| n254 | 30 |  | 10 | 15 |  |  |
|  | 60 |  | 10 | 15 |  |  |
|  | 15 | 5 |  |  |  |  |
| n253 | 30 |  |  |  |  |  |
|  | 60 |  |  |  |  |  |
|  | 15 | 5 | 10 | 15 | 20 | 30 |
| n251 | 30 |  | 10 | 15 | 20 | 30 |
|  | 60 |  | 10 | 15 | 20 | 30 |
|  | 15 | 5 | 10 | 15 | 20 | 30 |
| n250 | 30 |  | 10 | 15 | 20 | 30 |
|  | 60 |  | 10 | 15 | 20 | 30 |
| NOTE: Deployment of 30 MHz channel bandwidth for NTN SAN needs to be preceded by introduction of all applicable Tx RF, Rx RF, and demodulation requirements. |

* + Option 2: Other
* Recommended WF
	+ Specify the following initial SAN channel bandwidths for bands n253, n251 and n250:

| SAN Operating Band | SCS (kHz) | *SAN channel bandwidth* (MHz) |
| --- | --- | --- |
| 5 | 10 | 15 | 20 | 30(NOTE) |
|  | 15 | 5 |  |  |  |  |
| n253 | 30 |  |  |  |  |  |
|  | 60 |  |  |  |  |  |
|  | 15 | 5 | 10 | 15 | 20 | 30 |
| n251 | 30 |  | 10 | 15 | 20 | 30 |
|  | 60 |  | 10 | 15 | 20 | 30 |
|  | 15 | 5 | 10 | 15 | 20 | 30 |
| n250 | 30 |  | 10 | 15 | 20 | 30 |
|  | 60 |  | 10 | 15 | 20 | 30 |
| NOTE: Deployment of 30 MHz channel bandwidth for NTN SAN needs to be preceded by introduction of all applicable Tx RF, Rx RF, and demodulation requirements. |

#### Issue 3-3-3: SAN NR-ARFCN

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips).

Table 5.4.2.3-1: Applicable NR-ARFCN per *operating band* in FR1-NTN

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| n256 | 100 | 396000 – <20> – 402000 | 434000 – <20> – 440000 |
| n255 | 100 | 325300 – <20> – 332100 | 305000 – <20> – 311800 |
| n254 | 100 | 322000 – <20> – 325300 | 496700 – <20> – 500000 |
| n253 | 100 | 333600– <20> – 335000 | 303600 – <20> – 305000 |
| n251 | 100 | 325300– <20> – 332100 | 303600 – <20> – 311800 |
| n250 | 100 | 333600– <20> – 335000 | 303600 – <20> – 311800 |

* + Option 2: Other
* Recommended WF
	+ Specify the SAN NR-ARFCN for 100kHz channel raster for bands n253, n251 and n250 as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange 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 |

#### Issue 3-3-4: SAN NR-ARFCN for enhanced channel raster

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 5.4.2.3-2: Applicable NR-ARFCN per *operating band* for enhanced channel raster

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| n256 | 10 | 396000 – <2> – 402000 | 434000 – <2> – 440000 |
| n255 | 10 | 325300 – <2> – 332100 | 305000 – <2> – 311800 |
| n254 | 10 | 322000 – <2> – 325300 | 496700 – <2> – 500000 |
| n253 | 10 | 333600– <2> – 335000 | 303600 – <2> – 305000 |
| n251 | 10 | 325300– <2> – 332100 | 303600 – <2> – 311800 |
| n250 | 10 | 333600– <2> – 335000 | 303600 – <2> – 311800 |
| NOTE 1: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. These channel numbers shall also be such that the minimum guard band for each channel bandwidth and SCS specified in Table 5.3.3-1 are met for carriers located at the upper or lower edge of an operating band. |

* + Option 2: Other
* Recommended WF
	+ Specify the SAN NR-ARFCN for 10kHz enhanced channel raster for bands n253, n251 and n250 as follows:

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | ΔFRaster(kHz)  | Uplinkrange of NREF(First – <Step size> – Last) | Downlinkrange of NREF(First – <Step size> – Last) |
| n253 | 10 | 333600– <2> – 335000 | 303600 – <2> – 305000 |
| n251 | 10 | 325300– <2> – 332100 | 303600 – <2> – 311800 |
| n250 | 10 | 333600– <2> – 335000 | 303600 – <2> – 311800 |
| NOTE 1: The channel numbers that designate carrier frequencies so close to the operating band edges that the carrier extends beyond the operating band edge shall not be used. These channel numbers shall also be such that the minimum guard band for each channel bandwidth and SCS specified in Table 5.3.3-1 are met for carriers located at the upper or lower edge of an operating band. |

#### Issue 3-3-5: SAN SS Raster

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 5.4.3.3-1: Applicable SS raster entries per *operating band* (FR1-NTN)

|  |  |  |  |
| --- | --- | --- | --- |
| SAN operating band | SS Block SCS | SS Block pattern(NOTE) | Range of GSCN(First – <Step size> – Last) |
| n256 | 15 kHz | Case A | 5429 – <1> – 5494 |
| n255 | 15 kHz | Case A | 3818 – <1> – 3892 |
|  | 30 kHz | Case B | 3824 – <1> – 3886 |
| n254 | 15 kHz | Case A | 6215 – <1> – 6244 |
|  | 30 kHz | Case C | 6218 – <1> – 6241 |
| 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 |
| NOTE: SS Block pattern is defined in clause 4.1 in TS 38.213 [7]. |

* + Option 2: Other
* Recommended WF
	+ TBA

### Sub-topic 3-4: RRM Requirements

*Sub-topic description: RRM aspects*

*Open issues and candidate options before meeting:*

#### Issue 3-4-1: Band grouping

* Proposals
	+ Option 1: (ZTE Corporation, Sanechips)

Table 3.5.2A-1: NR frequency band groups for satellite access in FR1

|  |  |
| --- | --- |
| Group | NR FDD |
|  | Band group notation | Operating bands |
| A | NR\_FDD\_SAB\_FR1\_A | n254, n255, n256, n251, n250, n249 |
| B | NR\_FDD\_SAB\_FR1\_B |  |
| C | NR\_FDD\_SAB\_FR1\_C |  |
| D | NR\_FDD\_SAB\_FR1\_D |  |
| E | NR\_FDD\_SAB\_FR1\_E |  |
| F | NR\_FDD\_SAB\_FR1\_F |  |
| G | NR\_FDD\_SAB\_FR1\_G |  |
| H | NR\_FDD\_SAB\_FR1\_H |  |
| I | NR\_FDD\_SAB\_FR1\_I |  |
| J | NR\_FDD\_SAB\_FR1\_J |  |

* + Option 2: Other
* Recommended WF
	+ Agree Option 1

## Other Sub-topics/Issues

**Offline Agreement:**

* Other topics and issues are postponed to future meetings