

Raytheon IDS
Experimental Modification Application
Call Sign: WG2XVY
File Number: 0113-EX-ML-2015

Explanation of Need for Modification

Background:

Raytheon IDS builds a variety of advanced radar systems for the US military. A recent initiative to undertake rapid development of an advanced radar system with sophisticated signal processing, Raytheon needs to use an airborne synthetic target generator (STG) to simulate a remote radar signal that is in motion. This STG will exercise the radar, allowing for rapid development of the technology.

The proposed experimentation requires mounting the STG on a small unmanned aerial vehicle (UAV) platform which emulates the real target motion in the air. The low power of the STG will help test the perceptivity of the radar under development. The UAV-mounted STG will transmit the existing authorized waveforms at lower power levels and at five new mobile locations.

Technical Synopsis:

- Spectrum Needed: 5.4 – 5.5 GHz, mounted on UAV
- Power levels requested: 5 W output power, 50 W ERP
- Location of UAV use: very limited use in 100 meter radius around selected locations
- Maximum altitude: 400 feet above ground level
- Time of use: Use is limited to 15 minutes per flight, flights will be sporadic

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Explanation of Experiment:

Currently, Raytheon is working on advanced radar development. It holds license WG2XVY for test operations of the radar system that is the subject of this application. Various testing has been under way since this license was originally granted in September 2013. Recently, the program has determined that they can advance the development of the product more speedily if they can simulate a remote target in motion. The program determined that a ground-based moving target

would be shielded by cars and buildings too quickly to be of any use in the development of the radar system. Use of a piloted aircraft was prohibitively expensive, and the program has sought authorization from the FAA to use a UAV as the platform for the STG to be used in the next phase of the radar development.

The STG will be mounted on a DJI S900 Hexacopter. The Hexacopter can carry the weight of the transmitter with ease. The hexacopter, when it is flown within 400 feet of the ground, has enough range, altitude, speed and other factors to serve as an ideal platform for the STG to work on the radar system.

The radar will have line of sight access to the STG at each of the selected mobile operation sites. On clear and not-very-windy days, the program will run flights for 15 minutes apiece from one or more of the selected test sites. The testing is expected to be very sporadic, and the time of use of the spectrum will be limited to the hexacopter's 15 minutes of flight time.

Raytheon has a licensed pilot available to fly the UAV, to stay within the regulations prescribed by the FAA. No flight will take place unless and until the FAA also allows Raytheon to conduct these UAV tests.

Areas of operation:

To exercise the radar system adequately, Raytheon has identified five local test areas at or near its Pelham, New Hampshire facility. Each of these test areas offers the opportunity to examine different aspects of the radar's ability to deal with the geometry of distant object detection.

Site Locations (Lat, Long, & Alt. in ft)

Pelham Site, Site 0: 42-44-13 N, 71-21-15 W, 412

IDS HQ, Site 1: 42-38-13 N, 71-14-59 W, 197

MDC Site, Site 2: 42-31-18 N, 71-08-30 W, 107

Sudbury Site, Site 3 : 42-21-54 N, 71-25-51 W, 159

UAV Test Field, Site 4: 42-37-00 N, 71-30-38 W, 204

The *Figures 1-5* are taken from Google Earth, depicting the site locations with a 100 meter radius from the site coordinates. The radius is for informational purposes only, since the hexacopter will not fly throughout the whole radius. At the MDC and Sudbury sites, operations will be limited to the sectors shown, to ensure additional safety. When the hexacopter is in use, it will fly/hover in a very limited portion of the area shown. These images are presented to allow the reviewer to see that the areas selected are away from people and mostly away from buildings. In those areas, the hexacopter will fly in an oval or figure eight pattern, if it is not simply hovering.



Figure 1. Pelham Site (radius = 100 m)



Figure 2. Raytheon IDS Headquarters – back parking lot, showing potential flight pattern



Figure 3. Missile Defense Center (MDC), showing potential flight pattern

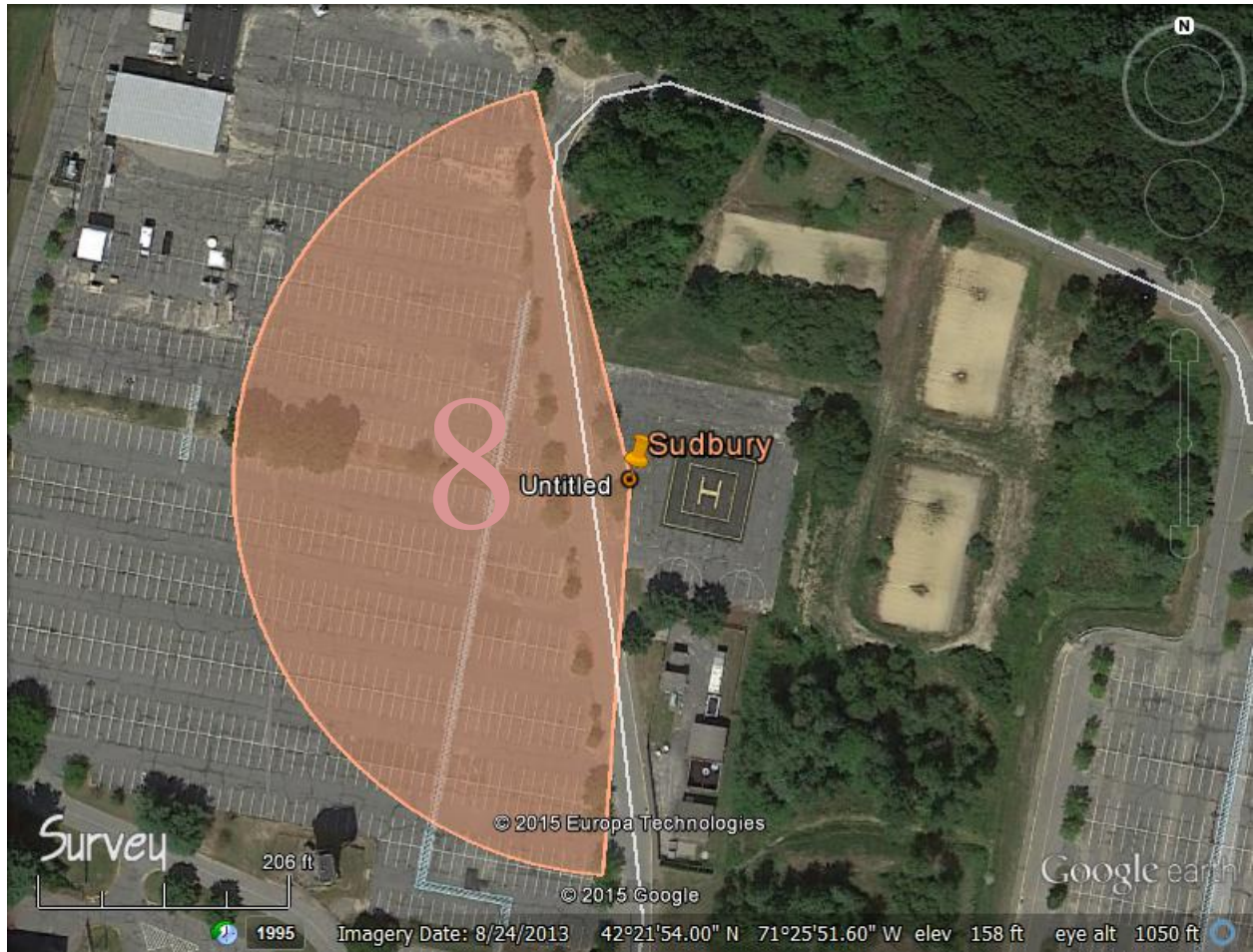


Figure 4. Sudbury location, showing a potential flight pattern

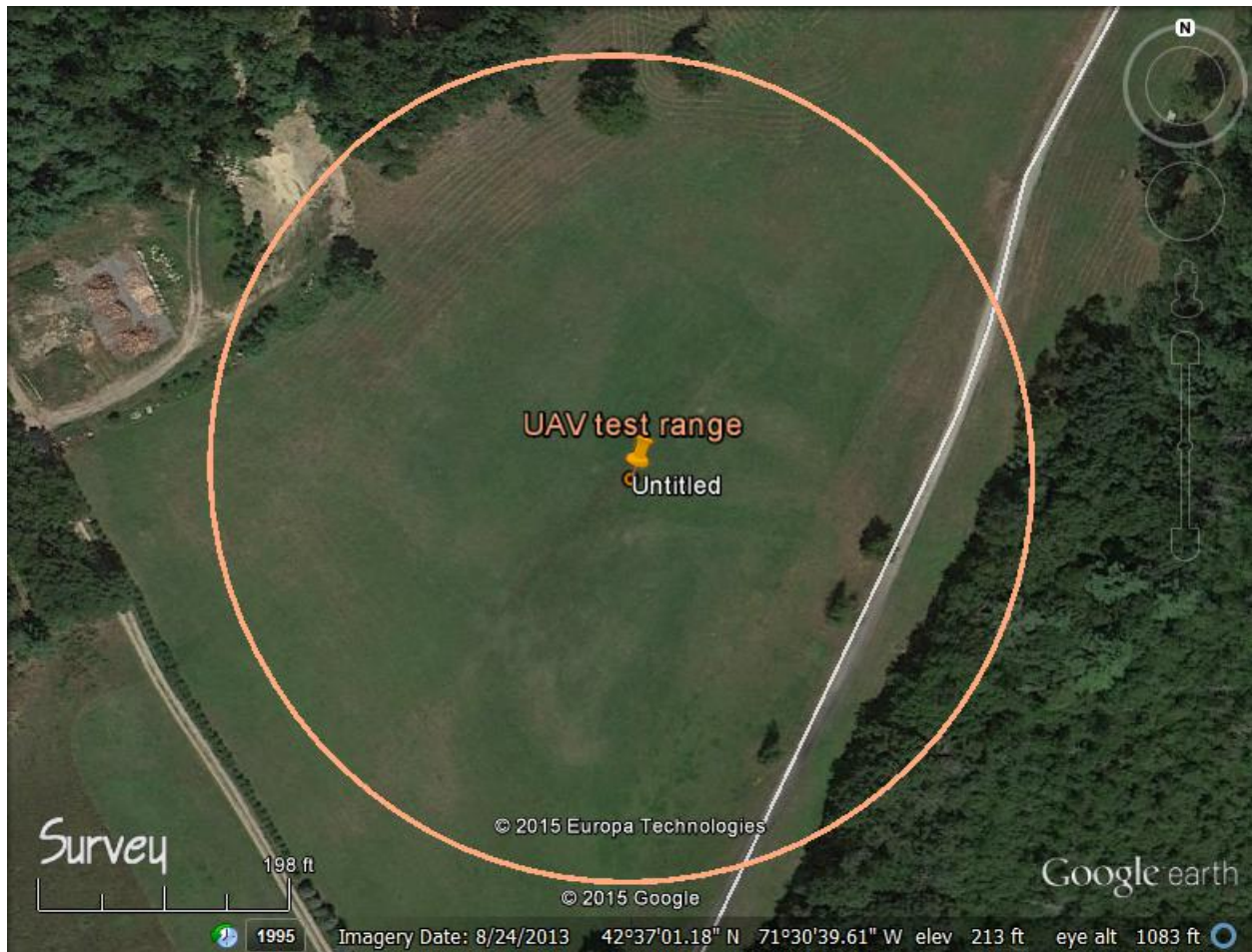


Figure 5. UAV test range

The diagram in *Figure 6* shows the position of the various test sites in relation to each other. The terrain at the Pelham site has the highest site elevation. Therefore, with the radar using some downtilt, it will be able to have line-of-sight to each of the other test areas when the UAV is in flight there, even though the flight altitude will be below 400 feet.

RF Laydown

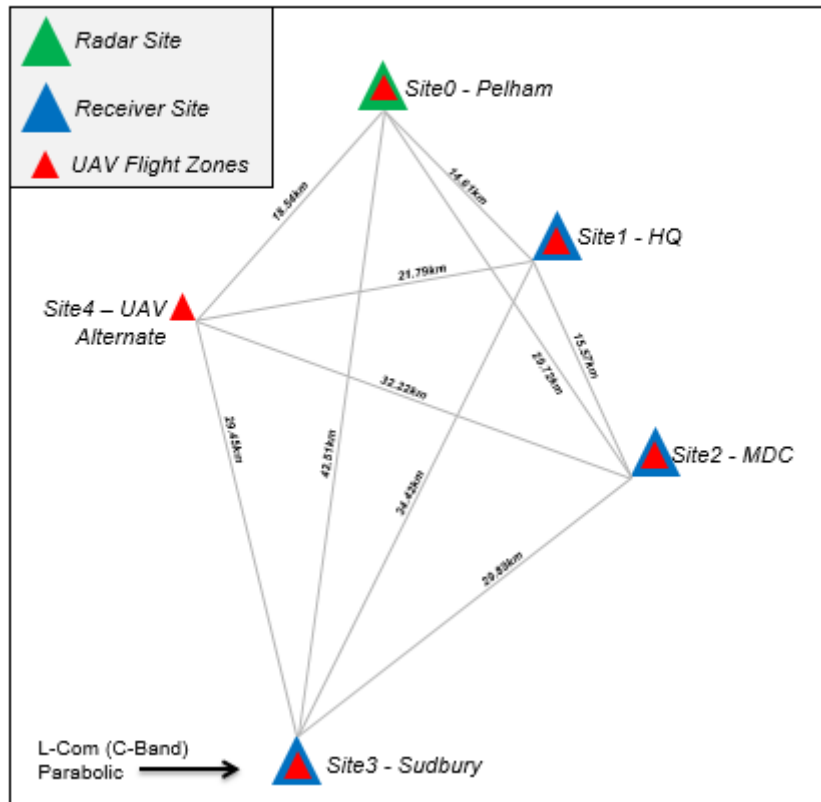


Figure 6. Overview of mobile test sites in relation to radar and each other

Technical details of Synthetic Target Generator:

Synthetic Target Generator

Manufacturer: Raytheon
Model: STG-UAV
Number of units: One
Experimental (Y/N): Yes

STG Characteristics:

RF output at the transmitter terminal on the UAV: 5 Watt
Effective radiated power from the antenna on the UAV: 50 Watts Peak
Frequency Tolerance: Less than 0.01

Waveforms and Emissions needed for testing:

The proposed testing will examine the operation of the radar when the STG is using a variety of different waveforms. The summary of those is presented in Table 1 below.

Waveform	Transmitter	Transmitter Output, Peak	ERP, Peak	Necessary BW (MHz)	Emission Designator
Linear FM Chirp	STG-UAV	5 W	50 W	52.3 27.3 4.80	52M3Q1N 27M3Q1N 4M80Q1N
Phase Coded Pulse	STG-UAV	5 W	50 W	9.0	9M0M1N
CW	STG-UAV	5 W	50W	N/A	N0N

Table 1. Parameters of Waveforms for STG-UAV at Test Areas:

The spectrum used will always be in the 5.4 – 5.5 GHz band.

Conclusion:

Raytheon IDS is working on advanced development of a radar system. This modification application seeks authority to add a mobile synthetic target generator to the existing radar license WG2XVY. The operations will be limited to very small areas at selected spots on or near Raytheon property that are ideal for the use of a UAV which can exercise the radar in ways that will advance the radar development. The time of use is highly limited. The geographic scope of operations is also very limited. The grant of this modification will significantly speed up the development of the radar system, creating significant savings for the US military.

If there are any questions regarding this application or the information in this exhibit, please contact Karen Dyberg, Spectrum Manager, Raytheon IDS, 508-450-9236 or Karen.dyberg@raytheon.com, or Anne Cortez, WFS, at 520-344-8525 or alc@conspcinternational.com.