**3GPP TSG RAN Meeting #90e RP-20xxxx**

**Electronic Meeting, Dec, 2020**

**Agenda item: x**

**Source: CMCC**

**Title:** **Email discussion for RAN4 R17 proposal on ATG**

**Document for: Discussion and Decision**

# 0. Introduction

This is an email discussion for RAN4 R17 non-spectrum proposal on ATG.

1. Rel-17 WI on ATG for NR

Related contributions in RAN#88e and RAN#89e:

RP-200764 Motivation for new WI on air-to-ground network for NR

RP-200765 New WID on air-to-ground network for NR

RP-201053 Discussion on ATG network

RP-201629 Motivation for new WI on air-to-ground network for NR

RP-201630 New WID on air-to-ground network for NR

Here are some key issues which are proposed for Rel-17 in above contributions in RAN#88e and RAN#89e.

## 2.1 Issue 2-1: ATG scenarios and RF requirements

**Scenarios:**

Air-to-ground (ATG) network refers to in-flight connectivity technique, using ground-based cell towers that send signals up to an aircraft’s antenna(s) of onboard ATG terminal. As a plane travels into different sections of airspace, the onboard ATG terminal automatically connects to the cell with strongest received signal power, just as a mobile phone does on the ground.

In RAN#86 meeting, the new WID (RP-193234) solutions for NR to support non-terrestrial networks (NTN) was approved. The NTN work item aims to specify the enhancements identified for NR NTN (non-terrestrial networks) especially LEO and GEO with implicit compatibility to support HAPS (high altitude platform station) and ATG (air to ground) scenarios according to the following principles:

* FDD is assumed for core specification work for NR-NTN.
  + NOTE: This does not imply that TDD cannot be used for relevant scenarios e.g. HAPS, ATG
* Earth fixed Tracking area is assumed with Earth fixed and moving cells
* UEs with GNSS capabilities are assumed.

Although the RAN1/2/3 aspects of standardization work are generally common for satellite, HAPS and ATG, the RAN4 aspects differ very significantly. The node definitions, spectrum considerations and co-existence considerations all differ. In the case of ATG, both base station and UE will be unique types. ATG will operate within existing bands and does not need new bands and band properties to be identified.

The NTN WI includes development of generic requirements for RAN4, however in practice the work will be separate and different for Satellite, HAPS and ATG. To avoid confusion and overloading of the NTN WI and the low dependency between RAN1-3 work and RAN4 work for ATG, it is proposed that the ATG RAN4 work is performed within the context of this WI. The proposal to split off RAN4 work is exceptional for the NTN work due to the large and complex scope of covering quite different types of system and low dependency on RAN1-3.

Form the trials and commercial operation [<https://inflight.telekom.net/ean/>] of proprietary ATG solutions, some characteristics could to be considered for ATG network deployment scenarios:

* ***Extreme large inter-site distance (ISD) and large coverage range:*** In order to control the network deployment cost and considering the limited number of flights, large ISD is preferred, e.g., about 100km to 200km. At the same time, when the plane is above the sea, the distance between the plane and the nearest base station could be more than 200km and even up to 300km. Therefore, ATG network should be able to provide up to 300km cell coverage range.
* ***Utilizing non-disjoint operators’ proprietary frequency for deploying both ATG and terrestrial networks:*** Operators are interested to adopt the same frequency for deploying both ATG and terrestrial networks to save frequency resource cost, while interference between ATG and terrestrial networks becomes nonnegligible and should be addressed. Especially, from China Mobile’s point of view, 4.8GHz is an interesting frequency for deploying both ATG and terrestrial NR network.
* ***Much powerful on-board ATG terminal capacity:*** On-board ATG terminal can be much powerful than normal terrestrial UE, e.g., with higher EIRP via much larger transmission power and/or much larger on-board antenna gain.

Considering the particularity of ATG network deployment, the following aspects should be addressed in a new ATG work item.

* Extreme large cell coverage range (e.g., up to 300 kilometres) and flight speed (e.g., up to 1200km/h).
* Coexistence requirements between ATG and terrestrial network.
* ATG BS/UE core and performance requirements

**Objectives:**

Specify features to core specifications of RF requirements for coexistence between ATG and IMT terrestrial network [RAN4]

* Identify key characteristics where it is absolutely necessary to differentiate ATG BS and UEs from ground based BS and UEs
  + Aim to reuse existing requirements for BS and UE where possible.
* Study and specify the framework how ATG core requirements are defined.
  + This includes identifying whether the requirements are captured within the existing specifications or new specifications are created.
  + Determine whether conducted, OTA or both types of requirement are required for both the BS and UE
* Identify the FR1 potential band(s) to be used as example for ATG
* Perform FR1 co-existence evaluation for ATG network (e.g. ACLR, ACS)
* Specify new UE/BS type(s) for ATG network if necessary
  + Taking into account identified differences between ATG and ground based systems
* Specify RF requirements for ATG UE/BS
  + Considering the results of co-existence simulations in terms of impact on emissions and RX requirements, cell sizes and link budgets, technology capabilities, likely BS and UE architectures and other relevant aspects.
* Specify test procedures for ATG BS conformance testing
  + Determine at an early phase whether conducted, OTA or both types of testing are needed

Q1: Companies are invited to share views on objectives

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| Company | Comments |
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## 2.2 Issue 2-2: RRM/Demod requirements

* The typical speed for civil aircraft are ranging from 900km/h to 1200km/h, and ISD of ATG BS are ranging from 100km to 300km which is also much larger than that of terrestrial NR network, which may have impact on RRM requirements. So RRM core requirements for ATG UE should be discussed.
* Channel model for ATG UE and BS could be different from legacy NR UE and BS. Doppler frequency shift and Tx/Rx antenna configuration between ATG UE and BS could also be different compared with legacy NR. ATG UE and BS demodulation requirements should also be discussed.
* The progress and outcome of Rel-17 NTN work item can be taken into account for ATG RRM and Demodulation requirements.

**Objectives:**

Indentify and specify RRM/Demod requirements for ATG, starting once the Rel-17 NTN WI has progressed sufficiently and taking into account the decisions/outcome of Rel-17 NTN work item.

* RRM core requirements for ATG UE. [RAN4]
  + Considering the different nature of ATG UEs and their view of the network, increased cell sizes and other relevant aspects.
* RRM performance requirements and test cases for ATG UE type. [RAN4]
* Demodulation performance requirements and test cases for ATG UE/BS. [RAN4]
  + Taking into account different cell sizes

Q2: Companies are invited to share views on objectives

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## 2.3 Issue 2-3: others

Other issues or objectives to be identified in Rel-17 (if needed).

Q3: Companies are invited to share views on this use case and objectives

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## 2.4 Summary for sub work area #2