

A Maritime Radar for Zephyr S

SPIDER (Ship Position and Detection Radar)

Maritime Security

- >90% of world trade goods and > 70% of global crude oil are transported by sea
- Growth in shipping increases likelihood of accidents and environmental damage
- Shipping increasingly a target for piracy, organised crime and terrorism
- Illegal maritime activities such as illegal fishing, drug trafficking, weapon movement/proliferation and illegal immigration are constantly on the rise

What is Required?

- Improved maritime monitoring and tracking services
- Enhanced vessel detection capabilities, operating in conjunction with AIS
- Augmenting or replacing HF radar systems providing coastal ship tracking
- Identification and discrimination of civilian and military vessels
- All weather day/night capability
- Low data latency – typically less than 1h
- Revisit time – typically less than 2h

Problems of current solutions

- AIS restricted to cooperative targets
- Restricted coverage of terrestrial AIS/radar
- Satellite radar instrument complexity, size, power and number required
- Latency of satellite AIS/radar
- Narrow FOV of airborne sensors

Our Solution!

- Low-cost persistent and reliable maritime security and surveillance from HAPS
- Novel low SWaP payload suitable for Zephyr S
- Specifically designed for ship position, detection, and tracking
- COTS components
- Complementary to and can provide cueing to other maritime sensors
- Potential progression to low-cost spaceborne SPIDER

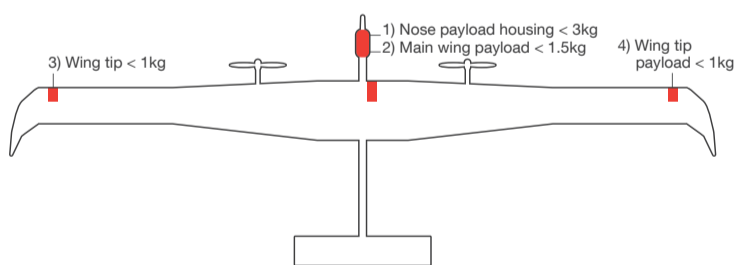
Key Features

Payload Characteristics	Payload Performance	
<ul style="list-style-type: none"> Total mass < 5kg Power consumption < 30W (avg.) Centre frequency: X-Band Bandwidth: up to 500 MHz CW Operation: PRN and Chirp pulses Antenna size <0.2 m x 0.2 m Beam Scanning capabilities for extended coverage 	Resolution	<ul style="list-style-type: none"> Maritime: 0.5 m x 100m SAR[†]: 2 m x 2 m
	Access	<ul style="list-style-type: none"> Maritime: 50 km* SAR[†]: 10 km (single-beam)
	Swath	<ul style="list-style-type: none"> Right/Left side operation Incidence angle: 20° - 55° Azimuth angle: ± 20°
	Performance	<ul style="list-style-type: none"> Prob. of detection > 0.9 Prob. False alarm < 10⁻⁶

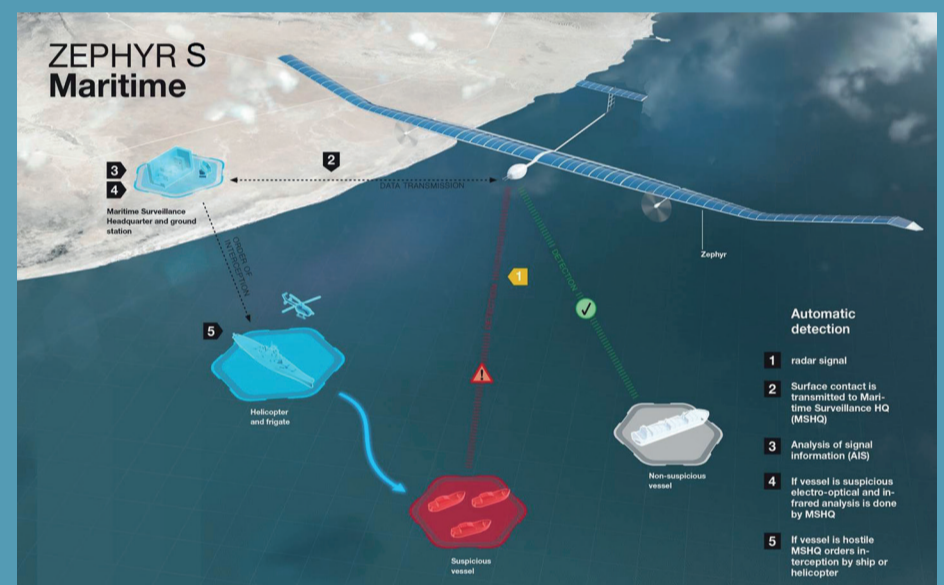
* Combines several elevation beams [†]SAR processing on-the-ground
 The predicted performance of the SPIDER ZS Radar will detect fishing trawlers and also larger ships with a probability of detection (Pd) >0.9 and a probability of false alarm (Pfa) <10⁻⁶, covering swaths from 26km to 70km even in very rough conditions, such as sea state 6.

Payload Accommodation on Zephyr S

- Two options depending on detailed mass budget:
- Whole payload in nose housing (only if <3kg feasible after optimisation).
 - Backend in main wing (<1.5kg) and rest in nose pod (<3kg).

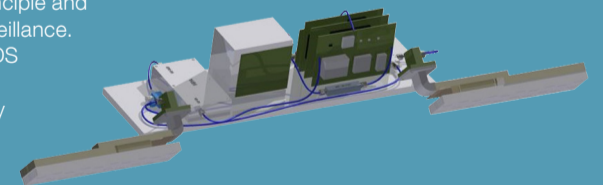


Potential Operational Scenario

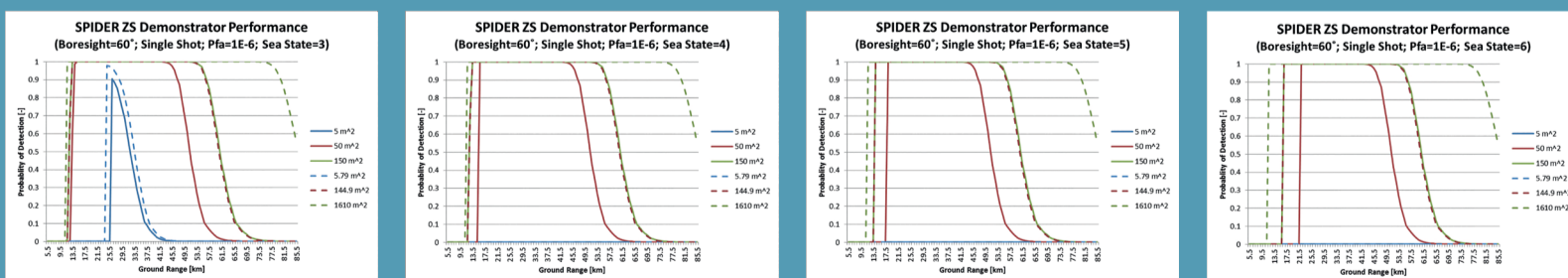


SPIDER Proof Concept Campaign

- Implementation, validation, and verification of a SPIDER PoCC demonstrator.
- Demonstration of SPIDER radar concept on an airplane ("controlled" environment).
- Demonstration of processing principle and radar operation for maritime surveillance.
- CEOI Program with 50% Airbus DS co-funding.
- Zephyr's radar design with mostly the same COTS components but without PCB integration.
- Instrument integration complete end October 2017.
- Flight trials planned for December 2017.



Simulation Results (PFA<10⁻⁶):



- Assumptions:
- 3m small boat: RCS=5.8m²
 - 15m ship: RCS=145m²
 - 50m ship: RCS=1610m²

Expected ship RCS at X-Band based on extensive TerraSAR-X data analysis carried out by Defence R&D Canada (http://publications.gc.ca/collections/collection_2016/rddc-drdc/D68-6-120-2013-eng.pdf).