5G!Drones Feasibility Tests - Athens Trials

Day 1
Location: Municipal Stadium of Egaleo (5GENESIS Athens platform), Greece
Date: 19 October 2020
Participants: CAFA Tech (EST), Hepta Airborne (EST), NCSR "DEMOKRITOS" (GRE), COSMOTE (GRE), Municipality of Egaleo (GRE), Robots Expert (FIN), INFOLYSiS (GRE)

5G!Drones partners conducted drone flights and technical tests at the Stavros Mavrothalassitis Stadium in Municipality of Egaleo, Athens, Greece on 19 October 2020 as part of the 5GDrones project trials (Use case #4: Connectivity during crowded events) over 5GENESIS 5G Athens platform. The purpose of this scenario is to demonstrate how UAVs through 5G network capabilities can improve connectivity services in a highly crowded environment e.g. during large events. The concept relies on providing end-to-end dedicated and reliable communication targeting specific user groups such as the event organizers to supervise and manage large events in an unhindered manner. At the same time, and with the proper dimensioning of the deployed solution in terms of capacity, the connectivity services can also be offered to the spectators.

Figure 1 – 5G!Drones team

5G!Drones team tested the control of drone flights over a 5G communication network. CAFA drone flight control software UGCS was installed on a 5G Edge server, which sent a flight mission to the drone controller over a 5G network.

In addition, 5G!Drones team connected the CAFA C2 system to Frequentis and Drone Radar's UTM (Unmanned Traffic Management) system, which distributes drone locations to air traffic services and other drone operators (**Figure 2**). In this way, we tested that we can all fly efficiently in the common airspace at the same time.

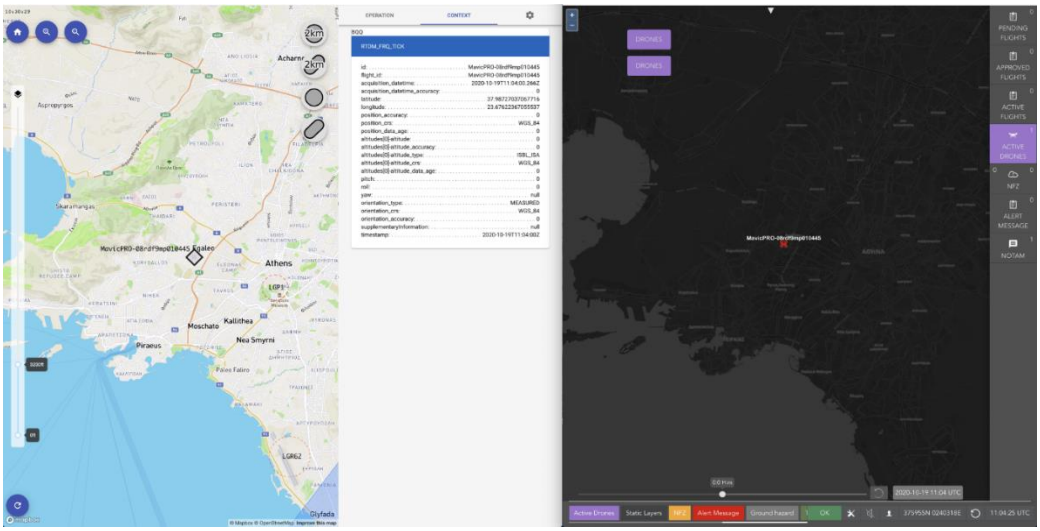

Figure 2 – DRR and FRQ UTM systems screens shows CAFA Mavic Pro

Initially, 5G!Drones team set up the 5G network provided by 5GENESIS Athens platform at the Egaleo stadium (NCSRD 5G Base station and Edge Server solution) and CAFA Tech then mapped the 5G coverage area and used it to plan the drone's flights.

Figure 3 – 5G network and MEC server configuration

The established 5G communication allows three main benefits for drones:

- Very small delay in drone control (latency up to 10ms)
- High bandwidth (4K and 8K) video transmission (speeds up to 1Gbps)
- Installation of applications on a server located at the 5G base station (MEC server), which can be used for real-time remote control of drones and robots (C2) as well as, for example, video analytics (Computer Vision).

During the day several tests and flights were conducted. CAFA Tech, using its Mavic drone, conducted an automatic flight over the 5G network, which was automatically controlled from the 5G edge server by the C2 application.

Figure 4 – CAFA Tech drone Mavic

The Hepta drone was also used and tested, lifting 10kg, which was very successful. The scope is the Hepta drone is to lift a real 5G base station during the next tests planned to be executed in 2021.

Figure 5 – Hepta drone

Day 2

Location: Municipal Stadium of Egaleo (5GENESIS Athens platform), Greece
Date: 20 October 2020
Participants: CAFA Tech (EST), Hepta Airborne (EST), NCSR "DEMOKRITOS" Research Center (GRE), COSMOTE (GRE), Municipality of Egaleo (GRE), Robots Expert (FIN), INFOLYSiS (GRE)

During the second day, 5G!Drones team continued with additional test flights and feasibility tests at the Municipal Stadium of Egaleo (5GENESIS Athens platform). The achievements and results of the second day are summarized below:

1. NCSRD 5G Base station and Edge Server solution were set up in 2nd position in 90 minutes (90 degrees different position on the stadium compared to day 1 position) as planned for the tests of the second day.
2. CAFA Tech C2 software worked in Edge Server and all C2 communication worked over 5G.
3. HEPTA C2 software QControl worked in Edge Server and all C2 communication worked over 5G.
4. Several manual flights were performed for identifying the spots where 5G coverage is lost

5. A co-existence flight with CAFA Tech drone Mavic and Hepta drone was performed at the end of the testing day

Figure 6 – NCSRD 5G Base station

In specific, the CAFA Tech drone Mavic and Hepta drone flew at the same time. Hepta drone had a 5G phone on board, which transmitted C2 information between the NUC server QControl application and the drone.

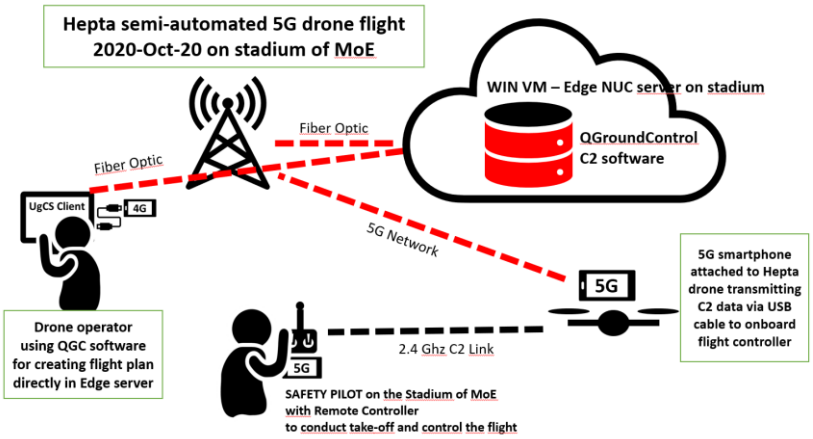

Figure 7 – Hepta drone semi-automated 5G drone flight

A 5G telephone was attached to the CAFA Mavic drone Remote Controller, which transmitted C2 information between the UGCS C2 application in the NUC server and the drone.

- Hepta's mission: Climb to a height of 20m and hover at this level for 5 minutes.
- CAFA drone mission: To make a circular flight around the Hepta drone at a height of 10 m and a radius of 20 meters from the Hepta drone, the flight length was 5 minutes.
- At 16.15 both drones took off and at 16.22 both drones landed.

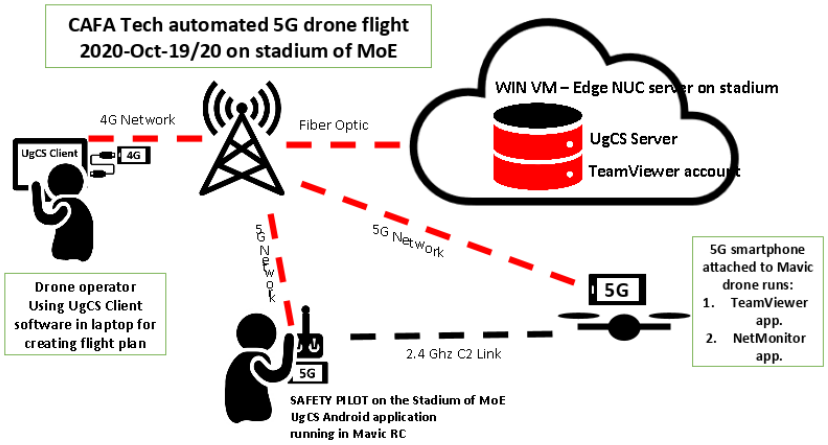

Figure 8 – CAFA Tech drone Mavic automated 5G drone flight

In specific, on 20th October, measurements of the 5G coverage area were performed at a height of 10m AGL, where the coverage area of the 5G test network was available (described in **Figure 9**). The problem was that if the 5G smartphone on board the drone lost its 5G coverage, the flight had to be interrupted and the ground the smartphone had to be switched on to the 5G network again. Therefore, only a few tests were performed at altitudes of 15m to 25m. At the same time, the central axis of the antenna of the 5G base station was turned upwards, which helped to achieve 5G coverage at a height of 25 meters in the central part of the stadium. Measurements taken at altitudes of 14m to 30m showed that the 5G propagation was related to the direction and pitch of the 5G antenna. When the antenna was turned upwards, the 5G coverage was also available at a height of 25 m, where previously the coverage was only up to a height of 14 m.

Figure 9 – Speedtests results measured using Ookla at Stadium-MoE at level of 10m AGL 2020- Oct-20

Videos from the Athens trials are available at the 5G!Drones YouTube channel: Day 1 and Day 2.