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RELEASE DATE:
31st March 2022

5G-NTN Support in OpenAirInterface™

CONTEXT AND BACKGROUND

Standardisation of 5G at 3GPP is progressing rapidly. Release 17 features supporting Non-Terrestrial Networks (i.e. satellites) will be frozen in March 2022 as planned. Early demonstrations and validation are essential to support further standardisation. Inevitably, any such activity relies on the availability of a 5G NTN protocol stack implementation. One implementation that is available for research purposes, i.e. open and accessible for the necessary NTN adaptations, is the one by the Open-Air Interface software alliance (https://openairinterface.org/).

Recognising the importance of a protocol stack implementation suitable for validating NTN aspects the European Space Agency contracted the 5G-GOA consortium to develop the necessary extensions to the OAI protocol stack implementation.

5G-GOA OBJECTIVES

Our ambition is to facilitate the implementation of emerging satellite services in the context of full integration among satellite and terrestrial networks in 5G. Therefore, the 5G-GOA consortium designs and implements the necessary modifications in the 5G New Radio standard to enable the direct radio access via geostationary satellites to terrestrial communication networks, a 5G RAN via (geostationary) satellite, closely following the 3GPP Work Item on Non-Terrestrial-Networks.

The 5G-GOA hardware and software development uses existing technologies, hardware and software components already available from the open-source project OpenAirInterface™ for the prototyping of 5G terrestrial systems. Our solution follows strictly 3GPP discussions and results and spans from physical layer techniques up to specific protocols and upper layer implementations of the radio access network, as needed. 5G-GOA focuses on geostationary satellite systems.

In summary, the objective of 5G-GOA is to develop a gNodeB (gNB) based gateway and User Equipment (UE) compliant with the 5G New Radio standard Release 17 for demonstrating the direct radio access connectivity in Non-Terrestrial Networks (NTN). 5G-GOA will demonstrate its developments live over the air using bi-directional links between the developed terminals and the gateway via an existing satellite transponder on a geostationary satellite.

OAI EXTENSIONS PLANNED BY 5G-GOA TO SUPPORT NTN FEATURES

5G-GOA is committed to provide the following OAI extensions necessary for NTN experimentation and validation considering geostationary satellites:

Features broader than NTN, but necessary for NTN experimentation

- PHY Layer
  – Support for Phase Tracking Reference Symbols in PDSCH and PUSCH
  – Support for 5 MHz BW with 15 kHz SCS
  – Extended support for multiple bandwidth parts (BWP)
- MAC Layer
  – Support for Multi-UE
  – Implementation of real FDD Scheduling
  – Implementation of QoS scheduling
- Implementation of a new KPI GUI

NTN specific feature extensions

- PHY Layer
  – Extend OAI rf-simulator to support simulation of long delay
  – Consider timing relation for UL scheduling at gNB
  – Disabling HARQ at gNB and UE
- MAC Layer
  – Adapting Uplink timing advance and RA procedure
- RLC Layer
  – Disabling HARQ-ARQ interaction
  – Increased ARQ buffer size to cope with large GEO delay
  – Increased maximum Sequence Number value
- PDCP Layer
  – Increased discard timer for SDU buffer
  – Increased reordering timer for PDU buffer
  – Increased size of PDU buffer
- RRC Layer
  – Increased selected timers (T300, T301, T311)
- NAS Layer
  – No adaptations foreseen

All the above NTN OAI extensions concerning UE and gNB will be compatible and interoperable with the OAI Stand-Alone Core Network.

AVAILABILITY OF THE IMPROVED OAI PROTOCOL STACK

5G-GOA will merge the developed extensions and improvements into the main development branch of OAI and release it as part of the OAI protocol stack available at https://openairinterface.org/oai-5g-ran-project/ and https://openairinterface.org/oai-5g-core-network-project/.

OAI PROTOCOL STACK EXTENSION TIMELINE

Considering that Release 17 specifications are frozen as of March 2022 and that 5G-GOA intends to release code that is not only standard compliant, but is thoroughly tested and verified, 5G-GOA plans to release this extended code for 5G-NTN in July 2022.