3GPP TSG-RAN WG4 Meeting # 104-e R4-22xxxxx

Electronic Meeting, August 15 – August 26, 2022

**Agenda item:** 11.12.5

**Source:** Moderator (CMCC)

**Title:** Email discussion summary for [104-e][136] NR\_ATG

**Document for:** Information

# Introduction

RAN#96 meeting approved RP-221369 [1] Revised WID on Air-to-ground network for NR in Rel-18.

This email discussion includes contributions in agenda 11.12,1, 11.12.2, 11.12,3 and 11.12.5, the targets of email discussion based on companies’ contributions submitted in this e-meeting:

* + Topic #1: General and work plan
  + Topic #2: FR1 co-existence evaluation for ATG network
  + Topic #3: Identification of UE and BS RF core requirements

# Topic #1: General and work plan

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

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2211952](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211952.zip)** | CMCC | RAN#96 meeting approved RP-221369 [1] Revised WID on Air-to-ground network for NR in Rel-18. A TR should be created for ATG Rel-18 NR WI. |
| **[R4-2211953](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211953.zip)** | CMCC | RAN#96 meeting approved RP-221369 [1] Revised WID on Air-to-ground network for NR in Rel-18. It is proposed to agree on the work plan for ATG. |

## 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 ATG work plan and TR skeleton

**Issue 1-1-1: ATG work plan**

* Proposals

|  |  |  |  |
| --- | --- | --- | --- |
| **WG** | **Meeting Number** | **TU** | **Task** |
| RAN4 | #104 | Core RF  0,5 | * Agreement on TR 38.876 skeleton. * Agreement on ATG work plan. * Discussion on the example bands relevant for ATG * Initial discussion on ATG BS and ATG CPE RF core requirements for ATG * Initial discussion how to Perform FR1 co-existence evaluation for ATG network |
| Core RD  0.5 | * Start the discussion on the RRM core requirements for ATG;   + Identify the differences between ATG and fully ground based systems |
| RAN4 | #104bis | Core RF  1 | * Define the ATG bands and the simulation frequency band * Focus on ATG co-existence simulation parameters and scenarios * Discussion key characteristics where it is necessary to differentiate ATG ground-based BS and UEs from conventional ground based BS and UEs |
| Core RD  0.5 | * Further discuss the RRM core requirements for ATG   + Identify and discuss the requirements which different from ground-based systems |
| RAN4 | #105 | Core RF  1 | * Agree on the use cases and scenarios * Define the ATG co-existence simulation parameters and conditions * Further discussion key characteristics where it is necessary to differentiate ATG ground-based BS and UEs from conventional ground based BS and UEs |
| Core RD  0.5 | * Further discuss the RRM core requirements for ATG   + Further discuss the ATG RRM core requirements   + Agree the requirements framework |
| RAN4 | #106 | Core RF  0.5 | * Discussion the results of coexistence simulation * Identify key characteristics where it is necessary to differentiate ATG ground-based BS and UEs from conventional ground based BS and UEs |
| Core RD  0.5 | * Further discuss the RRM core requirements for ATG * Discussion on CR work split |
| Perf  RD  0.5 | * For Demod perf   + Discuss the test case list and test parameters for UE demod and BS demod   + Discuss the simulation assumption |
| RAN4 | #106bis | Core RF  0.5 | * Further discussion the results of coexistence simulation * Discussion on ATG BS and ATG CPE RF core requirements for ATG |
| Core RD 0.5 | * Further discuss the RRM core requirements for ATG * Start drafting CRs provided there is sufficient progress |
| Perf  RD  0.25 | * For RRM perf   + Discuss RRM test cases and related parameters (if needed) * For Demod perf   + Decide the test case list, further discuss the test parameters for UE demod and BS demod   + Decide the simulation assumption |
| RAN4 | #107 | Core RF 0.25 | * Agree on the results of coexistence simulation * Further discussion on ATG BS and ATG CPE RF core requirements for ATG |
| Core RD 0.25 | * Address all remaining issues * Agree the RRM core requirements for ATG * Further drafting CRs based on progress |
| Perf  RD  0.5 | * For RRM perf   + Decide the test case list, further discuss RRM test case related parameters (if needed) * For Demod perf   + Further discuss the test parameters for UE demod and BS demod   + Simulation results collection |
| RAN4 | #108 | Core RF  1 | * Discussion on the core requirements for coexistence between ATG and IMT terrestrial network * Further discussion on ATG BS RF core requirements * Further discussion on ATG CPE RF core requirements |
| Core RD 0.25 | * Endorse CRs |
| Perf  RD  0.25 | * For RRM perf   + Further discuss RRM test case related parameters and test requirements (if needed)   + Discussion on CR work split * For Demod perf   + Further discuss the test parameters and test setups for UE demod and BS demod   + Simulation results collection   + Discussion on CR work split |
| RAN4 | #108bis | Core RF  1 | * Agree on the core requirements for coexistence between ATG and IMT terrestrial network * Agree on the RF requirements for ATG CPE * Agree on the RF requirements for ATG BS * Drafting CRs |
| Pref  RF  0.5 | * Drafting CRs |
| Pref  RD  0.5 | * For RRM perf   + Further discuss remaining issues   + Provide draft CRs * For Demod perf   + Further discuss the test parameters for UE demod and BS demod   + Simulation results collection   + Provide draft CRs |
| RAN4 | #109 | Core RF  1 | * Agree on ATG specific requirements * Endorse CRs |
| Pref  RF  0.5 | * Drafting CRs |
| Pref  RD  0.5 | * For RRM perf   + Address all remaining issues   + Endorse draft CRs * For Demod perf   + Address all remaining issues   + Simulation results collection   + Endorse draft CRs |
| RAN4 | #110 | Pref  RF  0.25 | * Endorse CRs |
| Pref  RD  0.5 | * Endorse CRs |

* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 1-1-2: TR skeleton**

* Proposal as R4-2211952
* Recommended WF
  + TBA. Collect companies’ view in 1st round

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Issue 1-1-1: Agree with the work plan.  Issue 1-1-2: Agree with the TR skeleton.  ….  Others: |
| ZTE | Issue 1-1-1:  the work plan is fine for us and RRM part should be also discussed in the RRM session.  Issue 1-1-2:  Agree with the TR skeleton. |

### 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** |
|  | 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#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #2: FR1 co-existence evaluation for ATG network

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **R4-2211712** | CATT | **Proposal 1: For the co-existence study, the ATG deployment is assumed to be deployed for in a large area as Figure 1(b) not just at airline routes.**  **Proposal 2: For adjacent channel co-existence simulation, the ATG system co-existence with NR system should be taken as high priority.**  **Proposal 3: RAN4 should discuss and decide if ATG co-existence with ATG simulation is needed.**  **Proposal 4: 2 GHz is used as the frequency of ATG adjacent channel co-existence study.**  **Proposal 5: The Rural, Urban macro scenarios of NR system can be taken as high priority. Dense Urban may not be needed or can be in low priority.**  **Observation 1: The methodology of studying of co-channel deployment ATG and terrestrial networks in 4.8 GHz needs more discussion.**  **Proposal 6: The layout of Figure 2 can be considered as the layout of co-existence between ATG and NR.**  **Proposal 7: For the co-existence of ATG and ATG, 7 ATG sites can be assumed as a cluster of ATG cells like HAPS. How many clusters and what’s the layout of the clusters can be discussed further.**  **Observation 2: TN BS AAS antenna parameters can be the starting point for the ATG BS antenna parameters. For ATG UE antenna parameters, they’re different with the TN UE. More discussion is needed.** |
| **R4-2211916** | Apple | **Proposal 1: The following interference scenarios need to be evaluated for ATG deployment in the TN bands.**  **Scenario 1:** ATG UE to TN gNB  **Scenario 2:** ATG gNB to TN UE  **Scenario 3:** ATG UE to TN UE  **Scenario 4:** ATG gNB to TN gNB  **Proposal 2: The ATG network should be distinguished from TN network to enable/disable specific type of UE access.** |
| **R4-2212315** | CMCC | **Proposal 1: at first phase, focus on the scenarios that ATG and TN systems are synchronization operation.**  **Proposal 2: co-existence interference scenarios are suggested as in table 1.**  **Proposal 3: TN gNB simulation assumptions are suggested as in table 2-4. gNB output power and antenna pattern could refer to the same value as in TR 38.863 for AAS gNB.**  **Proposal 4: TN UE simulation assumptions are suggested as in table 5.** |
| **R4-2212383** | LG Electronics UK | * + ***Proposal 1***: A down-selection of coexistence ATG/TN scenarios is needed and RAN4 needs to evaluate the worst case scenario first. In ATG coexistence evaluation, scenarios are can be determined by combination of followings.     - (ATG - ATG coexistence) and (ATG - TN coexistence)     - FDD and TDD     - TN deployment type (Urban, rural, indoor)     - ATG UE altitude (7~13km) and antenna type. (Beam footprint size)   + ***Proposal 2. RAN4 needs to study impact of ATG BS and TN BS co-located (or combined) case.*** |
| **R4-2212616** | Ericsson | **Proposal 1: Assume that the ATG BS are specific infrastructure for ATG and that their antenna installation is optimized for serving distant aircraft.**  **Proposal 2: RAN4 to clarify whether ATG BS can be co-located with TN BS.**  **Proposal 3: RAN4 clarify an assumption on the density of aircraft within the simulation area.**  **Proposal 4: Determine the ATG BS ISD and number of beams per BS considering the capacity that needs to be provided to aircraft as well as coverage.**  **Proposal 5: For commercial aircraft flight, RAN4 should clarify the range of altitudes that are applicable, and whether take-off, approach and landing are considered.**  **Proposal 6: RAN4 should discuss whether to consider other scenarios with lower altitude and speed (in addition to commercial aircraft) when setting requirements.**  **Proposal 7: Clarify whether ATG BS are deployed in dense urban or sub-urban locations or are deployed in rural locations.**  **Proposal 8: RAN4 should clarify the impacts of the aircraft environment on the possibilities for UE array geometry, output power, radome etc.**  **Proposal 9: RAN4 to discuss whether in some circumstances, in particular for output power, the ATG UE requirements should be more similar to BS requirements than other UE power classes.**  **Proposal 10: RAN4 to clarify whether scenarios with DC and possibly beams to more than one ATG BS could be relevant.**  **Proposal 11: RAN4 clarify whether pre-compensation of time and Doppler by the UE can be assumed and if so, how it is achieved.**  **Proposal 12: RAN4 should discuss and confirm whether there are any BS-BS interference issues due to the large ISD**  **Proposal 13: RAN4 should discuss and confirm whether there can be any UE-UE interference scenarios due to aircraft in proximity to one another being connected to BS at different distances**  **Proposal 14: RAN4 should discuss and confirm whether remote interference scenarios at distant ground locations due to atmospheric effects can occur.**  **Proposal 15: For DL ATG to TN co-existence analysis, in addition to average impacts to the whole terrestrial network, also examine the impact to TN cells that are in the area immediately around ATG BS.**  **Proposal 16: For UL ATG to TN co-existence analysis, clarify the assumptions on the aircraft UE beamforming capability and power in order to consider how to define a realistic simulation scenario**  **Proposal 17: For DL TN to ATG co-existence analysis, clarify the assumptions on the aircraft UE beamforming capability in order to consider how to define realistic simulations.**  **Proposal 18: For UL TN to ATG co-existence analysis, consider whether the simulation can be simplified by only modelling TN cells that are within a certain area around the ATG BS.** |
| **R4-2212617** | Ericsson | **Observation 1: For n78 DL, unless the aircraft is always close to the BS, the UE needs to have a similar sensitivity and array size to the BS in order to achieve the range cited in the WID.**  **Observation 2: More consideration on the impact of mounting of the UE on the fuselage is needed, as this could significantly impact the link budget.**  **Observation 3: For n1 DL, the UE needs to have a BS like antenna gain and sensitivity, and likely needs some degree of beam steering capability in order to achieve the range cited in the WID.** |
| **R4-2213158** | Huawei, HiSilicon | **Proposal 1: it’s assumed that aircraft cruising altitude is about 10~15km when we design network layout for ATG scenario.**  **Proposal 2: In order to cover a big enough area, +/-60 degrees horizontal coverage range and 55 ~ 80 degrees vertical coverage range with 22.5 degrees mechanical up tilt angle can be assumed for ATG network layout.**  **Observation 1: If the 60m height of ATG BS and 150km maximum coverage range can be assumed, the minimum flight height of airplane is about 1km. There is no need to consider the curvature’s impact of earth.**  **Proposal 3: to adopt table 2 AAS** **antenna parameters as the assumption for 4.9GHz Macro ATG.**  **Proposal 4: free space path loss model and LOS can be assumed for ATG scenario between ATG BS and airplane. FFS** **whether shadow fading should be considered.**  **Proposal 5: For uplink scenario, TPC model specified in Section 9.1 TR 36.942 is applied with following parameters.**  **- CLx-ile = 88 + 10\*log10(200/X) + 11 – Y, where X is UL transmission BW (MHz) and Y is the BS noise figure**  **- γ = 1** |
| **R4-2213186** | Qualcomm Incorporated | **Observation 1: The ATG system characteristics haven’t been discussed in 3GPP, therefore, the ATG topology and the system characteristics should be firstly discussed for the coexistence.**  **Observation 2: the example band n1 is adjacent to the NTN band n256. The interference between ATG and NTN can be neglected considering the high propagation loss and the low antenna gain on the interference signal direction.**  **Proposal 1: No need to consider the coexistence study between ATG and NTN in this WI.**  **Proposal 2: To consider the coexistence scenarios between ATG and conventional terrestrial network summarized in Table 3.**  **Proposal 3: The coexistence topology illustrated in Figure 1 and Figure 2 are proposed for initial discussion. The methodology for aggregated interference calculation should be further discussed.** |
| **R4-2213686** | ZTE Corporation | **Proposal 1**: to consider the coexistence scenario in Table 2.1-1 and proposed frequency and bandwidth configuration in Table 2.1-2 for ATG coexistence study.  **Proposal 2**: to use the simulation assumptions in this contribution as baseline for further coexistence study. |

## 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 General issues

**Issue 2-1-1: whether the following assumptions can be agreeable or not.**

**“*Assume that the ATG BS are specific infrastructure for ATG and that their antenna installation is optimized for serving distant aircraft*.”**

**“*The ATG network should be distinguished from TN network to enable/disable specific type of UE access*”**

* Proposals
  + Option 1: Yes.
  + Option 2: No, please comment.
  + Option 3: Others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-1-2: whether ATG BS can be co-located with TN BS**

* Proposals
  + Option 1: Yes, RAN4 needs to study impact of ATG BS and TN BS co-located (or combined) case.
  + Option 2: No, it isn’t allowed to deploy ATG BS which can be co-located with TN BS
  + Option 3: Others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-1-3: It’s proposed to clarify an assumption on the density of aircraft within the simulation area.**

* Proposals
  + Option 1: Please provide your assumption
  + Option 2: FFS.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-1-4: How can RAN4 determine the ATG BS ISD and number of beams per BS?**

* Proposals
  + Option 1: considering the capacity that needs to be provided to aircraft as well as coverage
  + Option 2: coverage.
  + Option 3: Others.
* Recommended WF
  + The specific method and assumptions with details should be provided for working group to further determine the ATG BS ISD and number of beams per BS.

**Issue 2-1-5: For commercial aircraft flight, RAN4 should clarify the range of altitudes that are applicable, and whether take-off, approach and landing are considered.**

* Proposals
  + Option 1: ATG UE altitude (7~13km)
  + Option 2: >10,000m.
  + Option 3: >10,000 ft. (1 feet = 0.3048 meters)
  + Option 4: it’s assumed that aircraft cruising altitude is about 10~15km when we design network layout for ATG scenario.
  + Option 5: ATG CPE altitude 7km, 12 Km
  + Option 6, others.
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-1-6: whether to consider other scenarios with lower altitude and speed (in addition to commercial aircraft) when setting requirements, e.g. helicopters.**

* Proposals
  + Option 1: Yes, we need to consider this case
  + Option 2: No, we don’t consider this case.
* Recommended WF
  + TBA.

### Sub-topic 2-2 The outline for ATG co-existence study

**Issue 2-2-1: whether the following outline can be a starting point for ATG co-existence study.**

1. **Co-existence simulation scenario**
2. **Co-existence simulation assumption**
   1. **Network layout model**
      1. **Co-existence between ATG and NR terrestrial network**
      2. **Co-existence between ATG and ATG (*Moderator’s note: It depends on whether ATG co-existence with ATG will be simulated*)**
   2. **System parameters**
      1. **ATG parameters**
      2. **ATG UE parameters**
      3. **TN BS and UE parameters**
   3. **Antenna and beamforming pattern modelling**
      1. **ATG BS antenna model**
      2. **ATG UE antenna model**
      3. **TN BS antenna model**
      4. **TN UE antenna model**
   4. **ACLR and ACS modelling**
   5. **Propagation model**
      1. **Propagation model between ATG BS and ATG UE**
      2. **Propagation model between TN BS and TN UE**
      3. **Propagation model between ATG BS and TN BS**
      4. **Propagation model between ATG BS and TN UE**
      5. **Propagation model between TN BS and ATG UE**
      6. **Propagation model between TN UE and ATG UE**
   6. **Transmission power control model**
      1. **TN UL TPC**
      2. **TN DL TPC**
      3. **ATG UL TPC**
      4. **ATG DL TPC**
   7. **Received power model**
   8. **Performance metric**
   9. **Link level performance for NR ATG coexistence**
3. **Co-existence simulation methodology**
4. **Co-existence simulation results**

* Proposals
  + Option 1: Yes.
  + Option 2: No, please comment.
  + Option 3: Others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-2-2: Is the co-existence scenario adjacent channel only or both adjacent channel and co-channel ?**

* Proposals
  + Option 1: Adjacent channel only
  + Option 2: Adjacent channel and co-channel (please then justify why to do co-channel simulaitonsi n RAN4)
  + Option 3: Others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

### Sub-topic 2-3 Co-existence simulation scenario

**Issue 2-3-1: Whether the following outline can be a starting point for ATG co-existence simulation scenario. (*Moderator’s note: the highlighted contents will be further discussed in the following issues and should not be concluded in this issue.*)**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| No. | Combination | Aggressor | | Victim | | Simulation frequency | Notes | Study Phase |
| deployment scenario  UL/DL | CBW  duplex mode | deployment scenario  UL/DL | CBW  duplex mode |
| 1 | TN with ATG  ATG with ATG | ATG  DL/UL | 20MHz/ 100MHz  FDD/TDD | TN rural/sub-urban  DL/UL | 20MHz/100MHz  FDD/TDD | 4.9 GHz  3.5 GHz  2.1GHz |  | Phase 1  Phase 2 |
|  |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |

* Proposals
  + Option 1: Yes.
  + Option 2: No, please comment.
  + Option 3: Others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-3-2: Which scenario combination(s) can be assumed in the following options.**

* Proposals
  + Option 1: TN with ATG.
  + Option 2: ATG with ATG.
    - Option 2A: phase 1.
    - Option 2B: phase 2
    - Option 2C: No need to consider this scenario
  + Option 3: ATG and NTN (QC proposed not to consider this scenario)
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-3-3: Which deployment scenario(s) for TN network can be assumed in the following options.**

* Proposals
  + Option 1: Rural.
  + Option 2: Sub-urban
  + Option 3: Dense urban
  + Option 4: Indoor
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-3-4: Which Simulation frequencie(s) can be assumed in the following options.**

* Proposals
  + Option 1: 4.9 GHz.
  + Option 2: 3.5 GHz
  + Option 3: 2.1GHz
  + Option 4: 2GHz
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-3-5: Which channel bandwdith(s) can be assumed in the following options for both ATG and TN.**

* Proposals
  + Option 1: 100MHz.
  + Option 2: 20MHz
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-3-7: Which duplex mode(s) can be assumed in the following options** **for ATG**

* Proposals
  + Option 1: TDD.
  + Option 2: FDD
  + Option 3: FDD and TDD
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-3-8:Which direction(s) can be assumed.**

* Proposals

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **No.** | **Combination** | **Aggressor** | **Victim** | **Notes** | **Study Phase** |
| 1 | TN with ATG | ATG DL | TN DL | Applicable for ATG and TN network operating in band n1, n78 and n79. |  |
| 2 | TN with ATG | ATG UL | TN UL | Applicable for ATG and TN network operating in band n1, n78 and n79. |  |
| 3 | TN with ATG | TN DL | ATG DL | Applicable for ATG and TN network operating in band n1, n78 and n79. |  |
| 4 | TN with ATG | TN UL | ATG UL | Applicable for ATG and TN network operating in band n1, n78 and n79. |  |
| 5 | TN with ATG | ATG UL | TN DL | Applicable for band n1 when co-exist with band n39 | Further check ACLR and ACS derived from case 1- 4 could still be applicable or not. |
| 6 | TN with ATG | TN DL | ATG UL | Applicable for band n39 when co-exist with band n1 | Further check ACLR and ACS derived from case 1- 4 could still be applicable or not. |
| 7 | TN with ATG | TN UL | ATG DL | Applicable for ATG and TN network operating in band n78 and n79 for non-synchronization operation | Further check ACLR and ACS derived from case 1- 4 could still be applicable or not. |
| 8 | TN with ATG | ATG DL | TN UL | Applicable for ATG and TN network operating in band n78 and n79 for non-synchronization operation | Further check ACLR and ACS derived from case 1- 4 could still be applicable or not. |
| 9 | ATG with ATG | ATG DL | ATG DL |  |  |
| 10 | ATG with ATG | ATG UL | ATG UL |  |  |

* Recommended WF
  + TBA. Collect companies’ view in 1st round

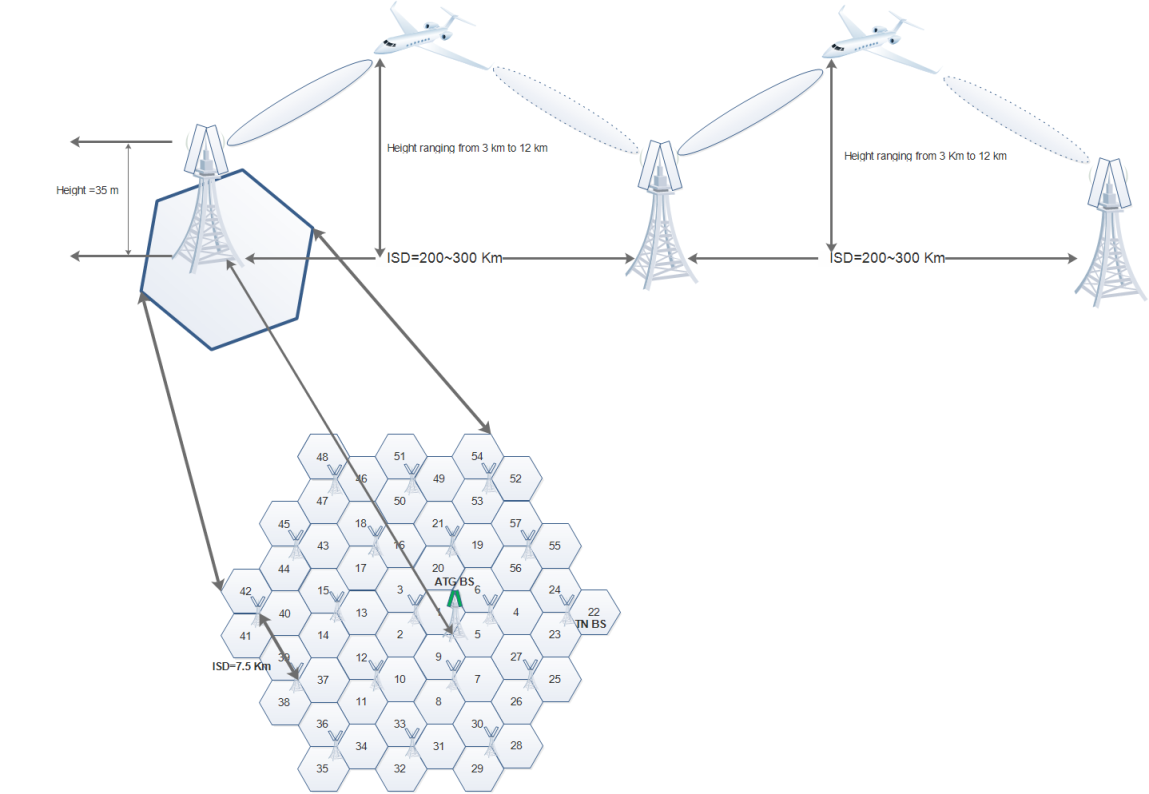
### Sub-topic 2-4 Co-existence network layout

**Issue 2-4-1: Potential assumption for network layout of ATG.**

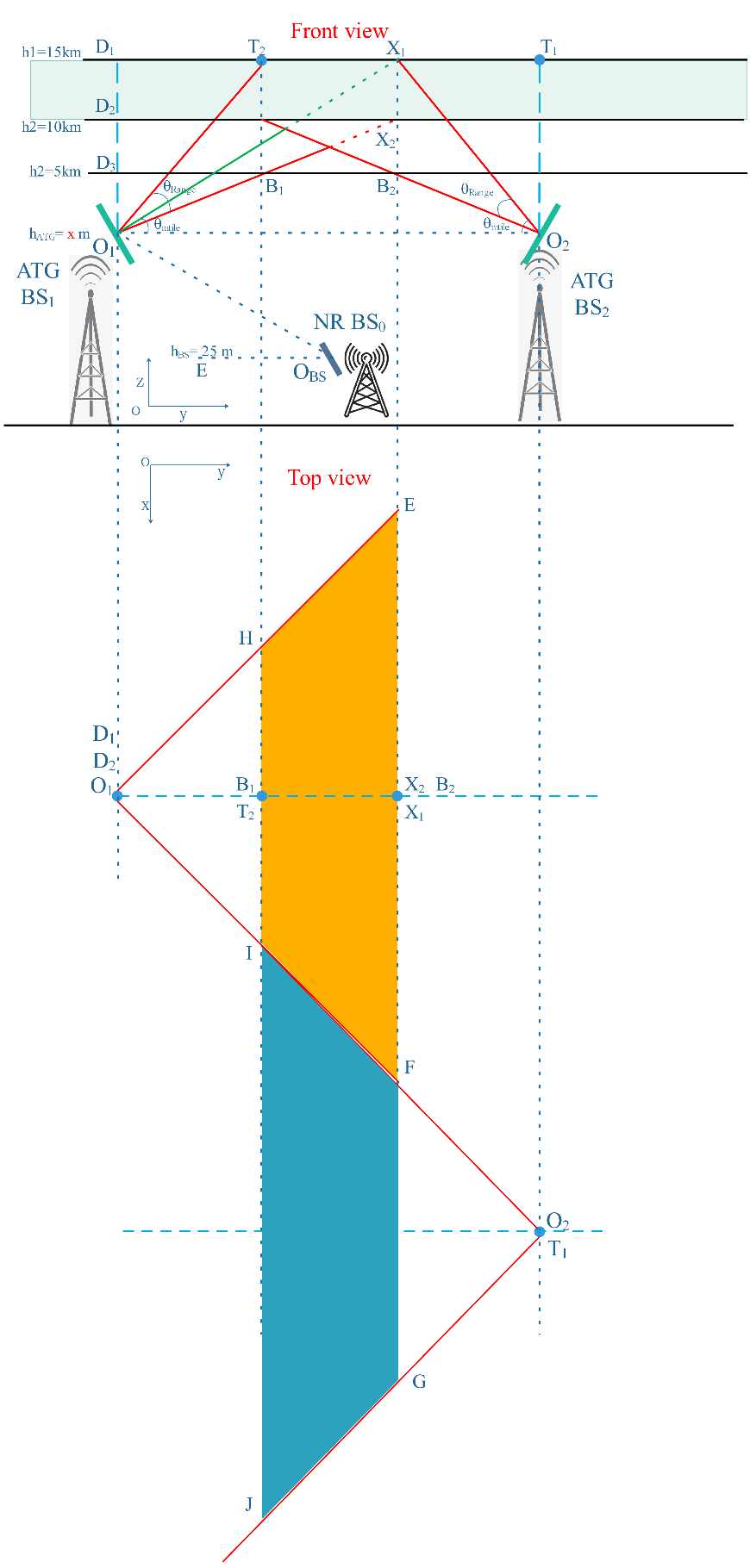
* Proposals
  + Option 1: ATG network can be deployed on the airline routes.
    - 
  + Option 2: ATG network can be deployed in larger area



* + Option 3: ATG network coexisting with terrestrial network [Rural area]



* + Option 4:



* + Option 5: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-4-2: The assumption for network layout of NR terrestrial network.**

* Proposals
  + Option 1: 19-sites 57 sectors with wrap-around.
  + Option 2: A cluster of TN cells is randomly dropped in the ATG coverage area’s projection to the ground.
  + Option 3: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-4-3: The assumption for network layout between ATG and between.**

* Proposals
  + Option 1: For the co-existence of ATG and ATG, 7 ATG sites can be assumed as a cluster of ATG cells like HAPS. How many clusters and what’s the layout of the clusters can be discussed further.
  + Option 2: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

### Sub-topic 2-5 Co-existence system parameters

**Issue 2-5-1: The initial system parameters outline for ATG BS.**

|  |  |
| --- | --- |
| ATG BS altitude |  |
| Carrier frequency |  |
| Frequency reuse factor |  |
| Duplex mode |  |
| Channel bandwidth |  |
| Subcarrier spacing (SCS) |  |
| Number of cells |  |
| Environment1 |  |
| UE distribution |  |
| Indoor UE percentage |  |
| Number of DL active UEs per cell (NOTE 2) |  |
| Number of UL active UEs per cell  (NOTE 2) |  |
| DL scheduled bandwidth per UE |  |
| UL scheduled bandwidth per UE |  |
| Traffic model |  |
| ATG BS maximum output power |  |
| ATG BS noise figure |  |
| Handover margin |  |
| NOTE 1: ATG BS is assumed to serve UEs in the rural environment.  NOTE 2: Same as the number of BS beam(s);  NOTE 3: ATG BS max TX power is defined per polarization | |

* Proposals
  + Option 1: Please provide comments.
  + Option 2: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-5-2: The initial system parameters outline for ATG UE.**

|  |  |
| --- | --- |
| ATG UE altitude |  |
| Carrier frequency |  |
| ATG UE max TX power in dBm |  |
| ATG UE min TX power in dBm |  |
| ATG UE noise figure |  |

* Proposals
  + Option 1: Please provide comments.
  + Option 2: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-5-3: The initial system parameters outline for TN BS and TN UE.**

|  |  |  |  |
| --- | --- | --- | --- |
| Parameters |  |  |  |
| Carrier frequency |  |  |  |
| Channel bandwidth |  |  |  |
| Scheduled channel bandwidth per UE (DL) |  |  |  |
| Scheduled channel bandwidth per UE (UL) |  |  |  |
| The number of active UE (DL) (Note 1) |  |  |  |
| The number of active UE (UL) (Note 1) |  |  |  |
| Traffic model |  |  |  |
| DL power control |  |  |  |
| UL power control |  |  |  |
| TN BS-UE min distance in meters |  |  |  |
| TN BS max TX power in dBm |  |  |  |
| TN UE max TX power in dBm |  |  |  |
| TN UE min TX power in dBm |  |  |  |
| TN BS Noise figure in dB |  |  |  |
| TN UE Noise figure in dB |  |  |  |
| Handover margin |  |  |  |
| Note 1 Same as the number of BS beam(s);  Note 2: TN BS max TX power is defined per polarization | | | |

* Proposals
  + Option 1: Please provide comments.
  + Option 2: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

### Sub-topic 2-6 Antenna and beamforming pattern modelling

**Issue 2-6-1: Please discuss the initial Antenna and beamforming pattern modelling outline for ATG BS.**

|  |  |  |
| --- | --- | --- |
|  |  | ATG |
| 1 | Base Station Antenna Characteristics | |
| 1.1 | Antenna pattern |  |
| 1.2 | Element gain (dBi) (Note 2) |  |
| 1.3 | Horizontal/vertical 3 dB beam width of single element (degree) |  |
| 1.4 | Horizontal/vertical front‑to‑back ratio (dB) |  |
| 1.5 | Antenna polarization |  |
| 1.6 | Antenna array configuration (Row × Column)  (Note 4) |  |
| 1.7 | Number of supported polarizations, *P* |  |
| 1.8 | Horizontal/Vertical radiating element spacing |  |
| 1.9 | Array Ohmic loss (dB) (Note 2) |  |
| 1.10 | Conducted power (before Ohmic loss) per antenna element (dBm) (Note 3) |  |
| 1.11 | Base station maximum coverage angle in the horizontal plane (degrees) |  |
| 1.12 | Base station vertical coverage range (degrees) (Note 1) |  |
| 1.13 | Mechanical uptilt (degrees) |  |

Note 1: The vertical coverage range is given for the elevation angle θ, defined between 0° and 180° as   
in [ITU-R M.2101](https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2101-0-201702-I!!PDF-E.pdf).

Note 2: The element gain in row 1.2 includes the loss given in row 1.9.

Note 3: The conducted power per element assumes Row × Column ×Number of supported polarizations elements (i.e. power per H/V polarized element).

Note 4: Row × Column means there are Row vertical and Column horizontal radiating elements.

* Proposals
  + Option 1: Please provide comments.
  + Option 2: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-6-2: Please discuss the initial Antenna and beamforming pattern modelling outline for ATG UE.**

* Proposals
  + Option 1: Omni antenna assumption.
  + Option 2: ATG UE has beamforming capability
  + Option 3: 4T4R CPE mounted in the aircraft

|  |  |
| --- | --- |
| Parameter | Values |
| Antenna element vertical radiation pattern (dB) |  |
| Antenna element horizontal radiation pattern (dB) |  |
| Combining method for 3D antenna element pattern (dB) |  |
| Maximum directional gain of an antenna element *GE,max* | 5 dBi |
| Peak gain normalized element radiation pattern |  |
| Composite array radiation pattern | , where |
| (Mg, Ng, M, N, P) | (1, 1, 2, 2, 1) |
| (dv, dh) | (0.5λ, 0.5λ) |
| *LE* (dB) | 2.0 dB |
| UE orientation | UE orientation is perpendicular to the ground |
| Note 1: MxN means there are M vertical and N horizontal elements  Note 2: LE is included in GE,max. | |

* + Option 4: antenna array assumption for ATG UE at 3.5GHz and 4.9GHz

|  |  |  |
| --- | --- | --- |
| 1.3 | Horizontal/vertical 3 dB beam width of single element (degree) | 90º for H  [54º] for V /[60-70] |
| 1.4 | Horizontal/vertical front‑to‑back ratio (dB) | 30dBc |
| 1.5 | Antenna polarization | Linear ±90º |
| 1.6 | Antenna array configuration (Row × Column)  (Note 4) | (8x2x2) or  (16x1x2) |
| 1.7 | Horizontal/Vertical radiating element spacing | 0.5 of wavelength for H, 0.5 of wavelength for V |

* + Option 5: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-6-3: Whether we need to consider both AAS BS and non-AAS BS**

* + Option 1: consider both AAS BS and non-AAS BS.
  + Option 2: only consider AAS BS
  + Option 3: others

**Issue 2-6-4: Please discuss the initial Antenna and beamforming pattern modelling outline for TN AAS BS**

|  |  |  |
| --- | --- | --- |
|  |  | Rural/sub-urban….. |
| 1 | Base Station Antenna Characteristics | |
| 1.1 | Antenna pattern |  |
| 1.2 | Element gain (dBi) (Note 2) |  |
| 1.3 | Horizontal/vertical 3 dB beam width of single element (degree) |  |
| 1.4 | Horizontal/vertical front‑to‑back ratio (dB) |  |
| 1.5 | Antenna polarization |  |
| 1.6 | Antenna array configuration (Row × Column)  (Note 4) |  |
| 1.7 | Number of supported polarizations, *P* |  |
| 1.8 | Horizontal/Vertical radiating element spacing |  |
| 1.9 | Array Ohmic loss (dB) (Note 2) |  |
| 1.10 | Conducted power (before Ohmic loss) per antenna element (dBm) (Note 3) |  |
| 1.11 | Base station maximum coverage angle in the horizontal plane (degrees) |  |
| 1.12 | Base station vertical coverage range (degrees) (Note 1) |  |
| 1.13 | Mechanical downtilt (degrees) |  |

Note 1: The vertical coverage range is given for the elevation angle θ, defined between 0° and 180° as   
in [ITU-R M.2101](https://www.itu.int/dms_pubrec/itu-r/rec/m/R-REC-M.2101-0-201702-I!!PDF-E.pdf).

Note 2: The element gain in row 1.2 includes the loss given in row 1.9.

Note 3: The conducted power per element assumes Row × Column ×Number of supported polarizations elements (i.e. power per H/V polarized element).

Note 4: Row × Column means there are Row vertical and Column horizontal radiating elements.

* Proposals
  + Option 1: Please provide comments.
  + Option 2: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 2-6-5: Please discuss the initial Antenna and beamforming pattern modelling outline for TN UE**

|  |  |
| --- | --- |
| Characteristics | Handheld |
| Antenna type and configuration | (1, 1, 2) with omni-directional antenna element |
| Polarisation | Linear: +/-45°X-pol |
| Tx/Rx Antenna gain | 0 dBi per element |
| the number of Tx and Rx | 1T2R |

* Proposals
  + Option 1: Please provide comments.
  + Option 2: others
* Recommended WF
  + TBA. Collect companies’ view in 1st round

## Companies views’ collection for 1st round

### Sub-topic 2-1 General issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| China Telecom | Issue 2-1-1: Agree with Option 1. The ATG network should be deployed independently from TN network.  Issue 2-1-2: Agree with Option 2. The deployment of ATG BS should take more into account the flight course, which is different from the TN.  Issue 2-1-3: Agree with Option 2. Flight density assumption needs to be tailored to local conditions. At least, the worst case should be considered for coexistence  Issue 2-1-4: Agree with Option 1. ISD of 100km is used in our deployment.  Issue 2-1-5: Option 6. Phases of flight take-off and landing should also be considered, 3km and 10km should be covered.  Issue 2-1-6: Option 2. Given that there is no fixed route for low-altitude aircraft, this scenario will not be considered for this WI. |
| Ericsson | Issue 2-1-1: We think that option 1 is a reasonable assumption since ATG antenna pointing may be different and there must be sufficient capacity to serve both air and ground users. It would be good for all interested parties to confirm that this is the intended deployment means.  Issue 2-1-2: In our view, we should consider co-location with TN as first priority (since this is probably a worst case) but then also examine non-co-located. For the co-located case, we need to discuss whether ATG and TN BS synchronization is assumed or whether there could be BS-BS interference (and if so, how to model the coupling between ATG and TN BS). So option 1 + also non-co-located.  Issue 2-1-3: 1 aircraft per BS would be an obvious starting point. However, with e.g. 100-200km ATG BS separation, this would imply 100-200km distance between aircraft and 1 aircraft in 31,000-12,000 square km. That does not seem very likely in congested airspace (e.g. Beijing-Shanghai). So potentially e.g. 10 aircraft per 100km radius cell could be considered (FFS the exact number. 10 is calculated based on an estimated peak of 5400 commercial aircraft simultaneously over the surface area of the USA (according to FAA figure), with 100km cells covering 31000 square km each. Since in reality aircraft are not evenly distributed, the number could be different in areas of congestion; other inputs welcome)  Issue 2-1-4: Option 1. If the airspace is congested then it may be needed to space ATG BS closer than 100-200km apart in the congested region. RAN4 should further discuss whether this has an impact on co-existence simulations, and whether closer spaced ATG BS could have an RRM impact. If they could have an impact, one option is to space BS to be within the expected minimum aircraft spacing. Another option could be more beams per BS, although that option may be somewhat limited by the achievable isolation between beams.  Issue 2-1-5: Most systems quote 10,000m or 10,000 ft. However, for ensuring a robust and future proof 3GPP specification with flexibility to extend the service when landing or waiting to land in a stack, it may be prudent to consider a lower altitude that is closer to the ground, even down to e.g. 1-2km ?  Issue 2-1-6: The intention here is to check whether it is useful, reasonable and feasible to enable support of a wider set of usage scenarios.  ….  Others: |
| Apple | Issue 2-1-1:  Option 1. The network shall be differentiated and have access control  Issue 2-1-2:  Option 2 is preferred.  Issue 2-1-5:  Option 1 seems more reasonable. But it would be better to extend to 15000km and down to several hundred meters.  Issue 2-1-6  Yes. E.g. UAV case. |
| Qualcomm | Issue 2-1-1: OK with Option 1.  Issue 2-1-2: Option 2. No co-location. the co-location scenario is very severe interference scenario. This would lead to very strict RF requirement. I think we don’t have very strong position for this. We can wait for the 2nd round review.  Issue 2-1-3: Option 1. We need to clarify the density of aircraft. One aircraft can be starting point which will be no need to consider the potential interference in adjacent cells of ATG.  Issue 2-1-4/5: need input from operator who has interest in deploying the ATG.  Issue 2-1-6: Option 2. No. only aircraft is considered. Other low altitude scenario will complicate the study. |
| ZTE | Issue 2-1-1:  Option 1 is reasonable assumption since its targeted service and UE type are different.  Issue 2-1-2:  Firstly, non-colocated deployment is typical use case and we have concern on on the co-located scenario since there might be some CLI problem which would be similar as Full duplex discussion we want to avoid the parallel discussion in two topics especially considering this is not typical use case.  Issue 2-1-3:  We prefer to assume single UE per ATG BS since this will simplify the coexistence study just similar as the coexisting study in other use case. For DL and UL, only one user assumed.  Issue 2-1-4:  From our understanding, different ISD .e.g. 100km and 200km could be considered.  Issue 2-1-5:  Since beam need to uptil toward the sky to serve the ATG CPE, at the low altitude, beam array gain or SINR quality is not quite good, this is not good side condition for ATG connection.  Option 5 is more preferred for coexistence study.  Issue 2-1-6:  This should be out of scope from our understanding and it could be discussed under the UAV topic instead of ATG topic. |

### Sub-topic 2-2 The outline for ATG co-existence study

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 2-2-1: This indeed looks to be the correct set of topics to discuss  Issue 2-2-2: In general, RAN4 should not do co-channel studies as they are either related to deployment parameters (not in scope of 3GPP) or means for the air interface to control interference (RAN1). |
| Qualcomm | Issue 2-2-2: Option 1. RAN4 should only consider the adjacent channel co-ex which is the RAN4 traditional work. |
| ZTE | Issue 2-2-1: option 1 all these parameters need to be confirmed for coexistence study.  Issue 2-2-2: From our RAN4 understanding, we need to focus on the adjacent channel scenario. For co-channel scenario, this should be up to the practical deployment. |

### Sub-topic 2-3 Co-existence simulation scenario

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Issue 2-3-3  Rural case should be considered.  But if the ATG antenna is omni-direction, urban case might also be needed. |
| China Telecom | Issue 2-3-2: Agree with Option 1. Coexistence of TN and ATG should be prioritized  Issue 2-3-3: Option 1 and Option 2 should be considered. Flights usually pass through suburban or rural areas.  Issue 2-3-4: Option1, 2 and 3. Band n1, n78 and n79 covered in WID should be covered.  Issue 2-3-7: Agree with Option 3.  Issue 2-3-8: Case 1~6 should be considered. |
| Ericsson | Issue 2-3-1/2: The table implies considering the impact of ATG to TN victim. For ATG to ATG, to clarify is the assumption that different ATG networks are always synchronized ? If so, it could be phase 2. If the ATG networks may not be synchronized then it should be studied earlier on. For NTN, we agree no need to study.  Issue 2-3-3: Our understanding is that ATG BS would likely be deployed in rural scenarios, not urban ones, but we would like to confirm. We can rule out indoor.  Issue 2-3-4: We should consider 2GHz (or 2.1, but not 2 and 2.1) and at least one of 3.5 or 4.9, or both of those. For now we propose 2 and 3.5GHz.  Issue 2-3-5: Propose 20MHz for 2GHz and 100MHz for 3.5GHz  Issue 2-3-7: Propose FDD for 2GHz and TDD for 3.5GHz.  Issue 2-3-8: The scenarios mostly make sense. For 7 and 8, it should be clarified whether non-synchronized operation should be catered for in the requirement; if not then the simulations are not needed. 9-10 could be in a second stage, but it should also be discussed whether different ATG networks could be not synchronized. |
| Qualcomm | Issue 2-3-2: Option 1 and option 2B  Issue 2-3-3: Option 1. Only rural case needs to be considered. The flight route usually located in the rural.  Issue 2-3-4: share the same view as Ericsson.  Issue 2-3-7: Feasibility analysis of using current design for TDD bands are preferred.  Issue 2-3-8: case 1-8 should be the first phase. Case 9-10 should be the second phase. |
| ZTE | Issue 2-3-1/2: only consider the option 1  We think that ATG coexist with ATG, we think that this might be not needed just similar as NTN vs NTN in Rel-17.  Issue 2-3-3:  Option 1, Rural scenario  Issue 2-3-4:  We could focus on 2.1GHz and 3.5GHz/4.9GHz. In addition, since 3.5GHz and 4.9GHz CPE type is similar, then for the simplification of coexistence study and maybe one freq could be picked.  Issue 2-3-5: Propose 20MHz for 2.1GHz and 100MHz for 3.5GHz/4.9GHz  Issue 2-3-7: FDD for 2.1GHz and TDD for 3.5GHz/4.9GHz.  Issue 2-3-8: . For 7 and 8, we don’t think it’s necessary to consider this case since ATG would have large DL-UL gap, then TN BS DL or UL just fall into the DL-UL gap of ATG system, we don’t see its necessity of conducing the coexistence studied.  For Case 9 and 10, please see our comments for issue 2-3-1./2 |
|  |  |

### Sub-topic 2-4 Co-existence network layout

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Apple | Issue 2-4-1  Option 3 |
| China Telecom | Issue 2-4-1: Agree with Option 1.  Issue 2-4-2: Agree with Option 2. |
| Ericsson | Issue 2-4-1: Regarding options 1 and 2; option 2 could be a good baseline if the aim is to cover surfaced area rather than providing capacity to dense areas. If there are scenarios where a quite dense deployment of basestations needs to be provided in order to meet capacity requirements, then it could be discussed whether option 1 or 2 is more important. It seems likely that in the area around major urban areas, aircraft could be flying in and out in different directions even at >10000m and so opton 2 may be more robust for assessing co-existence. Option 3, to assume a rural TN deployment can be added to either option 1 or option 2. There may need to be some discussion about how many TN cells to explicitly model in order to keep simulation complexity reasonable.  Issue 2-4-2: Dropping clusters of TN cells randomly may not capture the impact of the ATG properly, in particular if the impact of ATG is mostly on TN cells close to ATG BS. In that case, it may be better to drop TN clusters close to ATG BS.  Issue 2-4-3: Option 1 seems reasonable, but it should be further clarified whether co-location of the ATG cells is presumed, or some grid shift. |
| Qualcomm | Issue 2-4-1: Option 1. The ATG BS can be deployed on the airline route. This is a reasonable assumption and will not waste resources. The airline route is normally steady.  Issue 2-4-2: Option 2. The TN cluster randomly distributed. This can simulate an average interference.  Issue 2-4-3: Option 2. The ATG distributed linearly along the airline route. |
| ZTE | Issue 2-4-1:  For the option 2 is not practical deployment, usually ATG BS is only deployed in flight routes with large ISD.  Issue 2-4-2: Option 1 to drop the 19 sites BS next to ATG BS.  Issue 2-4-3: we don’t think this is needed to be studied similar as Rel-17 NR over NTN. |

### Sub-topic 2-5 Co-existence system parameters

|  |  |
| --- | --- |
| **Company** | **Comments** |
| China Telecom | Issue 2-5-1: 35~45m should be considered. Considering that ATG network is deployed on the airline routes, the ATG BS may be built on the mountain. Whether the height of the mountain is taken into account can also be discussed.  Issue 2-5-2: Considering that the ATG network can still provide service when the flight is climbing or landing, 3km and 10km should be considered for ATG CPE altitude. |
| Ericsson | Issue 2-5-1: Some comments below:   |  |  | | --- | --- | | ATG BS altitude | This may be an important parameter to clarify as it may directly impact the TN. Also, it will be important to properly model sidelobes and grating lobes of the ATG in the co-existence simulation.  [30m] ? | | Carrier frequency | 2GHz, 3.5GHz | | Frequency reuse factor | 1 | | Duplex mode | FDD@2GHz, TDD@3.5GHz | | Channel bandwidth | 20MHz@2GHz, 100MHz@3.5GHz | | Subcarrier spacing (SCS) | 15k@2GHz, 30k@3.5GHz | | Number of cells | TBC; depends on discussion on capacity | | Environment1 | Question on note 1; should it say that ATG BS are deployed in a rural TN environment ? The ATG serves UEs in the air, not in rural… | | UE distribution | TBC, depends on capacity assumption and whether 1 UE is served per ATG BS (with sufficient ATG BS to serve all UEs) or not | | Indoor UE percentage | None, it is serving BS in the air… | | Number of DL active UEs per cell (NOTE 2) | OK, but need to clarify number of beams | | Number of UL active UEs per cell  (NOTE 2) | OK, but need to clarify number of beams | | DL scheduled bandwidth per UE | Full bandwidth | | UL scheduled bandwidth per UE | Full bandwidth | | Traffic model | Full buffer ? | | ATG BS maximum output power | TBC…46-53dBm | | ATG BS noise figure | 5dB | | Handover margin | Is this needed for co-existence ? | | NOTE 1: ATG BS is assumed to serve UEs in the rural environment.  NOTE 2: Same as the number of BS beam(s);  NOTE 3: ATG BS max TX power is defined per polarization | | |
| Ericsson | Issue 2-5-2 Some comments below. In general, to decide the UE parameters an UL and DL link budget analysis should be provided to check whether the EIRP and directivity are sufficient and how much NF is tolerable.   |  |  | | --- | --- | | ATG UE altitude | TBC in section 2.2.1 | | Carrier frequency | 2, 3.5GHz | | ATG UE max TX power in dBm | TBC. Also the UE antenna gain and directivity assumptions need to be clarified. An assumed TRP and EIRP may be needed. | | ATG UE min TX power in dBm | This may not have much impact on co-existence simulaitons and could be discussed afterwards (UE will never be very close to the BS at low power) | | ATG UE noise figure | TBC whether to assume UE NF, or whether to assume that the UE is more like a BS and has a higher NF (to achieve link budget). | |
| ZTE | Issue 2-5-1  Please see the table **Table 2.2.1-1** in R4-2213686 for ATG BS  Issue 2-5-2  Please see the table **Table 2.2.2-1** in R4-2213686 for ATG UE  This could be further discussed in the simulation assumption directly. |

### Sub-topic 2-6 Antenna and beamforming pattern modelling

|  |  |
| --- | --- |
| **Company** | **Comments** |
| Ericsson | Issue 2-6-1:  In our view, the upd to date parameterized model in 38.803 section 5.2.3.2.4 should be used (apart from that the pre-set downtilt should be adjusted for ATG)  Issue 2-6-2:  It is not obvious that an omnidirectional UE antenna can achieve the link budget. The link budget should be checked. If the UE is directional, 38.803 5.2.3.3 provides a model, however if the UE array size and power is more like a BS then the model of 5.2.3.2.4 could be used.  Issue 2-6-3: It is likely that an AAS BS is needed to achieve sufficient BS and link budget, so considering AAS BS only is sufficient.  Issue 2.6.4: The TN BS should use the model of 38.803 section 5.2.3.2.4 using sub-arrays.  Issue 2-6-5: For the TN UE, the proposal in option 1 is fine. |
| ZTE | Issue 2-6-1:  Please see the  **Table 2.3.1-1** in R4-2213686 for ATG BS  Issue 2-6-2:  For 2.1GHz, propose option 1 for it and for 3.5GHz/4.9GHz, propose option 4 for it.  Issue 2-6-3:  For ATG BS ,only AAS based BS should be considered to provide the beam steering capability to track the aircraft.  Issue 2.6.4: The TN BS should use the model in **Table 2.3.2-1** in R4-2213686  Issue 2-6-5: For the TN UE, option 1 and PC3 UE considered. |

### 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** |
|  | 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#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Topic #3: Identification of UE and BS RF core requirements

## Companies’ contributions summary

|  |  |  |
| --- | --- | --- |
| **T-doc number** | **Company** | **Proposals / Observations** |
| **[R4-2211657](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211657.zip)** | CATT | **Observation 1: ATG BS class is different from current TN BS classes and HAPS BS class.**  **Observation 2: The ACLR, OBUE, and ACS requirements for ATG BS may be different from that of current TN BS.**  **Observation 3: TN BS requirements for WA BS class except ACLR, OBUE, and ACS can be reused for ATG BS.**  **Observation 4: Need to identify suitable frequency band(s) for ATG BS.**  **Observation 5: The following ATG Base station class definition can be as starting point.**  **ATG Base Stations are characterised by requirements derived from Direct Air to Ground communication scenarios with a ground BS to air UE minimum distance of typically around [TBD km].** |
| **[R4-2211774](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211774.zip)** | Huawei, Hisilicon | **Observation1: Although ATG BS has a little difference in scenario with conventional BS, there’s no need to specify new BS type for ATG network.**  **Observation 2: ATG BS is Wide Area Stations considering its scenario and needs .The mainstream type of ATG BS is 1-O and 1-H，however type 1-C is not excluded.**  **Proposal 1: Reuse the NR Operating band unwanted emissions specification for ATG BS.**  **Proposal 2: Reuse the NR transmitter spurious emissions specification for ATG BS.**  **Proposal 3: Reuse the Reference sensitivity level for ATG BS.** |
| **[R4-2211917](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2211917.zip)** | Apple | **Observation 1:** ATG UE is a specific type of UE in terms of operating scenario, formfactor, antenna pattern/gain, and RF requirement. It is different from any type of UE available in 38.101-1.  **Proposal 1: It is proposed to define a new type of UE (e.g. power class x) for ATG UE.**  **Proposal 2: It is proposed to define UE requirement for ATG UE in separate subclause with suffix J in 38.101-1.**  **Proposal 3: Focus on single carrier operation in Rel-18.**  **Proposal 4: It is proposed that ATG UE in R18 is GNSS capable.** |
| **[R4-2212316](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212316.zip)** | CMCC | **Proposal 1: ATG BS class is defined as indicated below:**  **- ATG Base Stations are characterized by requirements derived from ATG scenarios with a ground BS to air UE with typical vertical altitude range 8-12km.**  **- Unless otherwise stated, ATG BS class would refer to Wide Area BS class.**  **Proposal 2: it’s suggested to define a new UE type for ATG UE.**  **Observation 1: minimum 23dBm/MHz EIRP for ATG UE could make sure UL coverage.** |
| **[R4-2212618](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2212618.zip)** | Ericsson | **Proposal 1: Consider further whether to set a power level in the requirement, or set a requirement on power accuracy with a declared power (subject to a maximum limit).**  **Proposal 2: RAN4 to examine whether power control requirements are needed, or whether the dynamic range of power control can be simplified.**  **Proposal 3: RAN4 to discuss whether 1-O and 1-H are appropriate for an AAS like UE equipment.**  **Proposal 4: The in-band emissions requirements should be investigated further, as there are fewer scenarios for UEs to cause interference within a carrier than in the case of terrestrial scenarios.**  **Proposal 5: Consider RX sensitivity for ATG UEs in the light of the link budget and practical constraints for equipment mounted on an aircraft fuselage.**  **Proposal 6: Consider the in-band blocking requirements in the light of the fact that sources of blocking are unlikely to be close to the aircraft during the flight.**  **Proposal 7: Further investigate out of band blocking requirements.** |
| **[R4-2213159](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213159.zip)** | Huawei, HiSilicon | **Proposal 1: Based on the ATG UL link budget evaluation, 29dBm with 4T4R CPE mounted in the aircraft can be considered for ATG scenario to fully utilize existing IMT industry ecosystem and corresponding UE RF requirements.**  **Proposal 2: It’s recommended to adopt Table 1 UE array antenna pattern and parameters for ATG scenario.**  **Proposal 3: If beamforming is not allowed for CPE mounted in the aircraft**,  **and can be assumed as fixed values. Otherwise, there is no need to restrict Horizontal / Vertical coverage angle.** |
| **[R4-2213687](https://www.3gpp.org/ftp/TSG_RAN/WG4_Radio/TSGR4_104-e/Docs/R4-2213687.zip)** | ZTE Corporation | **Proposal 1**: to define the BS type 1-H and BS type 1-O for ATG BS.  **Proposal 2:** to the proposals in table 2 as baseline for ATG BS RF requirements;  **Proposal 3:** to the proposals in table 3 as baseline for ATG UE RF requirements; |

## 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 3-1 ATG UE

It is proposed to focus on the general requirements as following at frist in this meeting.

**Issue 3-1-1: Assumption for ATG operating mode**

* Proposals
  + Option1: Only consider single CC operation in Rel-18.
  + Option2: other, please specify
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 3-1-2: GNSS assumption**

* Proposals
  + Option1: It is proposed that ATG UE in R18 is GNSS capable.
  + Option2: other, please specify
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 3-1-2: Doppler/timing pre-compensation assumption**

* Proposals
  + Option1: NTN functionality is re-used together with GNSS (explain how)
  + Option2: other, please specify
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 3-1-3: subclause to capture ATG UE requirement**

* Proposals
  + Option1: It is proposed to define UE requirement for ATG UE in separate subclause with suffix J in 38.101-1.
  + Option2: other, please specify
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 3-1-4: Power class for ATG UE**

* Proposals
  + Option1: A separate UE power class is defined for ATG UE
  + Option3: not to define the power class for ATG UE similar as IAB-MT
  + Option2: Consider further whether to set a power level in the requirement, or set a requirement on power accuracy with a declared power (subject to a maximum limit)
* Recommended WF
  + TBA

**Issue 3-1-5: UE requirement type**

* Proposals
  + Option1: discuss whether 1-O and 1-H are appropriate for an AAS like UE equipment.
  + Option2: still use UE requirement structure and investigate what is specific aspects for ATG UE.
  + Option3: other, please specify
* Recommended WF
  + TBA

**Issue 3-1-6: power control**

* Proposals
  + Option1: RAN4 to examine whether power control requirement are needed, or whether the dynamic range of power control can be simplified
  + Option 2: Reduce the power control dynamic range according to the ATG scenario
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 3-1-7: power control accuracy**

* Proposals
  + Power control accuracy should be investigated, e.g. whether it can be tightened to reduce the interference.
  + Option 2: reuse the current requirement
  + Option 3: FFS
* Recommended WF
  + TBA. Collect companies’ view in 1st round

All other requirements will be discussed in detail in the next meeting.

### Sub-topic 3-2 ATG BS

**Issue 3-2-1: ATG BS class**

* Proposals
  + Option1: To follow the HAPS approach [CATT, CMCC]

- ATG Base Stations are characterized by requirements derived from ATG scenarios with a ground BS to air UE with typical vertical altitude range [8-12km].

* + Option2:.other
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 3-2-2: ATG BS type**

* Proposals
  + Option1: BS type 1-H and BS type 1-O and BS type 1-C is not precluded [Huawei]
  + Option2: BS type 1-H and BS type 1-O [ZTE]
* Recommended WF
  + TBA. Collect companies’ view in 1st round

**Issue 3-2-3: ATG BS RF requirements**

* Proposals
  + Option1: TN BS requirements for WA BS class except ACLR, OBUE, and ACS can be reused for ATG BS. [CATT]
  + Option 2: Reuse the NR Operating band unwanted emissions specification, and Reuse the NR transmitter spurious emissions specification and Reuse the NR Reference sensitivity level for ATG BS [Huawei]
  + Option3: ATG BS RF requirements proposal [ZTE]
* Recommended WF
  + TBA. Collect companies’ view in 1st round

## Companies views’ collection for 1st round

### Open issues

|  |  |
| --- | --- |
| **Company** | **Comments** |
| China Telecom | Issue 3-1-1: Option 1.  Issue 3-1-2: Option 1. Both ATG BS and UE are GNSS capable.  Issue 3-1-3: Agree with Option 1.  Issue 3-1-4: We propose another option: multiple ATG UE power classes can be defined to give more flexibility to ATG deployment.  Issue 3-1-6: Option 1. Power control accuracy should be defined. To control the interference to TN, power control should be used.  ….  Others: |
| Ericsson | Issue 3-1-1: Option 1 is OK, but we should be synchronized with the RRM decision  Issue 3-1-2: It is OK to presume GNSS, but it should be clarified what impact this has on RF. In RRM, it should be clarified how, using GNSS information the UE performs Doppler or timing pre-compensation in ATG. We think that the question on whether NTN functionality can be re-used should be addressed I the RRM thread.  Issue 3.1.4: It is likely that the existing UE power class are not sufficient. It may be sufficient to set an upper limit with a declaration; the needed UE power may be very dependent on aircraft type, usage etc. In any case a different power class is needed.  Issue 3-1-5: This depends on whether the UE has to use beamforming in order to achieve the link budget. If beamforming is needed, it may make sense to set OTA requirements. In this case, achieving EIRP in declared directions may be more relevant than spherical coverage.  Issue 3-1-6: Agree; the simulations and link budget estimation can establish the dynamic range of power control that is needed.  Issue 3-1-7: It is not so obvious whether the TX power changes so much and how important accuracy is. Open to discuss more.  Issue 3-2-1: The proposed definition looks OK. In case it would turn out that the requirements on the BS can be the same as a WA then it could be added as a note that the WA requirement covers also this scenario.  Issue 3-2-1: It is probably better to do AAS only to be clearer, since AAS BS is needed for ATG.  Issue 3-2-3: We should aim to align BS requirements with TN BS. ACLR and ACS should be studied; obviously changed if needed but otherwise aligned to TN if possible. |
| Apple | Issue 3-1-1: Option 1  Issue 3-1-2:  Option 1  Issue 3-1-3:  Option 1  Issue 3-1-4:  Option 1  Issue 3-1-5:  Option 2. .  Issue 3-1-6:  Option 1  Issue 3-1-7:  Option 1 |
| Qualcomm | Issue 3-1-1: Option 1  Issue 3-1-2: Option 1  Issue 3-1-2 (There are two issue 3-2-1): more analysis is needed based on the speed of aircraft scenario  Issue 3-1-3: OK with Option 1  Issue 3-1-4: OK with Option 1  Issue 3-1-5: OK with Option 2.  Issue 3-1-6: Option 1. Need more study.  Issue 3-1-7: Option 1. Need more study |
| ZTE | Issue 3-1-1: Option 1  Issue 3-1-2:  We are fine with option 1. GNSS could help do doppler/timing pre-compensation assumption, this should be left up to the implementation.  Issue 3.1.3:  Maybe it’s okay and this could be further discussed during the CR draft phase.  Issue 3.1.4:  We tend to agree with Ericsson, the IAB-MT approach might be better instead of fixing power class. We prefer option 3.  Issue 3-1-5:  For 3.5GHz and 4.9GHz, option 1 is fine, however we think that requirement is defined on the antenna connector is also feasible way.  For 2.1GHz, we think that this could be different, this could be further discussed.  Issue 3-1-6:  We still prefer to power control needed which is also aligned with practical usage we think. Option 2 could be further discussed.  Issue 3-1-7:  We still prefer to reuse the existing one since side condition for DL could be still maintained similar as TN DL, in other word, RSRP estimation should be similar and power control accuracy is also expected to be similar.  Issue 3-2-1: we think that the definition is fine for us.  Issue 3-2-2: Option 2 is more preferred as we mentioned before.  Issue 3-2-3: we tend to agree with Ericsson. Indeed lots of TN BS requirement is sufficient for ATG BS given its use case. |

### 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** |
|  | 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#1** | *Tentative agreements:*  *Candidate options:*  *Recommendations for 2nd round:* |

*Recommendations on WF/LS assignment*

|  |  |  |
| --- | --- | --- |
|  | **WF/LS t-doc Title** | **Assigned Company,**  **WF or LS lead** |
| #1 |  |  |

### CRs/TPs

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

|  |  |
| --- | --- |
| **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)

## Summary on 2nd round (if applicable)

*Moderator tries to summarize discussion status for 2nd round and provided recommendation on CRs/TPs/WFs/LSs Status update suggestion*

|  |  |
| --- | --- |
| **CR/TP/LS/WF number** | **T-doc Status update recommendation** |
| XXX | *Based on 2nd round of comments collection, moderator can recommend the next steps such as “agreeable”, “to be revised”* |

# Recommendations for Tdocs

## 1st round

**New tdocs**

|  |  |  |
| --- | --- | --- |
| **Title** | **Source** | **Comments** |
|  |  |  |

**Existing tdocs**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Tdoc number** | **Title** | **Source** | **Recommendation** | **Comments** |
|  |  |  |  |  |
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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** |
|  |  |  |  |  |

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