

# Satellite Systems, Mobile Networks, and UAV-based IoT Systems



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## Research activity



The group's research activity concerns terrestrial 5G networks and the recent evolution towards Non-Terrestrial Network (NTN) systems with communication via aerial platforms such as drones (Unmanned Aerial Vehicles, UAV) and low-altitude satellites (Low Earth Orbit, LEO). In this activity the group deals with both the problems of NTN 5G mobile radio networks according to the most recent release n. 17 of the international standardization body 3GPP and the problems of Internet of Things (IoT) systems for applications in the field of environmental monitoring (including emergency prevention) and intelligent agriculture. Of particular interest is the study of IoT systems in remote areas without Internet access where aerial systems such as UAVs can be used to scan large areas and read data communicated by both ground sensors and on-board sensors.

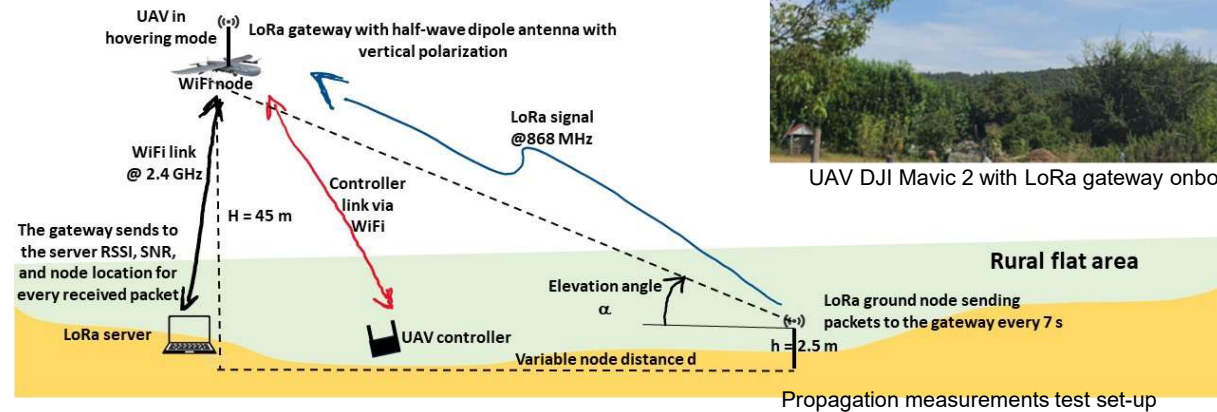
The main skills developed are:

- IoT systems via LEO satellite
- Protocols for 5G mobility5G network slicing to support quality of service
- Planning UAV missions to communicate with IoT devices (sensors/actuators) on the ground
- LoRa/LoRaWAN systems
- IoT gateway – IoT sensor communication design (from the propagative study to the configuration of the transceiver boards)
- AI/ML techniques for IoT data processing
- Testbed working with drones that read data from ground sensors.

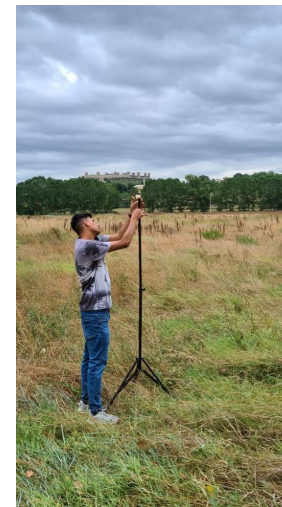
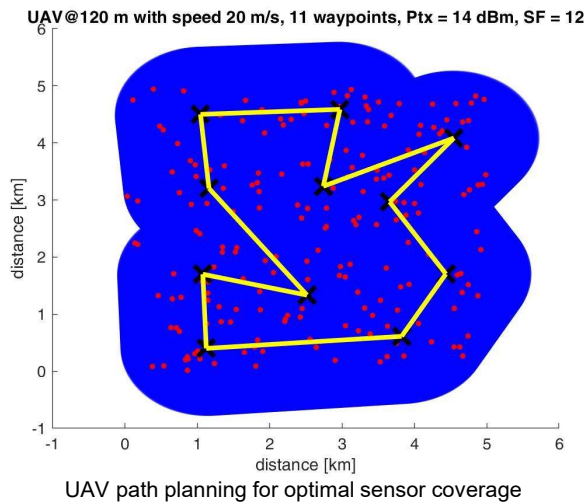
Set-up of our IoT system with UAV



### Test Bed Experiment: Path Loss Attenuation for LoRa Signal



UAV DJI Mavic 2 with LoRa gateway onboard



ground sensor deployment



Laboratory preliminary test set-up

## Technologies and services



We have developed an IoT & UAV testbed in a rural area based on:

Arduino UNO controller board + Semtech SX1276 LoRa transceiver @ 869MHz (ISM)

Open source Chirpstack software for LoRa gateway and LoRa server

RAK LoRa gateway

Coverage planning based on propagation model and cloudrf tool

UAV DJI Mavic 2 with LoRa gateway (payload)

Activities:

Design of UAV-based systems for remote reading of data from ground sensors in large areas and processing of georeferenced data.

## Applications and collaborations



- Project with Inmarsat Ltd. (UK): Research project to analyze the adoption of network coding solutions to improve the performance of multicast techniques on board aircraft (year 2018)
- Project with OQ-tech (Luxembourg): Research contract with OQ-tech to analyze an IoT 1access system via NB-IoT for LEO cubesat mission (year 2019)
- SatNEx project (ESA): Several annual research frameworks on various techniques, including satellite routing, network coding, multi-layer network protocol optimization (from year 2003 -)
- PNRR SPRINT project (Italy): Drone system for zero-touch AI processing of ground sensor data

For more information



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