Spherical View Radar

Airspace Awareness - Assured

White Paper

March 2022

Summary

Spherical View Radar brings next-generation sensor technology to the drone surveillance mission. It provides a spherical field of view (360° elevation and azimuth) through a bi-static configuration, using multilateration to detect and track the location of smallest micro drones (DJI Mini or similar; RCS as low as 0.001 m^2) in complete 3D with a positional accuracy of 1 cubic meter at ranges from 3 meters to 3 km.

Spherical View Radar is under development by Trident Defence, based in Ukraine. The product has been tested to TRL 7, with the production of demonstration versions scheduled for the beginning of 2022. The development is fully financed; we are looking for strategic partners to generate product synergy and facilitate access to global markets.

Mission

The protection of critical infrastructure and the development of Unmanned Traffic Management (UTM) and Advanced Air Mobility (AAM) require new surveillance capabilities. The emergence of small, maneuverable, and “dark” (no RF signal) drones has degraded the ability of current radar systems to provide assured situational awareness of the airspace. SVR addresses this challenge with a novel design and disruptive technology.

System Architecture

Spherical View Radar achieves market-beating performance in detection, 3D location and tracking by incorporating bi-static radar technologies with time difference of arrival (TDoA) localization (multilateration).

The basic configuration consists of:

- a receiver composed of several phased array antennas that constantly stare in all directions (360 degrees elevation and azimuth) to detect reflected signals from targets
- at least four (as many as 16 for illumination of additional areas) cooperating transmitters, each with a unique signal, which constantly illuminate the controlled volume of airspace

Two or more receivers can be networked to eliminate blind spots and provide coverage of sites of any size. The transmitters can be programed to work at different power levels (0.1W - 10 W) to meet the requirements of the site and to optimize range, ensuring positioning accuracy up to 3 km. With proprietary signal processing, the receiver converts the received signals into time referenced, 3D (x, y, z) target coordinates through multilateration.

Data is transferred through an encrypted protocol to a server that displays targets on 2D and 3D maps on desktop and mobile devices. Alternatively, the server can export data via an API using standard industry protocols (Asterix, Sapient) to the customer’s command and control

system or stream the RAW radar data using fiber optic interface for further processing by customer's systems.

Fig. 1. Mock-up of the receiver (left) and transmitter (right)

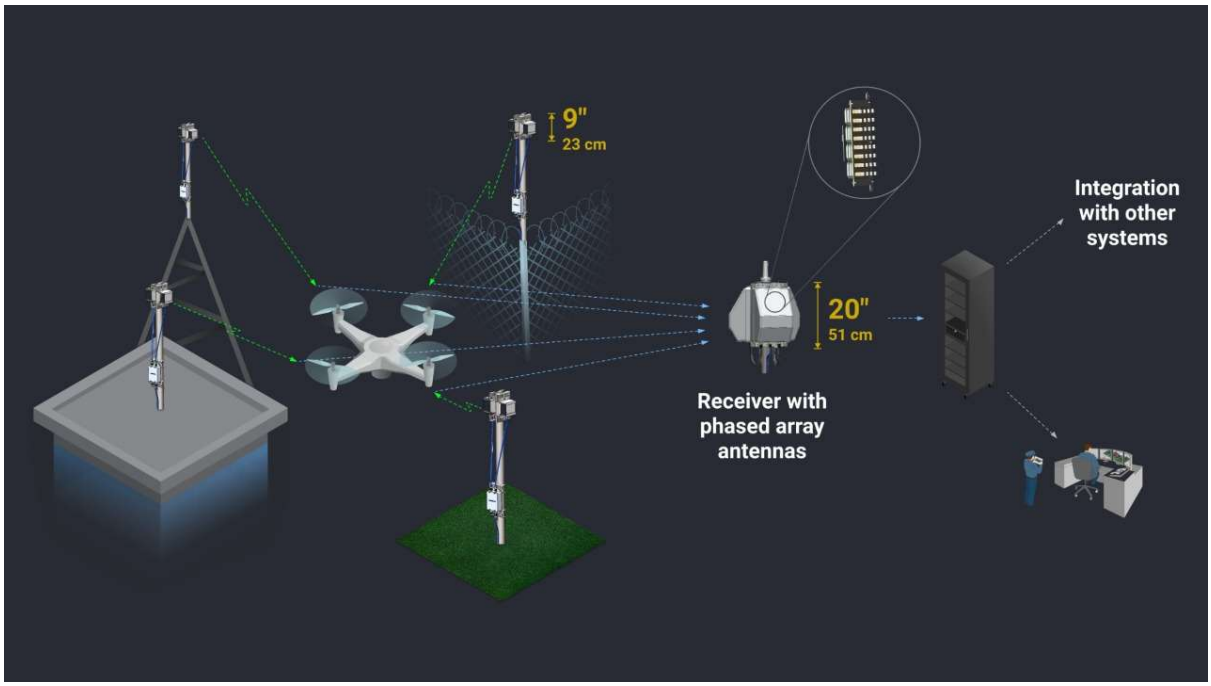

Fig. 2. System architecture

Performance / Features

- Spherical field of view – 360 degrees azimuth and elevation (straight up, straight down, and all the way around) with no 'cone of silence'
- Detection of airborne targets with radar cross section (RCS) of 0.001 square meters (3x3 cm), anywhere within the surveillance volume of 3 m to 3 km from the receiver
- Detection at longer ranges is predicted as follows: 4 km (RCS 0.01); 6 km (RCS 0.1 m); 10 km (RCS 1 m)
- Coverage area can be extended indefinitely, blind spots eliminated by networking two or more systems
- 3D positioning of the target (x,y,z coordinates) with an accuracy of 1 meter
- Bi-static approach enables superior detection of low-profile targets and false target filtration through multiangle illumination, radar signature analytics and machine learning
- Detects up to 100 targets simultaneously with 0.5 m separation, as low as 1 m above ground, at velocities from 0.0 to 500 km/h
- Resistant to jamming; operation of system can be difficult to detect
- Flexible user interface based on high precision custom 3D model of site enables target management, logging, history, geofencing and exclusion zones, false target filtration
- Industry standard protocols (Asterix, Sapient, RAW) for integration with other systems
- Flexible, programmable power level (0.1-10W); safe near people, does not interfere with other radio-frequency devices, no special training required
- Compact and light (less than 25 kg), easy to transport and install

User interface server

Target data acquired by the receiver is encrypted and provided to the UI Server using an ethernet connection. The server will process the data and provide following functions:

- Visual display of the detected targets on 2d and 3d maps using web interface
- Target management, logging and history
- Geofencing and exclusion zones (masking)
- Merging of target data from multiple receivers
- False target filtration, including birds
- Radar element configuration, health status monitoring
- Software and equipment firmware update
- API for integration with other systems using industry standard protocols (Asterix, Sapient)

Figure 3. Screenshot from the user interface
(Real time 3d view with imported custom 3d model)

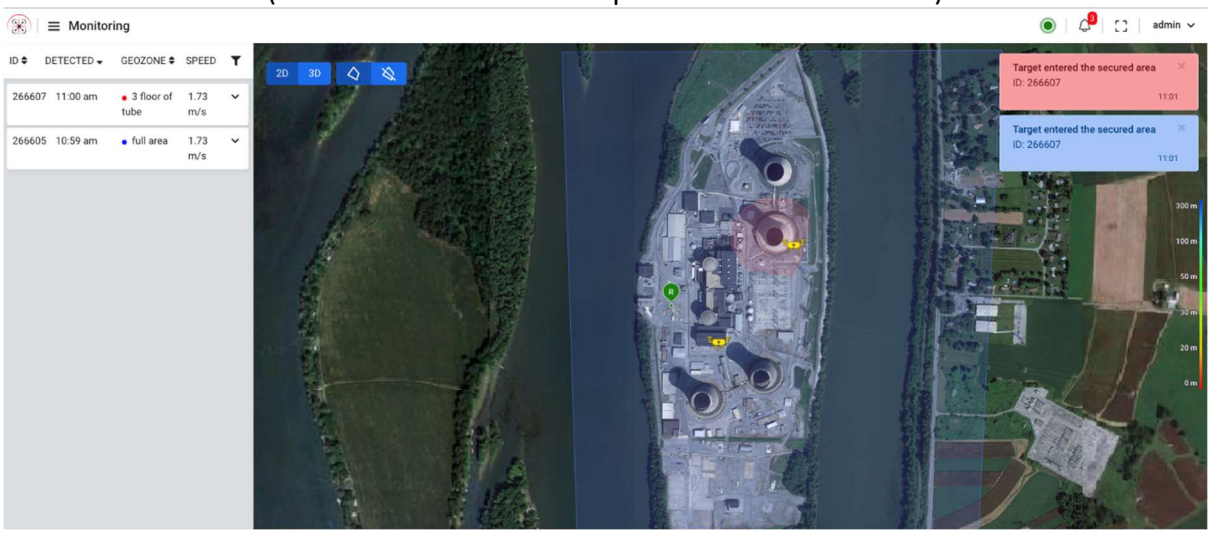

Figure 4. Screenshot from the user interface
(Real time 2d view with different priority geozones)

Figure 5. Screenshot from the user interface (History data player)

Development status

We have successfully completed field testing of a prototype of our radar, bringing the development to TRL 7. The results of these tests, performed with a DJI Mini and other small drones, demonstrates that the performance of the final production version will meet our stated specifications. We are now refining the design of the final production version and will begin tests for TRL 8 in the Spring-Summer of 2022.