**3GPP TSG-RAN WG4 Meeting # 100-e R4-210XXXX**

**Electronic Meeting, 16th -27th Aug., 2021**

**Agenda item:** 9.13.3&9.13.4

**Source:** Moderator (CATT)

**Title:** Email discussion summary for [100-e][314] NTN\_Solutions\_Part3

**Document for:** Information

# Introduction

*This E-mail thread will address the following issues for NTN*

* *BS RF requirements* 
  + *General aspects*
  + *TX requirements*
  + *RX requirements*
* *UE RF requirements*
  + *TX requirements*
  + *RX requirements*

# Topic #1: BS aspects

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

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| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2112009**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112009.zip) | CATT | Proposal 1: It is proposed to define type 1-C and type 1-H requirements for NTN BS in Rel-17 and use the figure 2-1 and 2-2 as the reference architecture.  Proposal 2: It is proposed to introduce 3 NTN BS types,   * + - NTN BS class A representing a typical operating altitude of 35786/50000 km     - NTN BS class B representing a typical operating altitude in the range of 7000-25000 km     - NTN BS class C representing a typical operating altitude in the range of 300-1500 km |
| [**R4-2112010**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112010.zip) | CATT | This paper gives detailed analysis on Tx requirements for satellite gNB (**See the discussion part in the paper**) |
| [**R4-2113746**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113746.zip) | Ericsson | **Proposal1: Define “Satellite Node” as the name of the NTN block which consists in the NTN payload, the feeder link, the NTN Gateway and the non-NTN infrastructure gNB functions.**  **Proposal2: When specifying Satellite Node Tx requirements, agree on the Way Forward described in Table 1 of this contribution.** |
| [**R4-2113932**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113932.zip) | ZTE Corporation | **Proposal 1**: if non-NTN infrastructure is not included in the conformance testing, then similar as RF repeater requirement, EVM distortion for NTN intra-gNB is needed.  **Observation 1**: the observation for RF requirements for NTN BS is listed in the following Table.   |  |  |  | | --- | --- | --- | | **General part** | | | | (such as BS channel bandwidth, NR-ARFCN, channel arrangement. etc) | | Band definition, BW,SCS, channel raster, sync raster, channel spacing for NTN S band has been addressed in other companion contribution. [4] | | NTN BS class | | To define GEO/LEO-600KM/LEO-1200KM NTN BS with the criteria of NTN BS height. | | **Tx part** | | | | Base station output power | This should rely on co-channel coexistence study between GEO, /LEO-600KM/LEO-1200KM BS similar as coexistence study for Wide area BS, Medium range BS and Local area BS; | | | Output power dynamics | This requirement is scaled with NRB for each BW. Once spectral utilization for NTNBW has been decided, then this requirement could be defined correspondingly. | | | Transmit ON/OFF power | This requirement is only applicable for TDD band, however NTN S band is FDD band..  ON-OFF transition period is also not applicable for NTN S band. | | | Transmitted signal quality | **Frequency error**: this requirement should be defined, regarding whether mobility of satellite should have impact on frequency error requirement could be FFS.  **EVM**: as mentioned in previous section 2.3, if non-NTN infrastructure is not included in the conformance testing, then similar as RF repeater requirement, EVM distortion for NTN intra-gNB is needed.  **TAE**: not sure whether this requirement should be defined. This should rely on whether MIMO transmission and CA operation on satellite is supported or not. | | | OBW | This could still follow the ITU regulation. | | | ACLR | This should rely on the evaluation results for NTN coexistence study.  Whether to support the CACLR requirement and non-contiguous operation for NTN should also rely on the operators’ deployment. | | | Operating band unwanted emissions | Similar as ACLR requirement, this should rely on evaluation results for NTN coexistence study  FOBUE requirement rely on the UEM and spurious emission definition, therefore this could be postponed to the later phase. | | | Transmitter spurious emissions | To follow the recommendation of ITU-R SM.329. | | | Tx intermodulation | Whether this requirement is applicable or not is also questionable, because the motivation of this requirement is based on the assumption of surrounding interfering BS existing, however for NTN BS multibeam antenna, not sure whether there would be multiple antenna equipped on satellite, if existing, what is the practical MCL between victim BS and interfering BS. | | |
| [**R4-2112011**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2112011.zip) | CATT | This paper gives detailed analysis on Rx requirements for satellite gNB（**See the discussion part in the paper**） |
| [**R4-2113747**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113747.zip) | Ericsson | **Proposal1: Clarify that, for most Rx requirements, the TAB connector is located in the satellite payload, while the throughput measurement is done in the “non-NTN infrastructure gNB”.**  **Proposal2: The FRCs specified in TS 38.104 shall be re-used to specify the satellite node Rx requirements.**  **Proposal3: When specifying Satellite Node Tx requirements, agree on the Way Forward described in Table 1 of this contribution.** |
| [**R4-2113933**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113933.zip) | ZTE Corporation | **Observation 1**: the observation for RF requirements for NTN BS is listed in the following Table.   |  |  | | --- | --- | | **Rx part** | | | REFSENS | REFSENS requirement should be defined based on Noise figure and FRC, SINR etc. Rel-15 NR FRC and the corresponding SINR could be reused. | | dynamic range | More system-level simulation results for co-channel interference over Iot is encouraged to check whether this requirement is needed for NTN BS. | | ACS, NBB | Similar as ACLR/UEM comments, this is also rely on simulation results of the NTN coexistence study.  In addition, NBB requirement is still applicable since system operating on adjacent channel might be standalone NB-IoT system. | | In-band blocking, | Similar as ACS requirement, this is also rely on simulation results of the NTN coexistence study and it’s also tightly related with ACS interfering signal in the past. | | OOBB | OOBB requirement -15dBm/CW might be not applicable anymore, we need to consider the worst case interfering signal for NTN case again.  FOOBB requirement rely on the OOBB requirements and in-band blocking requirements, this could be postponed to the later phase. | | RX IMD, general and NBB RX IMD | Similar as ACS/IBB requirements, power level of interfering signal should rely on the simulation results for NTN coexistence study. | | Rx spurious emission etc | FFS, maybe FR1 NR BS Rx spurious emission requirement could be reused as baseline. | | ICS | This requirement is needed since I/Q imbalance within RF chain always exist, however this also rely on the co-channel evaluation results similar as done for FR2 mmWave BS.  The corresponding FRC for NR in Rel-15 can be reused, however the corresponding power level should be further revisited. | |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 1-1 General aspects

*Sub-topic description:*

*In RAN4#99e meeting, it has been decided that BS type 1-H will be considered and BS type 1-O will be deferred to future release. FFS on BS type 1-C. The reference point needs to be decided for developing RF requirements.*

*NTN intra-gNB EVM distortion is another open issue to be solved.*

**Issue 1-1-1: What is the reference point and architecture for BS type 1-H**

* Proposals
  + Option 1:



* + Option 2:



* + Option 3:



* Recommended WF
  + TBA

**Issue 1-1-2: What is the reference point for BS type 1-C if it is in the scope of Rel-17 NTN**

* Proposal
  + Option 1:



* + Option 2: Please specify if any other proposal.
* Recommended WF
  + TBA

**Issue 1-1-3: Do you think NTN intra-gNB EVM distortion needs to be defined?**

* Proposal
  + Option 1: No. NTN payload + NTN-Gateway + non-NTN infrastructure gNB function will be treated as a single entity. EVM requirement is defined as a total requirement for the entity for the service link.
  + Option 2: Yes. Intra-gNB EVM distortion is needed.
* Recommended WF
  + TBA

### Sub-topic 1-2 Tx requirements for Satellite BS

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-2-1: Base station output power**

* Proposals
  + Option 1: This requirement is based on manufacturer declaration. FFS on whether accuracy can be reused.
  + Option 2: Define different power classes for GEO/LEO/MEO/HEO etc. the following framework is proposed

|  |  |
| --- | --- |
| Satellite BS class | Prated,c,AC |
| Satellite BS class A | (Note) |
| Satellite BS class B | ≤ TBD dBm |
| Satellite BS class C | ≤ TBD dBm |
| NOTE: There is no upper limit for the Prated,c,AC rated output power of the Satellite BS class A. | |

* + Option 3: This should rely on co-channel coexistence study between GEO, /LEO-600KM/LEO-1200KM BS similar as coexistence study for Wide area BS, Medium range BS and Local area BS;
  + Option 4: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-2: Radiated transmit power**

* Proposals
  + Option 1: Based on manufacturer declaration for each beam.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-3: RE power dynamic range**

* Proposal
  + Option 1: The current RE power dynamic range should be transposed for Satellite BS
    - The boosting-up requirement can be reused if UEM is not tightened.
    - The boosting-down requirement can be reused if EVM requirement is not tightened.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-4: total power dynamic range**

* Proposal
  + Option 1: The current total power dynamic range requirement can be reused.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-5: Transmit ON/OFF power**

* Proposal
  + Option 1: This requirement is not needed for satellite BS due to FDD operation.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-6: Frequency error**

* Proposal
  + Option 1: The current requirement can be reused.
  + Option 2: This requirement is FFS considering the impact of satellite mobility.
  + Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-7: Modulation quality (EVM)**

* Proposal
  + Option 1: The current requirement can be reused.
  + Option 2: Additional EVM distortion is needed.
* Recommended WF
  + TBA

**Issue 1-2-8: Time alignment error**

* Proposal
  + Option 1: The TAE requirement for MIMO transmission can be reused at this stage.
    - CA feature is not considered at this stage
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-9: Occupied BW**

* Proposal
  + Option 1: The current requirement can be reused.
  + Option 2: This could follow the ITU regulation.
  + Option 3: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-10: Operating band unwanted emission**

* Proposal
  + Option 1: This requirement relies on ACLR and spurious emission. It should be deferred to later stage.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-11: Transmitter spurious emissions**

* Proposal
  + Option 1: To follow the recommendation of ITU-R SM.329 and reuse current definition in 38.104.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-12: Protection of the BS receiver of own or different BS**

* Proposal
  + Option 1: This requirement is needed. FFS on the exact value.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-13: Co-location with other BS**

* Proposal
  + Option 1: This requirement is not needed since there is no co-location scenario foreseen for satellite.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-2-14: Transmitter intermodulation**

* Proposal
  + Option 1: This requirement is not needed since there is no nearby interfering signal reaching the transmitter unit via the antenna, RDN and antenna array.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

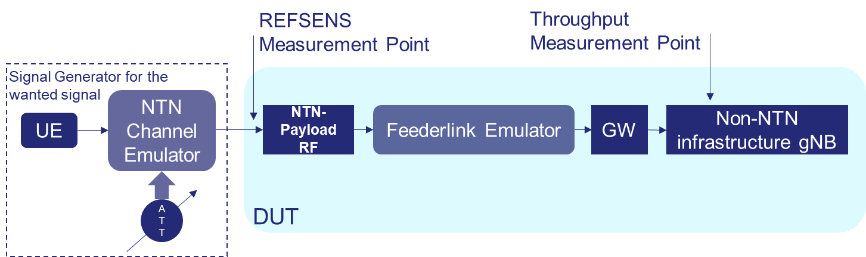
### Sub-topic 1-3 Rx requirements for Satellite BS

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 1-3-1: How to do measurement for Rx requirement**

* Proposals
  + Option 1: Clarify that, for most Rx requirements, the TAB connector is located in the satellite payload, while the throughput measurement is done in the “non-NTN infrastructure gNB”. As shown in the figure below



* + Option 2: Other, please specify
* Recommended WF
  + TBA

**Issue 1-3-2: FRC**

* Proposals
  + Option 1: The FRCs specified in TS 38.104 shall be re-used to specify the satellite node Rx requirements.
  + Option 2: Other FRC’s are defined for satellite BS.
* Recommended WF
  + TBA

**Issue 1-3-3: Reference sensitivity**

* Proposals
  + Option 1: Requirement structure should be reused from the current 38.104.
    - FFS on noise figure, SNR, margin etc.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-3-4: OTA sensitivity**

* Proposals
  + Option 1: The same requirement as in 38.104 can be reused as it is based on manufacture declaration.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-3-5: Dynamic range**

* Proposals
  + Option 1: FFS on the necessity of this requirement for satellite BS.
    - System-level simulation for co-channel interference over Iot is needed.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-3-6: ACS**

* Proposals
  + Option 1: wait for the co-existence simulation results
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-3-7: In-band blocking**

* Proposals
  + Option 1: Wait the co-existence simulation results
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-3-8: out-of-band blocking**

* Proposals
  + Option 1: OOBB requirement -15dBm/CW and FOOBB need to be reevaluated for satellite BS
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-3-9: co-location requirement**

* Proposals
  + Option 1: This requirement is not needed as there is no co-location scenario for satellite BS
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-3-10: Receiver spurious emission**

* Proposals
  + Option 1: This requirement should be transposed in satellite TS.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-3-11: Receiver intermodulation**

* Proposals
  + Option 1: This requirement is not needed considering the scenario of satellite BS.
  + Option 2: The requirement framework can be reused from 38.104. interference power level rely on system simulation.
  + Option 3: Other, please specify.
* Recommended WF
  + TBA

**Issue 1-3-12: In-channel selectivity**

* Proposals
  + Option 1: The requirement frame work can be reused. FFS on details.
  + Option 2: Other, please specify.
* Recommended WF
  + TBA

## Companies’ views collection for 1st round

### Open issues

*One of the two formats, i.e. either example 1 or 2 can be used by moderators.*

**Example 1**

|  |  |
| --- | --- |
| **Company** | **Comments** |
| ZTE | ….  Others: |

**Example 2**

Sub topic 1-1

|  |  |  |
| --- | --- | --- |
| **Company** | | **Comments** |
| ZTE | | **Issue 1-1-1:**  As we highlighted in our contribution for NTN BS class, the proposed diagram is only one candidate for NTN BS type 1-H, other antenna architecture might be also fine for NTN BS type 1-H.  **Issue 1-1-2:**  This should rely on the outcome in NTN BS type thread, we prefer not to define that.  **Issue 1-1-3:**  If NTN payload + NTN-Gateway + non-NTN infrastructure gNB function will be treated as a single entity, then intra-gNB EVM is not needed. |
| CATT | | **Issue 1-1-1:**  We prefer Option 1. Option 3 could also be OK. It depends whether we need to show the detains inside the satellite base stations.  **Issue 1-1-2:**  Depends on the outcome of E-mail thread#312. We prefer to keep 1-C since it may be useful for manufacture testing.  **Issue 1-1-3:**  Option1 according to the previous agreement on treating NTN payload + feeder link + NTN GW + “gNB” as a single entity. |
| Ericsson | | Issue 1-1-1: Option 3. We have clarified where all reference points apply. The other options would need further clarification. Option 1 has introduced a new term (satellite Base Station) which is confusing, not sure what this means.  Issue 1-1-2: option 2: We don’t think BS type 1-C should be specified for NTN, see thread [312].  Issue 1-1-3: option 1: the RAN4 agreement was to consider (payload + feeder link + GW + “gNB”) as a single entity, we shall not break requirements inside that block then. |
| THALES | | **Issue 1-1-1:**  Option 1 or Option 3. For Option 3, “Satellite Node” could be “gNB” or “Sat-gNB” or something else similar.  **Issue 1-1-2:**  Some companies already expressed concerns in RAN4#99-e meeting with respect to BS type 1-C, since it uses passive antenna and it may not be well adapted to satellite use case. Let us further discuss in E-mail thread#312.  **Issue 1-1-3:**  The RAN4 agreement was to consider (payload + feeder link + GW + **Non-Terrestrial Infrastructure gNB**) as a single entity.  **See agreement RAN4#99-e:**  **Proposal 1-1-3-1: RAN4 confirms the baseline assumption that from RF Tx, Rx requirements (for conductive RF requirements) perspective, NTN-Payload RF, Feederlink, GW, Non-NTN infrastructure gNB shall be considered as single entity.**  **Note:** The detailed test set-up can be further discussed. Further confirmation still required for OTA based RF requirements if introduced.  Option 1 should be considered, we share a similar view as Ericsson. |
| Huawei | | Issue 1-1-1: Options 1 and 2 do not give sufficient NTN context. Option 3 is preferred.  Issue 1-1-2: we agree that 1-C may not be very useful for the NTN application. However, based on CATT comments we would like to further check and still keep 1-C as FFS this meeting.  Issue 1-1-3: the original proposal from ZTE was referring to the non-NTN infrastructure and its consideration for the conformance testing. Issue 1-1-3 is slightly different. If (payload + feeder link + GW + “gNB”) is single entity, then no intra-gNB requirements. |
| Nokia | | Issue 1-1-1: Option 3 – It is needed to consider all included here also when RRM/timing has to be considered at a later stage.  Issue 1-1-2: Option 2 - BS type 1-C does not make sense in our opinion.  Issue 1-1-3: Option 1 – It is agreed to consider (payload + feeder link + GW + “gNB”) as a single entity, let’s not reopen that. |
| Hughes / Echostar | **Issue 1-1-1:**  Option 1 or Option 3. For Option 3, “Satellite Node” could be “Sat-gNB” or something similar.  **Issue 1-1-2:**  Further discussion required via e-mail thread #312.  **Issue 1-1-3:**  As per the RAN4 #99-e agreement (see Thales above). | |
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Sub topic 1-2

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| **Company** | **Comments** |
| ZTE | **Issue 1-2-1:**  Whether we need to have power limitation for different NTN BS, we need to answer the question whether GEO and LEO could operate at the same frequency. That’s one fundamental question we need to clarify firstly and this will have some impacts on RAN2 RRM measurement and RAN4 measurement gap discussion.  **Issue 1-2-2:**  We support Option 1  **Issue 1-2-3:**  This might be not needed for satellite system since RE power control for satellite interference mitigation might be limited different from TN side.  **Issue 1-2-4: total power dynamic range**  Since SU for NTN BW is decided yet, we prefer to postpone the discussion.  **Issue 1-2-5: Transmit ON/OFF power**  We support Option 1:  **Issue 1-2-6: Frequency error**  Option 2  **Issue 1-2-7: Modulation quality (EVM)**  The existing requirement could be reused, however the applicable modulation order could be further discussed based on system simulation  **Issue 1-2-8: Time alignment error**  Not sure how MIMO is supported for satellite node, this should be clarified by NTN vendors;  **Issue 1-2-9: Occupied BW**  Option 2 to follow the ITU recommendation.  **Issue 1-2-10: Operating band unwanted emission**  We support Option 1:  **Issue 1-2-11: Transmitter spurious emissions**  We support Option 1:  **Issue 1-2-12: Protection of the BS receiver of own or different BS**  We support Option 1:  **Issue 1-2-13: Co-location with other BS**  We would like to check with NTN vendor whether there are other BS installed on the same satellite.  **Issue 1-2-14: Transmitter intermodulation**  FFS, similar as issue 1-2-13; |
| CATT | **Issue 1-2-1:**  Option 2. Different operators may have different deployment for the same band. Different deployment is related to different power. It’s obvious that different power is needed for operating at LEO orbit and GEO orbit.  **Issue 1-2-2:**  Option 1.  **Issue 1-2-3:**  Option1. But we are also open for further study.  **Issue 1-2-4: total power dynamic range**  Option 1. The same requirement frame structure can be reused since it is related to the number of RBs only. SU discussion can be a separate discussion.  **Issue 1-2-5: Transmit ON/OFF power**  Option 1  **Issue 1-2-6: Frequency error**  Option 2  **Issue 1-2-7: Modulation quality (EVM)**  Option 1. Same view as ZTE on applicable modulation scheme for satellite.  **Issue 1-2-8: Time alignment error**  Option 1.  **Issue 1-2-9: Occupied BW**  Option 1.  **Issue 1-2-10: Operating band unwanted emission**  Option 1:  **Issue 1-2-11: Transmitter spurious emissions**  Option 1:  **Issue 1-2-12: Protection of the BS receiver of own or different BS**  Option 1:  **Issue 1-2-13: Co-location with other BS**  Option 1. Further input from satellite operators on scenarios is also welcome.  **Issue 1-2-13: Transmitter intermodulation**  Currently Option 1. Further input from satellite operators on scenarios is also welcome! |
| Ericsson | Issue 1-2-1: It’s not yet obvious that the maximum output power would be based on satellite node class actually: 2 sets of parameters have been mentioned in TR 38.821 with different output power for the same satellite orbiter. Also, MEO has not been discussed in RAN4 so far, there won’t be any requirement in the scope of this WI for MEO then…  Issue 1-2-2: option 1  Issue 1-2-3: option 1, but why would we tighten EVM requirement?  Issue 1-2-4: option 1  Issue 1-2-5: option 1  Issue 1-2-6: TS 38Hu.104 requirement should be the starting point for this requirement, whether satellite mobility has any impact on this requirement could be further investigated and discussed.  Issue 1-2-7: option 1 as RAN4 agreed to consider the satellite node as a block.  Issue 1-2-8: option 2: do we really need TAE requirement?  Issue 1-2-9: option 1: option 2 should be covered by option 1, RAN4 doesn’t specify any requirement which would not comply with ITU regulation.  Issue 1-2-10: option 1  Issue 1-2-11: option 2. For Europe we shall follow ERC 74-01. And we should then check if requirement in TS 38.104 is aligned with ERC 74-01 for satellite equipment.  Issue 1-2-12: option 1  Issue 1-2-13: option 1 |
| THALES | **Issue 1-2-1:**  Option 1, or a new Option 5 (as wide area BS).  It does not make sense to define power classes, for several reasons.   * Firstly, the transmission power will depend on the orbit, minimum elevation angle, target data rate, interference context, number of simultaneous active beams, and therefore not only orbit. * Secondly, the maximum transmission power of the satellite should not be limited. In any case, it should be equivalent to wide area BS, i.e. no power limitation.   Let us further discuss in #312.  **Issue 1-2-2:**  Option 1. Same as above.  **Issue 1-2-3:**  We could consider Option1 as baseline, but it might not be needed for NTN use case. Moreover, the NTN interference scenarios are different from TN.  **Issue 1-2-4: total power dynamic range**  We can consider Option 1 as baseline.  **Issue 1-2-5: Transmit ON/OFF power**  Option 1  **Issue 1-2-6: Frequency error**  Option 1. Mobility is a different issue, however the resulted error can be included in the global frequency error, as previously discussed.  **Issue 1-2-7: Modulation quality (EVM)**  Option 2. Additional EVM may be required for NTN.  **Issue 1-2-8: Time alignment error**  Option 2. At this stage it may not be required. Maybe for CA in Rel-18.  **Issue 1-2-9: Occupied BW**  Option 1 seems very reasonable.  **Issue 1-2-10: Operating band unwanted emission**  Option 1.  **Issue 1-2-11: Transmitter spurious emissions**  Option 1 or Option 2.  **Issue 1-2-12: Protection of the BS receiver of own or different BS**  Option 1.  **Issue 1-2-13: Co-location with other BS**  Option 1. Inputs from satellite operators may be required.  **Issue 1-2-13: Transmitter intermodulation**  Option 1. |
| Huawei | Issue 1-2-1: for now the only obvious conclusion seems to be that multiple classes are needed. The Prated,c,AC is reused form 1-C, which seems to be FFS for now – probably 1-H terminology to be reused, or a new term for the NTN rated power.  Issue 1-2-2: Option 1  Issue 1-2-3: power control aspects for the NTN may need more analysis due to scenario specifics. Prefer to keep it open.  Issue 1-2-4: derivation of the total power dynamic range is quite straightforward once we know Nrb.  Issue 1-2-5: option 1, with the clarification that this is due to FDD duplex.  Issue 1-2-6: Option 2, while NR requirement may be the starting point.  Issue 1-2-7: same as ZTE and CATT.  Issue 1-2-8: first clarify on the scenarios and features (e.g. MIMO, CA) before concluding on TAE.  Issue 1-2-9: ITU regulation to be double-checked first (as 3GPP needs to follow it anyway). Option 1 can be considered as starting point.  Issue 1-2-10: to be postponed.  Issue 1-2-11: agree with Ericsson view.  Issue 1-2-12: option 1  Issue 1-2-13: clearly there is need to clarify not only the assumed scenarios, but practical deployment aspects. It shall be clarified, that co-location requirements were defined by 3gpp and are not regulatory requirements. For TN, colocation requirements were accounting for colocation for other 3gpp systems, only (due to TN deployments). In case of NTN, this may differ and requires inputs from interested companies.  Issue 1-2-14: FFS, based on motivation as for 1-2-13. |

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| Nokia | Issue 1-2-1: The BS classes is also discussed in 312 – see our comments there  Issue 1-2-2: Option 1  Issue 1-2-3: Option 1 main bullet is okay, not sure about the sub-bullets  Issue 1-2-4: Option 1  Issue 1-2-5: Option 1 – if someone suggests TDD bands this obviously needs revisiting.  Issue 1-2-6: TN NR req. should be starting point, but this can be further discussed.  Issue 1-2-7: Option 1  Issue 1-2-9: Option 1  Issue 1-2-10: Option 1  Issue 1-2-11: Option 2. Agree with Ericsson.  Issue 1-2-12: Option 1  Issue 1-2-13: Option 1 |

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| Hughes / EchoStar | **Issue 1-2-1:**  Option 1, or a new Option 5 (as wide area BS).  Let us further discuss in #312.  **Issue 1-2-2:**  Option 1. Same as above.  **Issue 1-2-3:**  Option1: noting however that the interference scenarios for NTN and TN are different.  **Issue 1-2-4: total power dynamic range**  Option 1.  **Issue 1-2-5: Transmit ON/OFF power**  Option 1.  **Issue 1-2-6: Frequency error**  Option 1.  **Issue 1-2-7: Modulation quality (EVM)**  Option 2: noting that NTN may require additional EVM.  **Issue 1-2-8: Time alignment error**  Option 2.  **Issue 1-2-9: Occupied BW**  Option 1.  **Issue 1-2-10: Operating band unwanted emission**  Option 1.  **Issue 1-2-11: Transmitter spurious emissions**  Option 1 or Option 2.  **Issue 1-2-12: Protection of the BS receiver of own or different BS**  Option 1.  **Issue 1-2-13: Co-location with other BS**  Option 1.  **Issue 1-2-13: Transmitter intermodulation**  Option 1. |

Sub topic 1-3

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| --- | --- | --- |
| **Company** | | **Comments** |
| ZTE | | **Issue 1-3-1: How to do measurement for Rx requirement**  Fine with option 1  **Issue 1-3-2: FRC**  Fine with option 1  **Issue 1-3-3: Reference sensitivity**  Fine with option 1, however it depends on the outcome of issue 1-3-2.  **Issue 1-3-4: OTA sensitivity**  Fine with option 1, however it depends on the outcome of issue 1-3-2.  **Issue 1-3-5: Dynamic range**  Fine with option 1  **Issue 1-3-6: ACS**  Fine with option 1  **Issue 1-3-7: In-band blocking**  Fine with option 1  **Issue 1-3-8: out-of-band blocking**  Fine with option 1  **Issue 1-3-9: co-location requirement**  FFS similar as previous Tx side  **Issue 1-3-10: Receiver spurious emission**  Fine with option 1  **Issue 1-3-11: Receiver intermodulation**  FFS similar as previous Tx side.  **Issue 1-3-12: In-channel selectivity**  Fine with option 1 |
| CATT | | **Issue 1-3-1: How to do measurement for Rx requirement**  OK with ption 1  **Issue 1-3-2: FRC**  Ok with option 1.  **Issue 1-3-3: Reference sensitivity**  Option 1.  **Issue 1-3-4: OTA sensitivity**  Option 1.  **Issue 1-3-5: Dynamic range**  Fine with option 1  **Issue 1-3-6: ACS**  Option 1  **Issue 1-3-7: In-band blocking**  Option 1.  **Issue 1-3-8: out-of-band blocking**  Option 1  **Issue 1-3-9: co-location requirement**  Option 1. Further input from satellite operators on scenarios is also welcome!  **Issue 1-3-10: Receiver spurious emission**  Option 1  **Issue 1-3-11: Receiver intermodulation**  Option 1. Further input from satellite operators on scenarios is also welcome!  **Issue 1-3-12: In-channel selectivity**  Option 1 |
| Ericsson | | Issue 1-3-1: option 1, to clarify. This figure would need some updates but it’s very useful to understand the testing points.  Issue 1-3-2: option 1  Issue 1-3-3: Option 2: we can’t really say we will reuse TS 38.104 requirement as we would have to discuss SNR, NF, implementation margin, … but we will adapt/transpose this requirement of NTN.  Issue 1-3-4: option 1  Issue 1-3-5: Option 2. What ”Iot” means in option 1? The dynamic range requirements measures the capability of the receiver to receive a wanted signal while a higher power level interferer is also present, measuring the effects of receiver impairments. Further study on such potential interferer would be needed before making decision on not having this requirement.  Issue 1-3-6: option 1  Issue 1-3-7: option 1  Issue 1-3-8: option 1  Issue 1-3-9: option 1  Issue 1-3-10: option 1, as mentioned before we should check with ERC 74-01 for satellite equipment.  Issue 1-3-11: Option 1, there should not be any UE from an adjacent operators transmitting close enough to the NTN payload, Rx IM might not be needed then.  Issue 1-3-12: option 1 |
| THALES | | **Issue 1-3-1: How to do measurement for Rx requirement**  Option 1.  **Issue 1-3-2: FRC**  Option 1  **Issue 1-3-3: Reference sensitivity**  Option 1, since the question is with respect to requirement structure.  **Issue 1-3-4: OTA sensitivity**  Option 1.  **Issue 1-3-5: Dynamic range**  FFS, none of the options.  **Issue 1-3-6: ACS**  Option 1 should be considered.  **Issue 1-3-7: In-band blocking**  Option 1.  **Issue 1-3-8: out-of-band blocking**  Option 1.  **Issue 1-3-9: co-location requirement**  Option 1.  **Issue 1-3-10: Receiver spurious emission**  Option 1.  **Issue 1-3-11: Receiver intermodulation**  Option 1.  **Issue 1-3-12: In-channel selectivity**  Option 1. |
| Huawei | | Issue 1-3-1: option 1 seems good clarification. The figure would be better to be re-drawn based on the agreed architecture figure in 1-1.  Issue 1-3-2: not sure if we need to decide it already. Related decision on the modulation order needed first?  Issue 1-3-3: not clear what is meant by the “structure” here. More analysis before concluding on this.  Issue 1-3-4: to be manufacturer declared, but it does not necessarily mean that this is the same requirement as in 38.104.  Issue 1-3-5: same as Ericsson.  Issue 1-3-6: option 1  Issue 1-3-7: option 1  Issue 1-3-8: more study needed. No point in agreeing option 1  Issue 1-3-9: see 1-2-13.  Issue 1-3-10: option 1.  Issue 1-3-11: more analysis for the need of the requirement is needed based on the foresee deployment cases.  Issue 1-3-12: option 1 as starting point. |
| Nokia | | Issue 1-3-1: Option 1 – please update figure  Issue 1-3-2: Option 1  Issue 1-3-3: Option 2 – See comment from Ericsson  Issue 1-3-4: Option 1  Issue 1-3-6: Option 1  Issue 1-3-7: Option 1  Issue 1-3-8: Option 1  Issue 1-3-9: Option 1  Issue 1-3-10: Option 1.  Issue 1-3-11: Option 1  Issue 1-3-12: Option 1 |
| Hughes / EchoStar | **Issue 1-3-1: How to do measurement for Rx requirement**  Option 1.  **Issue 1-3-2: FRC**  Option 1.  **Issue 1-3-3: Reference sensitivity**  Option 1.  **Issue 1-3-4: OTA sensitivity**  Option 1.  **Issue 1-3-5: Dynamic range**  All options rejected since this requires further study.  **Issue 1-3-6: ACS**  Option 1.  **Issue 1-3-7: In-band blocking**  Option 1.  **Issue 1-3-8: out-of-band blocking**  Option 1.  **Issue 1-3-9: co-location requirement**  Option 1.  **Issue 1-3-10: Receiver spurious emission**  Option 1.  **Issue 1-3-11: Receiver intermodulation**  Option 1.  **Issue 1-3-12: In-channel selectivity**  Option 1. | |

### CRs/TPs comments collection

*For close-to-finalize WIs and maintenance work, comments collections can be arranged for TPs and CRs. For ongoing WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

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| --- | --- |
|  | **Status summary** |
| **Sub-topic #1-1** | *Tentative agreements:*  **Issue 1-1-1: What is the reference point and architecture for BS type 1-H**   * + Option 1: (CATT, Thales，Hughes/Echostar)      * + Option 2: (ZTE)      * + Option 3: （Ericsson，CATT，Thales，Huawei，Nokia，Hughes/Echostar）     Recommendation:  It is proposed to continue the discussion in the 2nd round between Option 1 and option 3, including the details in the box.  **Issue 1-1-2: What is the reference point for BS type 1-C if it is in the scope of Rel-17 NTN**  Recommendation:  Per the GTW discussion, this issue can be closed and wait for further check for BS type 1-C in the next meeting.  **Issue 1-1-3: Do you think NTN intra-gNB EVM distortion needs to be defined?**   * + Option 1: (ZTE, CATT, Ericsson, Thales，Huawei，Nokia，Hughes/Echostar)   No. NTN payload + NTN-Gateway + non-NTN infrastructure gNB function will be treated as a single entity. EVM requirement is defined as a total requirement for the entity for the service link.   * + Option 2:   Yes. Intra-gNB EVM distortion is needed.  Recommendation:  It is proposed to agree Option1. |

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|  | **Status summary** |
| **Sub-topic #1-2** | *Tentative agreements:*  **Issue 1-2-1: Base station output power**   * + Option 1: (Thales, Hughes/EchoStar)   This requirement is based on manufacturer declaration. FFS on whether accuracy can be reused.   * + Option 2: (CATT)   Define different power classes for GEO/LEO/MEO/HEO etc. the following framework is proposed   |  |  | | --- | --- | | Satellite BS class | Prated,c,AC | | Satellite BS class A | (Note) | | Satellite BS class B | ≤ TBD dBm | | Satellite BS class C | ≤ TBD dBm | | NOTE: There is no upper limit for the Prated,c,AC rated output power of the Satellite BS class A. | |  * + Option 3:   This should rely on co-channel coexistence study between GEO, /LEO-600KM/LEO-1200KM BS similar as coexistence study for Wide area BS, Medium range BS and Local area BS;   * + Option 4: (ZTE, Ericsson, Thales, CATT, Huawei, Nokia, Hughes/EchoStar)   FFS  Recommendation:  It is proposed to further discuss in the 2nd round.    **Issue 1-2-2: Radiated transmit power**   * + Option 1: (ZTE, CATT, Ericsson, Thales, Huawei, Nokia, Hughes/EchoStar)   Based on manufacturer declaration for each beam.   * + Option 2:   Other, please specify.  Recommendation:  It is proposed to agree option 1.  **Issue 1-2-3: RE power dynamic range**   * + Option 1\*: (Ericsson, CATT, Thales, Nokia, Hughes/EchoStar)   The current RE power dynamic range should be transposed for Satellite BS   * + Option 2: (ZTE, Huawei)   Other, please specify.  Recommendation:  It is proposed to use Option 1 as the starting point.  Note \*: The original sub-bullets have been removed since it is confusing.  **Issue 1-2-4: total power dynamic range**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Nokia)   The current total power dynamic range requirement can be reused.   * + Option 2: (ZTE)   Other, please specify.  Recommendation:  It is proposed to use Option 1 as the starting point.  **Issue 1-2-5: Transmit ON/OFF power**   * + Option 1: (ZTE, CATT, Ericsson, Thales, Huawei, Hughes/EchoStar)   This requirement is not needed for satellite BS due to FDD operation.   * + Option 2:   Other, please specify.  Recommendation:  It is proposed to agree option 1.  **Issue 1-2-6: Frequency error**   * + Option 1: (Hughes/EchoStar)   The current requirement can be reused.   * + Option 2: (ZTE, CATT, Ericsson, Huawei, Nokia)   This requirement is FFS considering the impact of satellite mobility. 38.104 requirements can be a starting point.   * + Option 3: (Thales?)   Other, please specify.  Recommendation:  It is proposed to use current 38.104 requirements as the starting point and further check the impact of satellite mobility.  **Issue 1-2-7: Modulation quality (EVM)**   * + Option 1: （ZTE, CATT, Ericsson, Huawei, Nokia）   The current requirement can be reused.   * + Option 2: (Thales, Hughes/EchoStar)   Additional EVM distortion is needed.  Note \*: applicable modulation order could be further discussed based on system simulation.  Recommendation:  It is proposed to use current 38.104 requirements as the starting point and further check whether additional EVM is needed.  **Issue 1-2-8: Time alignment error**   * + Option 1: (CATT, )   The TAE requirement for MIMO transmission can be reused at this stage.   * + - CA feature is not considered at this stage   + Option 2: (ZTE, Huawei, Ericsson, Thales, Huawei, Thales, CATT)   Clarification from satellite operators on whether MIMO、CA feature is included and whether this requirement is needed.  Recommendation:  It is proposed to discuss in the 2nd round whether MIMO/CA feature is included in Rel-17 NTN.  **Issue 1-2-9: Occupied BW**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Nokia, Hughes/EchoStar)   The current requirement can be reused.   * + Option 2: (ZTE)   This could follow the ITU regulation.   * + Option 3:   Other, please specify.  Recommendation:  It is proposed to agree Option 1?  Is ZTE ok to agree option 1since there is no RAN4 requirement conflicting ITU regulations in 38.104?.  **Issue 1-2-10: Operating band unwanted emission**   * + Option 1: (ZTE, CATT, Ericsson, Thales, Huawei, Nokia, Hughes/EchoStar)   This requirement relies on ACLR and spurious emission. It should be deferred to later stage.   * + Option 2:   Other, please specify.  Recommendation:  It is proposed to agree on Option 1.  **Issue 1-2-11: Transmitter spurious emissions**   * + Option 1: (ZTE, CATT, Thales, Hughes / EchoStar)   To follow the recommendation of ITU-R SM.329 and reuse current definition in 38.104.   * + Option 2: (Ericsson, Thales, Huawei, Nokia, Hughes / EchoStar)   For Europe we shall follow ERC 74-01. And we should then check if requirement in TS 38.104 is aligned with ERC 74-01 for satellite equipment.  Recommendation:  It is proposed to use 38.104 requirement as starting point and further check compliance to ERC 74-01 for Europe.  **Issue 1-2-12: Protection of the BS receiver of own or different BS**   * + Option 1: (ZTE, CATT, Ericsson, Thales, Huawei, Nokia, Hughes / EchoStar)   This requirement is needed. FFS on the exact value.   * + Option 2:   Other, please specify.  Recommendation:  It is proposed to Agree option 1.  **Issue 1-2-13: Co-location with other BS**   * + Option 1: (CATT, Ericsson, Thales, Nokia, Hughes / EchoStar)   This requirement is not needed since there is no co-location scenario foreseen for satellite.   * + Option 2: (ZTE, Huawei)   To check the scenarios for satellite, e.g. whether there is other BS installed on the same satellite.  Recommendation:  To check in the 2nd round whether Option 1 is agreeable or not.  **Issue 1-2-14: Transmitter intermodulation**   * + Option 1: (CATT, Ericsson, Thales, Nokia, Hughes / EchoStar)   This requirement is not needed since there is no nearby interfering signal reaching the transmitter unit via the antenna, RDN and antenna array.   * + Option 2: (ZTE, Huawei)   To check the scenarios for satellite, e.g. whether there is other BS installed on the same satellite.  Recommendation:  To check in the 2nd round whether Option 1 is agreeable or not. |

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|  | **Status summary** |
| **Sub-topic #1-3** | *Tentative agreements:*  **Issue 1-3-1: How to do measurement for Rx requirement**   * + Option 1: （ZTE, CATT, Ericsson, Thales, Huawei, Nokia, Hughes / EchoStar）   Clarify that, for most Rx requirements, the TAB connector is located in the satellite payload, while the throughput measurement is done in the “non-NTN infrastructure gNB”. As shown in the figure below     * + Option 2: Other, please specify   Recommendation:  It is proposed to Agree option 1.  **Issue 1-3-2: FRC**   * + Option 1: （ZTE, CATT, Ericsson, Thales, Nokia, Hughes / EchoStar）   The FRCs specified in TS 38.104 shall be re-used to specify the satellite node Rx requirements.   * + Option 2: （Huawei）   Propose to determine the modulation order.  Recommendation:  It is proposed to Agree option 1.  **Issue 1-3-3: Reference sensitivity**   * + Option 1: （ZTE, CATT, Thales, Nokia, Hughes / EchoStar）   Requirement structure should be reused from the current 38.104.   * + - FFS on noise figure, SNR, margin etc.   + Option 2: （Ericsson, Huawei, Nokia）   Transpose the38.104 requirement after discussion on SNR, NF, implementation margin.  Recommendation:  It is proposed to further discuss this issue, including SNR, NR, implementation etc…  **Issue 1-3-4: OTA sensitivity**   * + Option 1: （ZTE, CATT, Ericsson, Thales, Nokia, Hughes / EchoStar）   The same requirement as in 38.104 can be reused as it is based on manufacture declaration.   * + Option 2: （Huawei）   To be manufacturer declared, but it does not necessarily mean that this is the same requirement as in 38.104.  Recommendation:  Confirm in the second round whether Option 1 is agreeable.  **Issue 1-3-5: Dynamic range**   * + Option 1: (ZTE, CATT )   FFS on the necessity of this requirement for satellite BS.   * + - System-level simulation for co-channel interference over noise floor is needed.   + Option 2: (Ericsson, Thales, Huawei, Nokia, Hughes / EchoStar)   FFS  Recommendation:  It is proposed to further clarify this in the 2nd round.  **Issue 1-3-6: ACS**   * + Option 1: (ZTE, CATT, Ericsson, Thales, Huawei, Nokia, Hughes / EchoStar)   wait for the co-existence simulation results   * + Option 2: Other, please specify.   Recommendation:  It is proposed to agree on Option 1.  **Issue 1-3-7: In-band blocking**   * + Option 1: (ZTE, CATT, Ericsson, Thales, Huawei, Nokia, Hughes / EchoStar)   Wait the co-existence simulation results   * + Option 2: Other, please specify.   Recommendation:  It is proposed to agree on Option 1.  **Issue 1-3-8: out-of-band blocking**   * + Option 1: (ZTE, CATT, Ericsson, Thales, Nokia, Hughes / EchoStar)   OOBB requirement -15dBm/CW and FOOBB need to be reevaluated for satellite BS   * + Option 2: (Huawei)   FFS.  Recommendation:  It is proposed to agree on Option 1.  **Issue 1-3-9: co-location requirement**   * + Option 1: (Ericsson, CATT, Thales, Nokia, Hughes / EchoStar)   This requirement is not needed as there is no co-location scenario for satellite BS   * + Option 2: (ZTE, Huawei)   FFS  Recommendation:  To check in the 2nd round whether Option 1 is agreeable or not.  **Issue 1-3-10: Receiver spurious emission**   * + Option 1: (ZTE, CATT, Ericsson, Thales, Huawei, Nokia, Hughes / EchoStar)   This requirement should be transposed in satellite TS.   * + Option 2: Other, please specify.   Recommendation:  It is proposed to agree option 1.  **Issue 1-3-11: Receiver intermodulation**   * + Option 1: (Ericsson, CATT, Thales, Nokia, Hughes / EchoStar )   This requirement is not needed considering the scenario of satellite BS.   * + Option 2:   The requirement framework can be reused from 38.104. interference power level rely on system simulation.   * + Option 3: (ZTE, Huawei)   FFS  Recommendation:  To check in the 2nd round whether Option 1 is agreeable or not.  **Issue 1-3-12: In-channel selectivity**   * + Option 1: (ZTE, CATT, Ericsson, Thales, Huawei, Nokia, Hughes / EchoStar)   The requirement frame work can be reused. FFS on details.   * + Option 2: Other, please specify.   Recommendation:  It is proposed to agree option 1, e.g. take the requirement in 38.104 as the starting point. |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provides recommendation on CRs/TPs Status update*

*Note: The tdoc decisions shall be provided in Section 3 and this table is optional in case moderators would like to provide additional information.*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

# Topic #2: UE aspects

*Main technical topic overview. The structure can be done based on sub-agenda basis.*

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| [**R4-2113297**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113297.zip) | Xiaomi | **Proposal 1:** **it is proposed NTN bands are arranged in descending order from n256 on a “first come first served” basis.**  **Proposal 2: above proposals in table 1for UE RF requirement shall be considered**   |  |  |  | | --- | --- | --- | | Section | Requirement | proposals | | **Tx requirements** | | | | 6.2.1 | UE maximum output power | Can be reused from n65 | | 6.2.2 | UE maximum output power reduction | Need revaluation (depends on output RF spectrum emissions requirements) | | 6.2.3 | UE additional maximum output power reduction | Need revaluation (depends on additional requirements) | | 6.2.4 | Configured transmitted power | Can be reused | | 6.3.1 | Minimum output power | Depends on system simulation results | | 6.3.2 | Transmit OFF power | Depends on system simulation results | | 6.3.3 | Transmit ON/OFF time mask | Need FFS | | 6.3.4 | Power control | Need FFS | | 6.4 | Transmit signal quality | Can be reused | | 6.5.1 | Occupied bandwidth | Can be reused | | 6.5.2 | Out of band emission (ACLR) | Depends on co-existence study | | 6.5.3 | Spurious emissions | Depends on Regulation requirements | | 6.5.4 | Transmit intermodulation | Need FFS | | **Rx requirements** | | | | 7.3 | Reference sensitivity | Need FFS (SNR depends on link level simulation) | | 7.4 | Maximum input level | Depends on link level simulation | | 7.5 | Adjacent channel selectivity | Depends on co-existence study | | 7.6 | Blocking characteristics | Need FFS | | 7.7 | Spurious response | Need FFS | | 7.8 | Intermodulation characteristics | Need FFS | |
| [**R4-2111933**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111933.zip) | CATT | |  |  | | --- | --- | | Requirements in 38.101 section 6 | Remarks | | 6.2.1 UE maximum output power | Reuse with adaption | | 6.2.2 UE maximum output power reduction  6.2.3 UE additional maximum output power reduction | FFS based on system simulation | | 6.2.4 Configured transmitted power | Reuse with adaption | | 6.3 Output power dynamics | Reuse with adaption | | 6.4 Transmit signal quality | Reused | | 6.5 Output RF spectrum emissions | reused except for ACLR | |
| [**R4-2113429**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2113429.zip) | Huawei, HiSilicon | **Proposal 1:** **RAN4 can trigger the studies for UE RF requirements assuming Power Class 3 handheld UE for satellite communication system in release 17.**  Table 1 UE Power Class for satellite communication system   |  |  |  | | --- | --- | --- | | NR  band | Class 3 (dBm) | Tolerance (dB) | | nX | 23 | ±2 |   **Proposal 2:** **It’s proposed to specify UE power class as table 1 for exemplary S-band.**  **Observation 1: there is no need to restrict the UE relative channel bandwidth for satellite communication system.**  **Observation 2:** **it can be FFS whether to specify the 64QAM and 256QAM requirements for PC3 satellite UE due to the lower UL SINR.**  **Observation 3:** **The additional maximum output power reduction framework for TN UE can be reused for satellite UE.**  **Observation 4:** **The Configured transmitted power framework for TN UE can be reused for satellite UE. The formula can be further simplified for satellite UE.**  **Observation 5:** **For Minimum output power, Transmit OFF power and Power control, the framework for TN UE can be reused for satellite UE. However, there is no need to specify transmit ON/OFF time mask due to FDD exemplary band.**  **Observation 6:** **It isn’t clear whether the UE used for satellite service can belong to Land mobile service (mobiles and base stations) in the** **Category B limits.**  **Observation 7:** **Sensitivity = -174dBm(kT) + 10\*log(RX BW) + NF + SNR +IM – diversity gain can be reused to specify the REFSENS for satellite UE.**  **Observation 8:** **the Maximum input level for satellite UE should be specified.** |
| [**R4-2111934**](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_100-e/Docs/R4-2111934.zip) | CATT | |  |  | | --- | --- | | Requirements in 38.101 section 7 | Remarks | | 7.3 Reference sensitivity | Reused | | 7.4 Maximum input level | FFS | | 7.5 Adjacent channel selectivity | FFS | | 7.6.2 In-band blocking | FFS | | 7.6.3 Out-of-band blocking | Reused | | 7.7 Spurious response | Reused | | 7.8 Intermodulation characteristics | no need to define | | 7.9 Spurious emissions | Reused | |

## Open issues summary

*Before e-Meeting, moderators shall summarize list of open issues, candidate options and possible WF (if applicable) based on companies’ contributions.*

### Sub-topic 2-1 transmitter requirements

*Sub-topic description:*

*Open issues and candidate options before e-meeting:*

**Issue 2-1-1: UE maximum output power**

* Proposals
  + Option 1: the UE power class can be defined as

|  |  |  |
| --- | --- | --- |
| NR band | Class 3 (dBm) | Tolerance (dB) |
| nX | 23 | ±2 |

* + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-1-2: UE maximum output power reduction**

* Proposals
  + Option 1: MPR, A-MPR requirements should be further evaluated after ACLR/SEM is defined.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-1-3: Configured transmitted power**

* Proposals
  + Option 1: The requirement in 38.101-1 can be reused with some parameter adaption.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-1-4: Minimum output power & transmit OFF power**

* Proposals
  + Option 1: The requirement in 38.101-1 can be reused for NTN FR1.
  + Option 2: System level simulation is needed to check whether new requirement should be defined.
  + Option 3: other, please specify.
* Recommended WF
  + TBA

**Issue 2-1-5: Transmit ON/OFF time mask**

* Proposals
  + Option 1: this requirement is not needed due to FDD operation for NTN.
  + Option 2: the requirement frame work can be reused. Further check whether some adaption is needed.
  + Option 3: other, please specify.
* Recommended WF
  + TBA

**Issue 2-1-6: Transmit modulation quality**

* Proposals
  + Option 1: this requirement can be reused for NTN UE.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-1-7: Output RF spectrum emissions**

* Proposals
  + Option 1: All the requirements except ACLR can be reused for NTN UE.
    - ACLR needs to wait the co-existence simulation.
    - Need to check whether there special regulation for SEM.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-1-8: Tx intermodulation**

* Proposals
  + Option 1: FFS whether this requirement is needed considering the NTN UE operating scenario.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

### Sub-topic 2-2 Receiver requirements

*Sub-topic description*

*Open issues and candidate options before e-meeting:*

**Issue 2-2-1: Reference sensitivity**

* Proposals
  + Option 1: The same requirement can be reused for NTN UE.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-2-2: maximum input level**

* Proposals
  + Option 1: Further evaluation is needed considering minimum CL between satellite and UE.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-2-3: ACS**

* Proposals
  + Option 1: wait the co-existence study.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-2-4: out-of band blocking**

* Proposals
  + Option 1: this requirement can be reused.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-2-5: spurious response**

* Proposals
  + Option 1: this requirement can be reused.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-2-6: intermodulation characteristics**

* Proposals
  + Option 1: FFS this requirement is needed considering the NTN UE operating scenario.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

**Issue 2-2-7: spurious emissions**

* Proposals
  + Option 1: this requirement can be reused.
  + Option 2: other, please specify.
* Recommended WF
  + TBA

## Companies views’ collection for 1st round

### Open issues

**Sub-topic 2-1 transmitter requirements**

|  |  |  |
| --- | --- | --- |
| **Company** | | **Comments** |
| CATT | | **Issue 2-1-1: UE maximum output power**  Option 1  **Issue 2-1-2: UE maximum output power reduction**  Option 1  **Issue 2-1-3: Configured transmitted power**  Option 1  **Issue 2-1-4: Minimum output power & transmit OFF power**  Either option 1 or option 2 is ok.  **Issue 2-1-5: Transmit ON/OFF time mask**  Option 2  **Issue 2-1-6: Transmit modulation quality**  Option 1  **Issue 2-1-7: Output RF spectrum emissions**  Option 1  **Issue 2-1-8: Tx intermodulation**  Option 1 |
| Ericsson | | Issue 2-1-1: option 1  Issue 2-1-2: option 1  Issue 2-1-3: option 2 for the time being: option 1 depends on the proposed adaptation?  Issue 2-1-4: option 1  Issue 2-1-5: option 2, masks apply also to FDD.  Issue 2-1-6: option 1  Issue 2-1-7: Option 2: for general spurious, we should first check if NTN UE would be a satellite device or not and then verify the corresponding limits in ERC 74-01. SEM would also need further investigation, checking also coexistence results.  Issue 2-1-8: option 1, should we consider UE might also operating in TN simultaneously? |
| THALES | | **Issue 2-1-1: UE maximum output power**  Option 1.  **Issue 2-1-2: UE maximum output power reduction**  Option 1.  **Issue 2-1-3: Configured transmitted power**  Option 1.  **Issue 2-1-4: Minimum output power & transmit OFF power**  Option 1.  **Issue 2-1-5: Transmit ON/OFF time mask**  Option 2 most probably.  **Issue 2-1-6: Transmit modulation quality**  Option 1.  **Issue 2-1-7: Output RF spectrum emissions**  Option 2. Why “except”? Even for ACLR is not sure if it can or not be reused for an NTN UE. We first need co-existence simulations.  **Issue 2-1-8: Tx intermodulation**  Option 1 |
| Huawei | | Issue 2-1-1: option 1  Issue 2-1-2: option 1  Issue 2-1-3: option 1, further discussion is needed.  Issue 2-1-4: option 1  Issue 2-1-5: More discussion is needed. Why time mask could be used for FDD UE, but FDD satellite.  Issue 2-1-6: Based on the initial simulation results, FFS whether UL 64QAM and 256QAM can be excluded at this stage.  Issue 2-1-7: It isn’t clear whether the UE used for satellite service belong to Land mobile service (mobiles and base stations) in the Category B limits.  Issue 2-1-8: option 1 |
| Qualcomm | | **Issue 2-1-1: UE maximum output power**  **Option 1**  **Issue 2-1-2: UE maximum output power reduction**  **Option 1**  **Issue 2-1-3: Configured transmitted power**  **Option 1**  **Issue 2-1-4: Minimum output power & transmit OFF power**  **Option 2**  **Issue 2-1-5: Transmit ON/OFF time mask**  **Option 2. Transmit ON/OFF time mask applies for both FDD and TDD**  **Issue 2-1-6: Transmit modulation quality**  **Option 2. Need more study on whether the TN requirements can be reused for NTN**  **Issue 2-1-7: Output RF spectrum emissions**  **Option 1**  **Issue 2-1-8: Tx intermodulation**  **Option 1** |
| Xiaomi | | **Issue 2-1-1: UE maximum output power**  **Option 1**  **Issue 2-1-2: UE maximum output power reduction**  **Option 1**  **Issue 2-1-3: Configured transmitted power**  **Option 1**  **Issue 2-1-4: Minimum output power & transmit OFF power**  **Option 2**  **Issue 2-1-5: Transmit ON/OFF time mask**  **Option 2. Transmit ON/OFF time should apply to both FDD and TDD bands**  **Issue 2-1-6: Transmit modulation quality**  **Option 1. Requirements can be reused for the same modulation scheme**  **Issue 2-1-7: Output RF spectrum emissions**  **Option 1**  **Issue 2-1-8: Tx intermodulation**  **Option 1** |
| Nokia | | Issue 2-1-1: Option 1  Issue 2-1-2: Option 1  Issue 2-1-3: Option 1  Issue 2-1-4: Option 1  Issue 2-1-5: Option 2, masks apply also to FDD.  Issue 2-1-6: Option 1  Issue 2-1-7: Option 1  Issue 2-1-8: Option 1 |
| Hughes / EchoStar | **Issue 2-1-1: UE maximum output power**  Option 1.  **Issue 2-1-2: UE maximum output power reduction**  Option 1.  **Issue 2-1-3: Configured transmitted power**  Option 1.  **Issue 2-1-4: Minimum output power & transmit OFF power**  Option 1.  **Issue 2-1-5: Transmit ON/OFF time mask**  Option 2.  **Issue 2-1-6: Transmit modulation quality**  Option 1.  **Issue 2-1-7: Output RF spectrum emissions**  Option 2. We follow THALES.  **Issue 2-1-8: Tx intermodulation**  Option 1 | |

**Sub-topic 2-2 Receiver requirements**

|  |  |  |
| --- | --- | --- |
| **Company** | | **Comments** |
| CATT | | **Issue 2-2-1: Reference sensitivity**  Option 1  **Issue 2-2-2: maximum input level**  Option 1  **Issue 2-2-3: ACS**  Option 1  **Issue 2-2-4: out-of band blocking**  Option 1. Further input from satellite operator on scenarios is also welcome!  **Issue 2-2-4: spurious response**  Option 1  **Issue 2-2-5: intermodulation characteristics**  Option 1. Input from satellite on scenarios is welcome!  **Issue 2-2-6: spurious emissions**  Option 1 |
| Ericsson | | Issue 2-2-1:Option 2. The option 1 is unclear: same requirement as what? Should we reuse n1 or n65 REFSENS, or…?  Issue 2-2-2: option1  Issue 2-2-3: option 1  Issue 2-2-4 (OOB): option 1  Issue 2-2-5: option 1, would UE operate also in TN simultaneously?  Issue 2-2-6: option 2: we need first to agree on how to consider such UE (satellite equipment or not) and check with ERC 74-01. |
| THALES | | **Issue 2-2-1: Reference sensitivity**  Option 1, if e.g. n1 or n65 TN UE.  **Issue 2-2-2: maximum input level**  Option 1.  **Issue 2-2-3: ACS**  Option 1.  **Issue 2-2-4: out-of band blocking**  Option 1.  **Issue 2-2-4: spurious response**  Option 1.  **Issue 2-2-5: intermodulation characteristics**  Option 1.  **Issue 2-2-6: spurious emissions**  Option 1. |
| Huawei | | Issue 2-2-1:Option 2. **Sensitivity = -174dBm(kT) + 10\*log(RX BW) + NF + SNR +IM – diversity gain can be reused to specify the REFSENS**  Issue 2-2-2: option1  Issue 2-2-3: option 1  Issue 2-2-4: option 1  Issue 2-2-5: option 1  Issue 2-2-6: option 1 |
| Qualcomm | | **Issue 2-2-1: Reference sensitivity**  **Option 2. Option 1 is not clear for example which band will be leveraged? In addition, we need to study the reference channel and FRC for NTN.**  **Issue 2-2-2: maximum input level**  **Option 1.**  **Issue 2-2-3: ACS**  **Option 1**  **Issue 2-2-4: out-of band blocking**  **Option 1**  **Issue 2-2-4: spurious response**  **Option 1**  **Issue 2-2-5: intermodulation characteristics**  **What does option 1 mean? need clarification.**  **Issue 2-2-6: spurious emissions**  **Option 1** |
| Xiaomi | | **Issue 2-2-1: Reference sensitivity**  **Option 2. The equation to derive the REFSENS can be reused but the parameter (such as SNR ) needs to be further check.**  **Issue 2-2-2: maximum input level**  **Option 1.**  **Issue 2-2-3: ACS**  **Option 1**  **Issue 2-2-4: out-of band blocking**  **Option 1**  **Issue 2-2-4: spurious response**  **Option 1**  **Issue 2-2-5: intermodulation characteristics**  **Option 1**  **Issue 2-2-6: spurious emissions**  **Option 1** |
| Nokia | | Issue 2-2-1: Please elaborate on option 1  Issue 2-2-2: Option1  Issue 2-2-3: Option1  Issue 2-2-4: Option 1  Issue 2-2-5: Option 1 |
| Hughes / EchoStar | **Issue 2-2-1: Reference sensitivity**  Option 1.  **Issue 2-2-2: maximum input level**  Option 1.  **Issue 2-2-3: ACS**  Option 1.  **Issue 2-2-4: out-of band blocking**  Option 1.  **Issue 2-2-4: spurious response**  Option 1.  **Issue 2-2-5: intermodulation characteristics**  Option 1.  **Issue 2-2-6: spurious emissions**  Option 1. | |

### CRs/TPs comments collection

*Major close to finalize WIs and Rel-15 maintenance, comments collections can be arranged for TPs and CRs. For Rel-16 on-going WIs, suggest to focus on open issues discussion on 1st round.*

|  |  |
| --- | --- |
| **CR/TP number** | **Comments collection** |
| XXX | Company A |
| Company B |
|  |
| YYY | Company A |
| Company B |
|  |

## Summary for 1st round

### Open issues

*Moderator tries to summarize discussion status for 1st round, list all the identified open issues and tentative agreements or candidate options and suggestion for 2nd round i.e. WF assignment.*

|  |  |
| --- | --- |
|  | **Status summary** |
| **Sub-topic#2-1** | **Issue 2-1-1: UE maximum output power**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   The UE power class can be defined as   |  |  |  | | --- | --- | --- | | NR band | Class 3 (dBm) | Tolerance (dB) | | nX | 23 | ±2 |  * + Option 2: other, please specify.   Recommendation:  It is proposed to agree option 1.  **Issue 2-1-2: UE maximum output power reduction**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   MPR, A-MPR requirements should be further evaluated after ACLR/SEM is defined.   * + Option 2: other, please specify.   Recommendation:  It is proposed to agree option 1.  **Issue 2-1-3: Configured transmitted power**   * + Option 1: (CATT, Thales, Huawei, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   The requirement in 38.101-1 can be reused with some parameter adaption.   * + Option 2: (Ericsson)   FFS  Recommendation:  It is proposed to agree that the configured transmitted power requirement in 38.101 is used as the starting point for NTN UE.  **Issue 2-1-4: Minimum output power & transmit OFF power**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Nokia, Hughes / EchoStar)   The requirement in 38.101-1 can be reused for NTN FR1.   * + Option 2: (Qualcomm, Xiaomi, )   System level simulation is needed to check whether new requirement should be defined.   * + Option 3: other, please specify.   Recommendation:  It is proposed to further discuss the following 2 options.   * + Option 1: The requirement in 38.101-1 is reused for NTN FR1.   + Option 2: the minimum output power is determined by system level simulation.   **Issue 2-1-5: Transmit ON/OFF time mask**   * + Option 1:   This requirement is not needed due to FDD operation for NTN.   * + Option 2: (CATT, Ericsson, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   The requirement frame work can be reused. Further check whether some adaption is needed.   * + Option 3: (Huawei)   FFS  Recommendation:  It is proposed to agree option 2.  **Issue 2-1-6: Transmit modulation quality**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Xiaomi, Nokia, Hughes / EchoStar)   This requirement can be reused for NTN UE.   * + Option 2: (Huawei, Qualcomm)   FFS, e.g. whether UL 64QAM and 256QAM can be excluded.  Recommendation:  It is proposed to agree the following,  The current requirement is reused for NTN UE for the same modulation scheme.   * FFS whether UL 64QAM and 256QAM should be excluded.   **Issue 2-1-7: Output RF spectrum emissions**   * + Option 1: (CATT, Thales, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   All the requirements except ACLR can be reused for NTN UE.   * + - ACLR needs to wait the co-existence simulation.     - Need to check whether there special regulation for SEM.   + Option 2: (Ericsson)   For general spurious, we should first check if NTN UE would be a satellite device or not and then verify the corresponding limits in ERC 74-01. SEM would also need further investigation, checking also coexistence results.   * + Option 3: (Thales, Hughes/EchoStar)   FFS  Recommendation:  It is proposed to agree the following,   * Wait co-existence simulation results to determine SEM/ACLR * Further check if NTN UE would be a satellite device or not and the compliance to DRC 74-01.   **Issue 2-1-8: Tx intermodulation**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   FFS whether this requirement is needed considering the NTN UE operating scenario.   * + Option 2: other, please specify.   Recommendation:  It is proposed to agree on Option 1. |

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| --- | --- |
|  | **Status summary** |
| **Sub-topic#2-2** | **Issue 2-2-1: Reference sensitivity**   * + Option 1: (Hughes / EchoStar)   The same requirement can be reused for NTN UE.   * + Option 2: (Ericsson, Qualcomm, Xiaomi, CATT, Nokia)   FFS on which band requirement to be reused, the FRC, SNR etc….   * + Option 3: (Huawei)   Sensitivity = -174dBm(kT) + 10\*log(RX BW) + NF + SNR +IM – diversity gain can be reused to specify the REFSENS  Recommendation:  It is proposed to further check whether Option 2 and Option 3 can be agreeable in the second round.  **Issue 2-2-2: maximum input level**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   Further evaluation is needed considering minimum CL between satellite and UE.   * + Option 2: other, please specify.   Recommendation:  It is proposed to agree Option 1.  **Issue 2-2-3: ACS**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   Wait the co-existence study.   * + Option 2: other, please specify.   Recommendation:  It is proposed to agree Option 1.  **Issue 2-2-4: out-of band blocking**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   This requirement can be reused.   * + Option 2: other, please specify.   Recommendation:  It is proposed to agree Option 1.  **Issue 2-2-5: spurious response**   * + Option 1: (CATT, Ericsson, Thales, Huawei, Qualcomm, Xiaomi, Nokia, Hughes / EchoStar)   This requirement can be reused.   * + Option 2: other, please specify.   Recommendation:  It is proposed to agree Option 1.  **Issue 2-2-6: intermodulation characteristics**   * + Option 1: (CATT, Thales, Huawei, Xiaomi, Hughes / EchoStar)   FFS this requirement is needed considering the NTN UE operating scenario.   * + Option 2: other, please specify.   Ericsson asked a question, would UE operate also in TN simultaneously?  Qualcomm asked for clarification on option 1.  Recommendation:  It is proposed to further discuss this issue in the 2nd round.  **Issue 2-2-7: spurious emissions**   * + Option 1: (CATT, Thales, Huawei, Qualcomm, Xiaomi, Hughes / EchoStar)   This requirement can be reused.   * + Option 2: (Ericsson)   Need to check how to consider such UE (satellite equipment or not) and check with ERC 74-01.  Recommendation:  It is proposed to agree the following,   * Use the 38.101-1 requirement as the starting point. * Further check whether NTN UE would be a satellite device and the compliance to ERC 74-01. |

### CRs/TPs

*Moderator tries to summarize discussion status for 1st round and provided recommendation on CRs/TPs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP number** | **CRs/TPs Status update recommendation** |
| XXX | *Based on 1st round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

## Discussion on 2nd round (if applicable)

*Moderator can provide summary of 2nd round here. Note that recommended decisions on tdocs should be provided in the section titled ”Recommendations for Tdocs”.*

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
| WF on NTN BS RF requirement | CATT… |  |
| WF on NTN UE RF requirement | Huawei… |  |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
|  |  |  |  |  |
|  |  |  |  |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics incl. existing and new tdocs.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. For new LS documents, please include information on To/Cc WGs in the comments column
4. Do not include hyper-links in the documents

## 2nd round

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
| R4-210xxxx | CR on … | XXX | Agreeable, Revised, Merged, Postponed, Not Pursued |  |
| R4-210xxxx | WF on … | YYY | Agreeable, Revised, Noted |  |
| R4-210xxxx | LS on … | ZZZ | Agreeable, Revised, Noted |  |
|  |  |  |  |  |

Notes:

1. Please include the summary of recommendations for all tdocs across all sub-topics.
2. For the Recommendation column please include one of the following:
   1. CRs/TPs: Agreeable, Revised, Merged, Postponed, Not Pursued
   2. Other documents: Agreeable, Revised, Noted
3. Do not include hyper-links in the documents

# Annex

Contact information

|  |  |  |
| --- | --- | --- |
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|  |  |  |

Note:

1. Please add your contact information in above table once you make comments on this email thread.
2. If multiple delegates from the same company make comments on single email thread, please add you name as suffix after company name when make comments i.e. Company A (XX, XX)