TRITON

Hellenic Drones

Docks the Future – Network of Excellence (DTF-NOE)

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Motivation

The concept of **Advanced Air Mobility (AAM)** has drawn the attention of the aviation industry during the last few years, and has revealed a whole new potential of air transport.

Under the AAM model, **hundreds of aircraft are expected to fly at a low altitude within a limited airspace.** Therefore, **the AAM aircraft should be able to operate autonomously** in order to ensure flights' safety under this novel concept of operation.

The method to integrate AAM flights into existing air traffic management is the creation of **a separate airspace with a new set of rules and standards to accommodate AAM flights (U-Space**).

However, **U-Space rules will only be able to manage cooperative traffic**; additional systems are required for non-cooperative traffic management.

The vision-based aerial obstacle detection and localization system "TRITON", offered by Hellenic Drones, is able to address non cooperative traffic management through advanced computer vision methods.

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Aim & Objectives

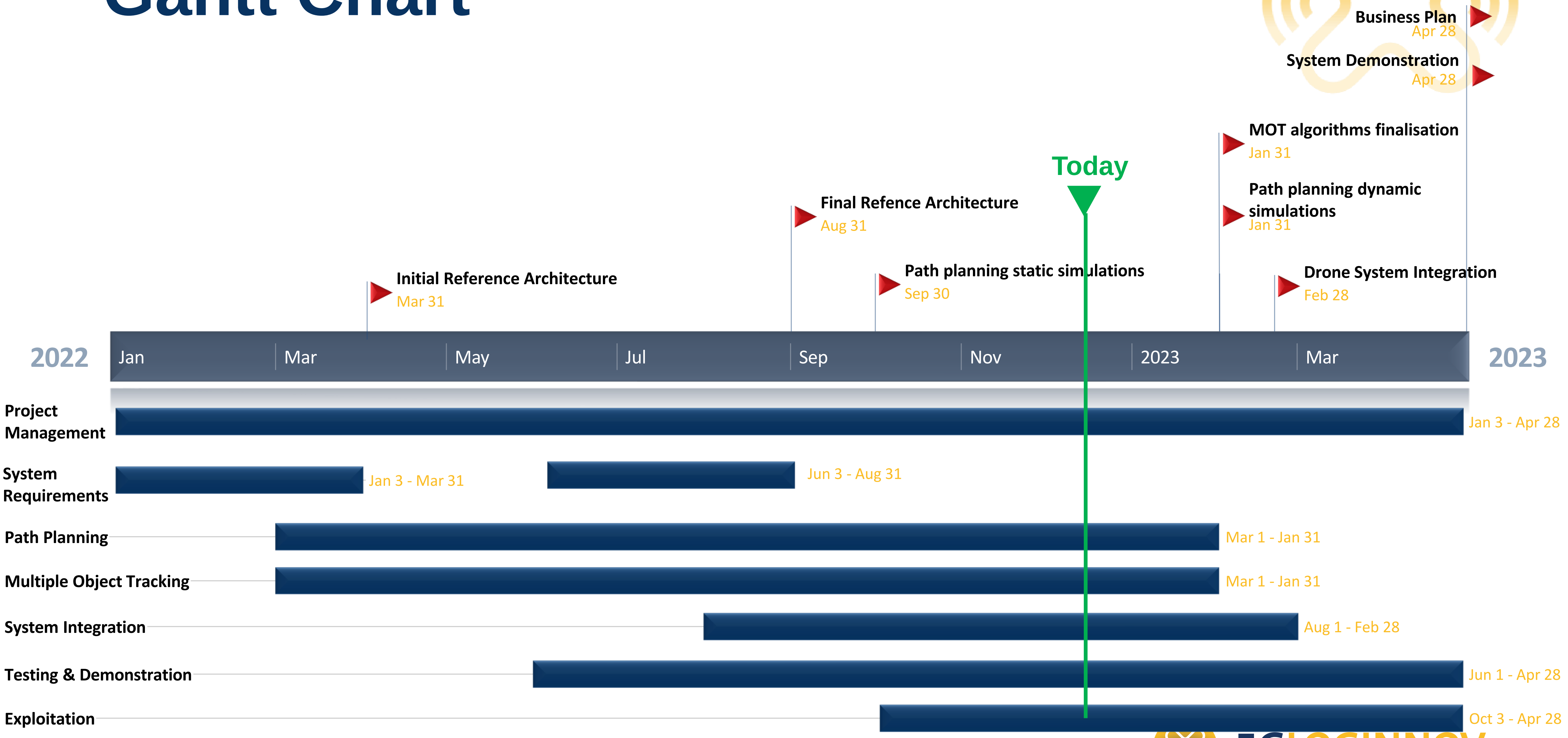
Aim

The TRITON project aims to develop a system that will enable autonomous drone flights specifically designed for port environments.

Objectives

- Detect aerial obstacles within the drone’s routes.
- Establish communication between the UAV, and the central server via 5G network
- Calculate a potential aerial collision
- Trigger a collision avoidance manoeuver

Gantt Chart



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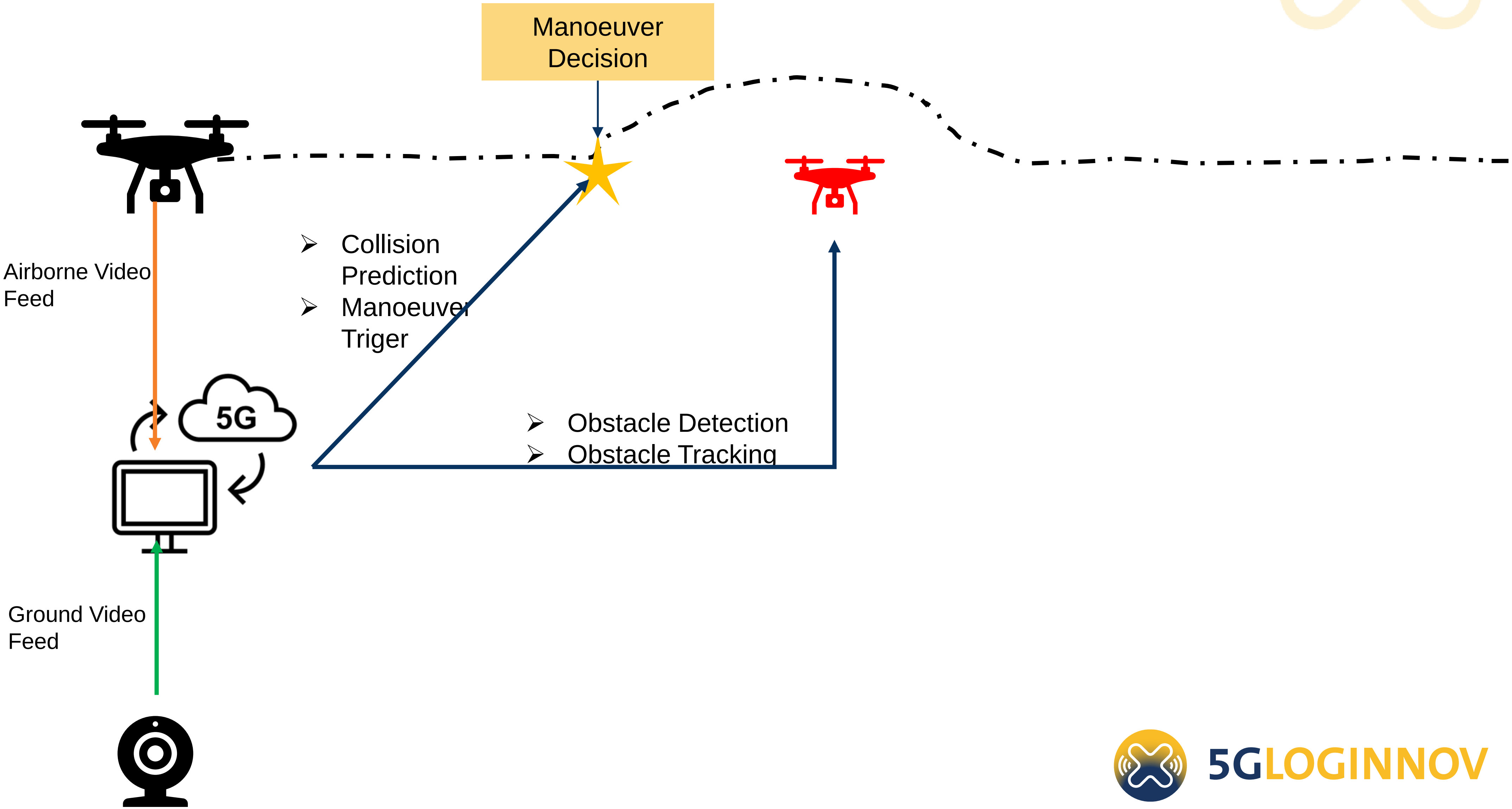
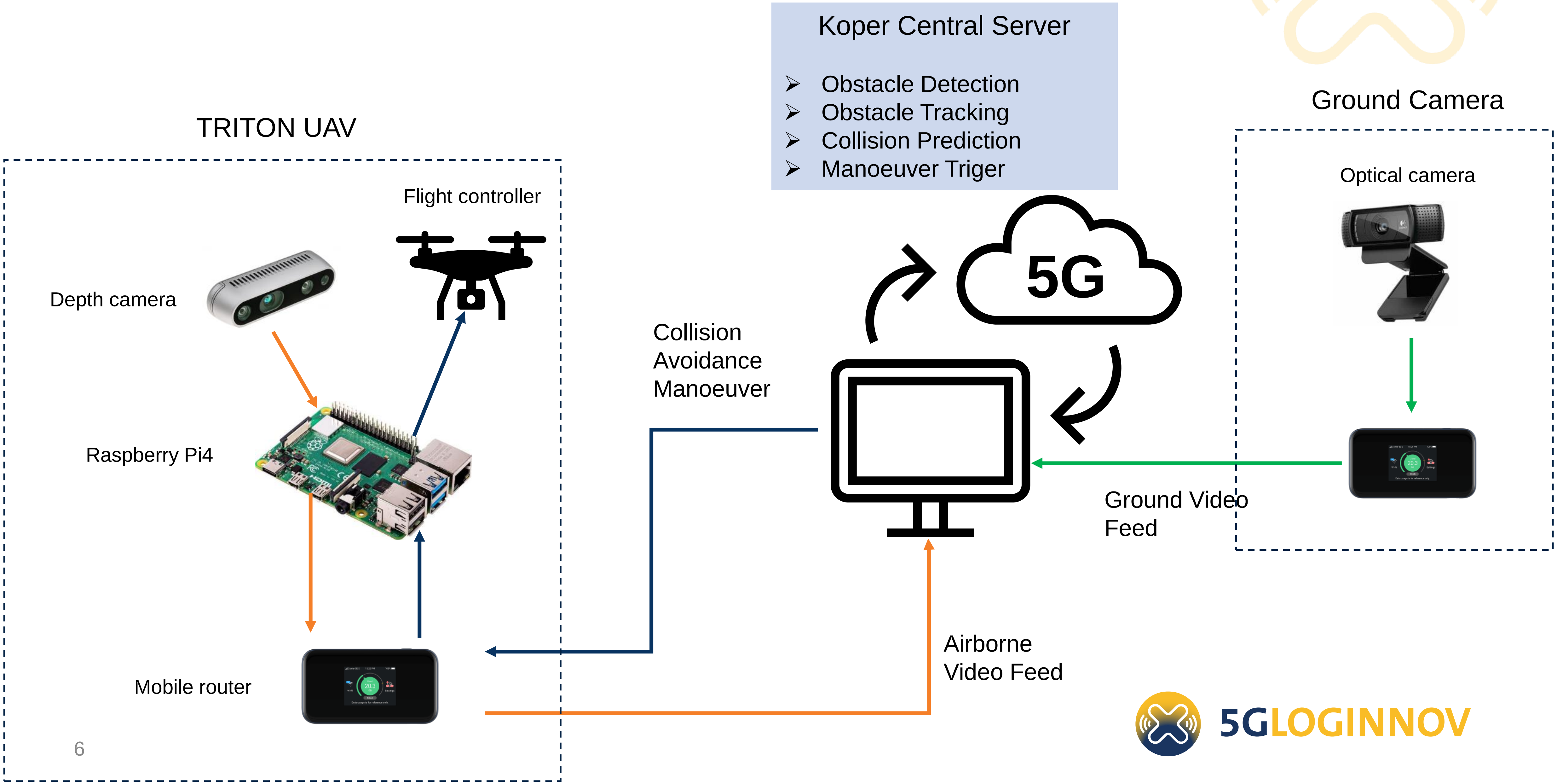
System architecture



Telecommunication architecture



Development challenges

- Aerial Object Detection, Tracking & Depth Estimation
- Collision avoidance manoeuver
- UAV Integration
- Piloting

Aerial Obstacle Detection, Tracking & Depth Estimation

The criteria used to select TRITON's detection and tracking algorithms are:

- High performance metrics on benchmark datasets
- Flexibility to be combined with other models, and be adjusted for different datasets
- Real time inference and can implemented on edge accelerators

- In order to train TRITON's detection and tracking model, we used a **12TB dataset containing aerial encounters of aircraft, helicopters, small UAVs, birds, and other aerial obstacles**.
- The aerial object dataset that we used to train the TRITON model has significant differences compared to other the widely used human detection and tracking datasets:
  - The aerial object dataset is collected by **moving cameras**
  - The aerial object dataset consists of **parse, small and fast moving objects**
- **The TRITON model has demonstrated superior performance compared to the existing state-of-the-art model for aerial object detection and tracking.**

Aerial Object Tracking

Aerial Object Tracking

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Collision Avoidance Manoeuver

The collision avoidance follows the paradigm of the Airborne Collision Avoidance System (ACAS) Resolution Advisories (RAs) that dictates vertical changes in the aircraft path to avoid collision.

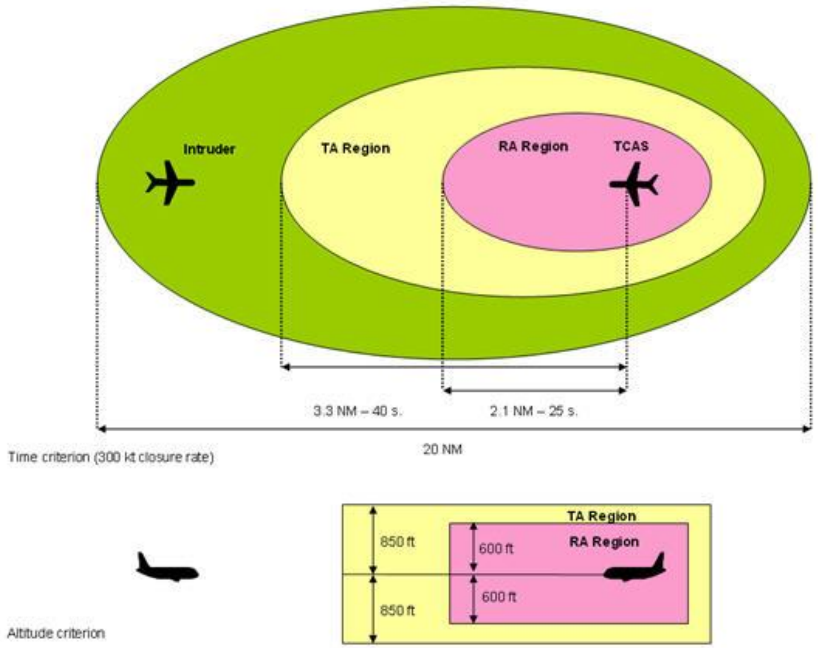
<u>Concept of operation</u>

- The system will consider obstacles located in front of the UAV
- The collision avoidance manoeuver will be triggered when the following conditions will be triggered:
    - an obstacle is detected from the onboard video feed
    - the ground video feed detects two UAVs (the TRITON and the intruded)
    - the distance of the detected obstacle is less than 20 meters of the TRITON UAV
- The collision avoidance manoeuver will change the TRITION's UAV flight altitude in order to fly above the detected obstacle.

<u>Demonstration scenario</u>

During the system's testing activities, the following steps will be followed

- The flight test will be conducted at 20 meters altitude
- 4 people will be involved in the flight test
- If the avoidance manoeuver is not executed at 10 meters distance the test is aborted.



Example of ACAS Protection Volume between 5000 and 10000 feet

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UAV Integration

- Ardupilot flight controller
- Hexacopter UAV
- Onboard computer: Raspberry Pi4
- Operating System: Robotic

  Operating System (ROS)

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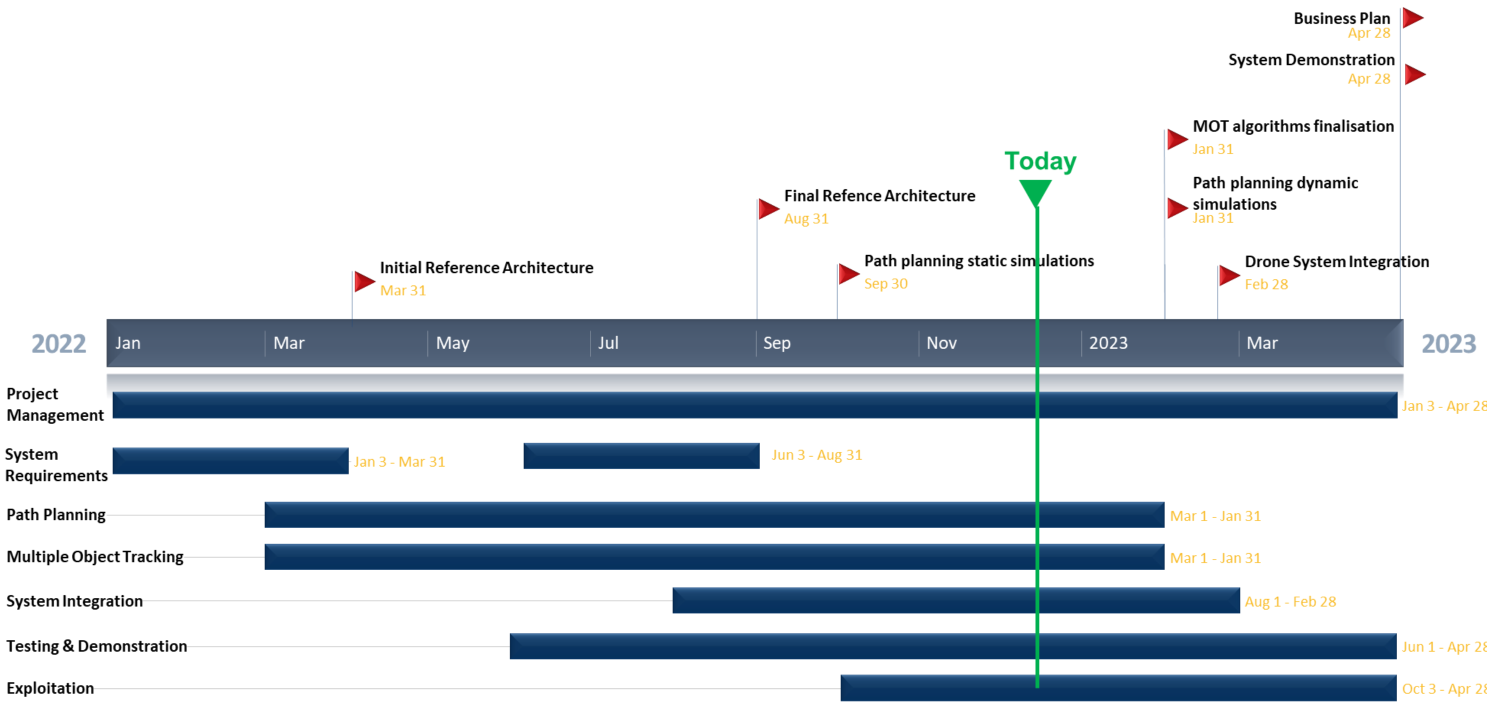
Where we are now?

- Finalising the system integration activities
- Conducting field tests of the integrated system
- Development of a business plan for the TRITON project
- Dissemination of the TRITON project in social media



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