A Concept Note

Wakanda Beyond
Peer Action Group

DroneTrack: Affordable open tracking hook on device

AN INITIATIVE OF: DRONES DOING GOOD ALLIANCE

WITH SUPPORT FROM: UKaid from the British people · sada SMART AFRICA DIGITAL ACADEMY · FRONTIER TECH HUB

Increased adoption of drone technology, also known as Unmanned Aerial Vehicles (UAVs), has introduced new challenges impacting airspace management and flight safety. In particular, Civil Aviation Authorities (CAAs) are concerned about ensuring safety during Beyond Visual Line of Sight (BVLOS) operations, where operators cannot directly see their UAVs during flight. As BVLOS operations are becoming more common with the rise of drone delivery programs and large-scale mapping projects, CAAs would like to be able to more effectively track the flights occurring in their airspaces. Here, we propose a solution that will help monitor UAV operations within standard airspaces to support operational safety.

Civil Aviation Authorities (CAAs) would like access to real-time flight data, including UAV identification, 3D position, and movement details. Our goal is to create an open hardware hook-on attachment for drones capable of providing consistent live position data under all circumstances, including in areas without GSM network coverage. This innovation addresses the limitations of existing systems and will allow the authorities to verify whether or not operators are adhering to flight and safety regulations. Implementing this solution represents a critical step in enhancing flight safety and security. Moreover, by being open hardware, it can be manufactured at relatively low costs, making it accessible for use in low-resource settings.

One of the main issues associated with existing tracking systems is their reliance on GSM for communication. This dependence on GSM networks renders live tracking impossible in areas that lack GSM coverage.

> *“ Our solution involves developing a robust hook-on live tracking device that will operate even without GSM coverage. This advancement will enable drone operations in remote areas and in areas with limited or unstable GSM coverage. ”*

The Challenge

Any device added to a UAV must meet the following requirements:

Lightweight: Since UAVs have limited payload capacity, additional weight reduces usability.

1. **Low power consumption:** High power usage limits the range of operation.
2. **User-friendly installation:** Operators are pilots, not necessarily avionics specialists.
3. **Cost-effective:** Aimed at affordable drones, additional devices should be financially accessible both in acquisition and operation.
4. **Safe:** Tracking devices should not disrupt safe flight operations *(e.g., electromagnetic interference).*
5. **Reliable under adverse conditions:** Devices should function in various weather conditions.
6. **Data security:** Tracking data must be protected against malicious interference.
7. **Protection against spoofing:** Guard against false or unavailable GPS data, a prevalent issue globally.
8. **System-wide security:** Both airborne and ground-based components, including communication equipment and servers, should be able to operate even in adverse conditions and be safe against malicious parties *(i.e., hackers).*
9. **Redundant:** Implement redundancy to ensure safe operation.
10. **Utilization of existing networks:** Leverage available networks, whether ground-based or space-based, to avoid the need for expensive ground equipment.
11. **Easy maintenance:** Ensure batteries can be charged from standard power supplies *(e.g., wide input range chargers).*
12. **Vendor independence:** Avoid reliance on specific equipment vendors to prevent being locked in; prioritize open-source solutions for continual access to data and the ability to develop improved, cost-effective versions.

Our Solution

The drone industry has seen significant growth in recent years, with numerous companies offering solutions. However, many available solutions require ideal conditions, such as strong 5G GSM network coverage, to operate effectively. However, it is critical for drone solutions to be resilient and operational during challenging conditions, as these are often the circumstances where drones can add the most value. For instance, during natural disasters such as an earthquake or severe flooding, the GSM ground network may be overwhelmed, or base stations might be damaged. In this situation, it is important that solutions are fully operational when GSM coverage is limited or unavailable or if its experiencing high network loads.

Some companies offer technical alternatives utilizing dedicated ground stations, such as LoRa technology. However, deploying these stations to achieve sufficient coverage can be a challenge. Additionally, some vendors claim extended range capabilities beyond what the technology was initially designed for. It's crucial to determine whether these claims hold up under real-world conditions or only in ideal scenarios.

Our solution offers a practical and cost-effective technical solution that has been proven to work reliably in real-world situations. We propose utilizing two technologies to transmit our data to a system server accessible to both the operator and the Civil Aviation Authority *(CAA)*.

1. GSM (4G/5G) for regular operations: This communication method is reliable when network coverage is available, functioning properly, and not overloaded. A GSM modem installed in the airborne unit can send data to the ground, verifying system functionality.

2. Iridium satellite system as an automatic fallback: Iridium offers a service called Short Burst Data (SBD), sending small data packets over its system to its ground station, then to a predefined server via email. A comprehensive status message containing all flight data (position, altitude, speed) can be sent in a 30-byte SBD message for $0.05. Sender identification is automatically generated using the unique IMEI of the modem, eliminating the need for unit configuration.

Position data from the airborne device can be verified using the data contained in the SBD mail sent to the server. Iridium provides this information with approximately 1km resolution, ensuring redundant communication from the UAV to the server.

While GSM is generally cheaper and faster under normal conditions, Iridium takes about 15 to 20 seconds per message. This was confirmed during field tests with a helicopter in Sao Paulo, Brazil, and the server in Taipei,
Taiwan. For Iridium, the base subscription costs about $13/month, with $0.05 per message. Assuming one status message every 20 seconds, this amounts to $9/flight hour if solely reliant on Iridium. GSM pricing depends on local provider rates and network capabilities.

Iridium is a proven technology, having been utilized in 50 Helicopter Emergency Medical Service (HEMS) systems without any glitches or issues. It remained operational even during an incident where a rogue Russian satellite collided with one of the active Iridium satellites, causing no interruptions.

The tracker device will include a GNSS receiver capable of obtaining data from multiple systems *(GPS, GLONASS, Beidu, or Galileo)*, ensuring resilience against outages and spoofing. Additionally, the device will feature a battery with sufficient capacity to last at least one full flight back to base, rechargeable with a standard USB charger.

The entire device must be waterproof for all-weather flying and tested according to relevant sections of DO-160. Full operation requires a server, which can be any PC with a reliable internet connection, obtainable from server farms for approximately $10/month, including hardware maintenance. Software for receiving tracker data, storing it in a database, and providing access to operators will be developed based on open-source systems. This software, along with access management for operators *(via PC or mobile phone)*, will prioritize safety, security, and resilience against hackers.

How it works

The entire project should be managed as an open-source initiative, with well-defined guidelines for all participants to ensure the project's progression and the development of a viable product that meets its objectives. All project data and artifacts should be stored in a project repository, with GitHub being a suitable platform for this purpose.

Project Stages & Deliverables

1. Definition of a project policy
2. Definition of system requirements and milestones
3. Defining the requirements on different levels *(hardware, software. etc)*
4. Definition of verification methods
5. Design of the hardware
6. Building prototypes
7. Design of the different software components
8. Software test
9. Integration test
10. Deployment
11. Test of the full system
12. Produce the system

This project has the potential to be a significant milestone, introducing a dependable and cost-effective open hardware live tracking device. It has the capability to facilitate Beyond Visual Line of Sight (BVLOS) flights, even in remote areas. This advanced technology can be manufactured in Africa, contributing to the growth of the manufacturing sector in the region.

Join us

Become part of the Wakanda Beyond Alliance, joining forces with partners dedicated to enhancing drone safety and operational efficiency across Africa and beyond.

If you share our vision for a seamlessly integrated airspace, we invite you to express your interest. Together, we can contribute to making Africa the easiest place to fly drones safely.