UK SPF Cluster 1: Future demand for unlicensed spectrum

Presented by Dr Steve Clark

CEO & Founder, Cambridge Sensoriis

Cambridge Sensoriis

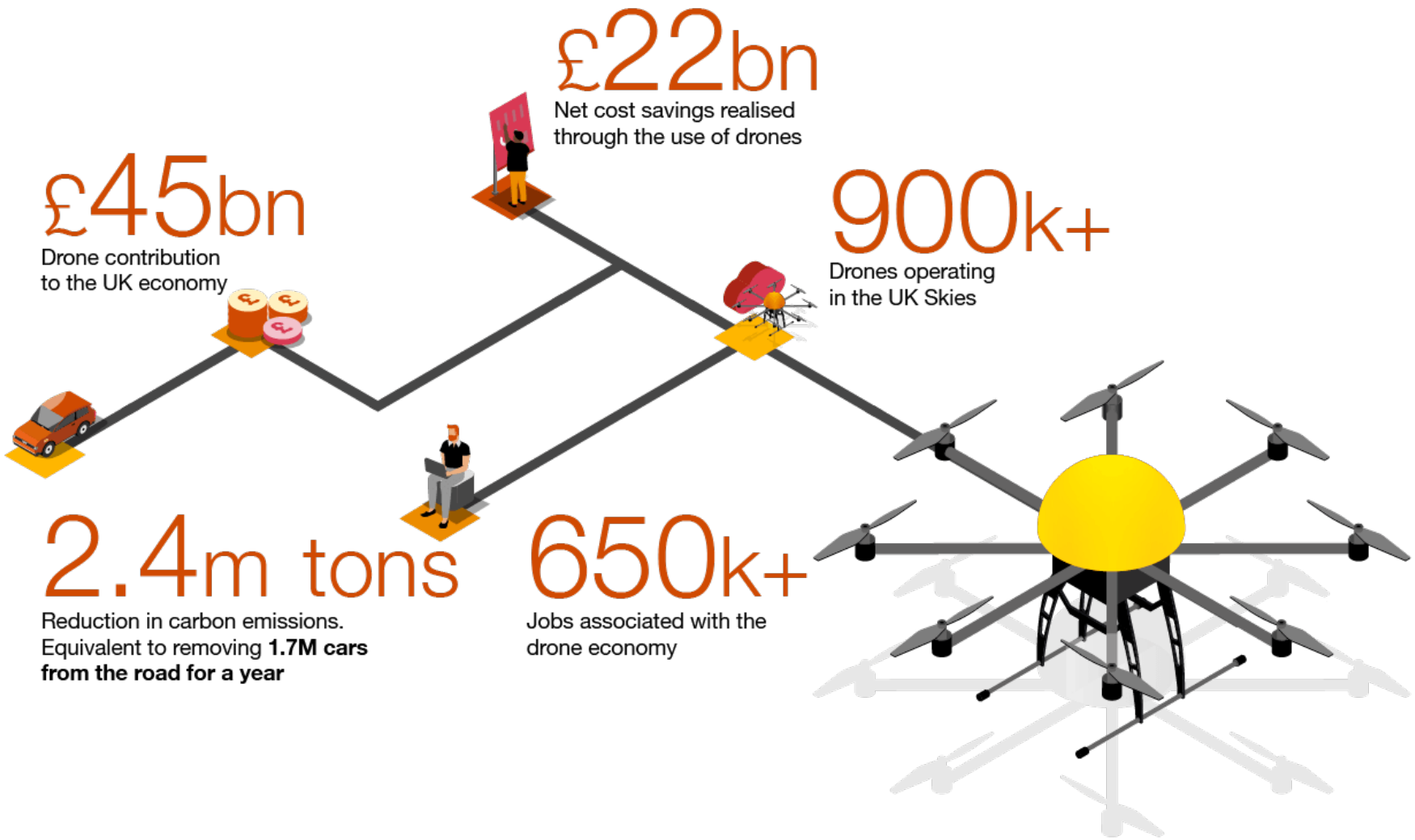
Company Profile

- UK-based, designer and manufacturer of micro-Radar systems.
- On-drone Radar, supporting drone missions. Beyond Visual Line of Sight. Autonomy
- Developed proprietary micro-radar technology, specifically for Uncrewed Aerial Vehicles (UAVs):
  - **A**ctive **R**adar **C**o-operating technology: resilient localisation, and automation
  - **R**adar **A**ware: object detection, tracking and collision avoidance
- Low SWaP (Size, Weight and Power) footprint – essential for UAV deployment
- Deep domain expertise – staff has 50 years combined experience in radar systems

Applications

- **Inspection** of industrial plants and ORE
- **Surveying** of sites and landscapes
- **Delivery** of commercial goods & supplies
- **Surveillance** of hostile presence
- **Emergency Services** response & rescue
- **Defence** & Military operations

PwC Skies Without Limits report
Contribution of Drones to the UK economy (2030)



Cambridge Sensoriis products give new capabilities to operators with long distance or complex missions

Automated Maritime surveillance

High demand to replace piloted surveillance with market for US coastguard $511m in 2020*

Asset Infrastructure monitoring

25,732 drones in UK alone in Agriculture, Mines, Utilities & offshore wind by 2030+

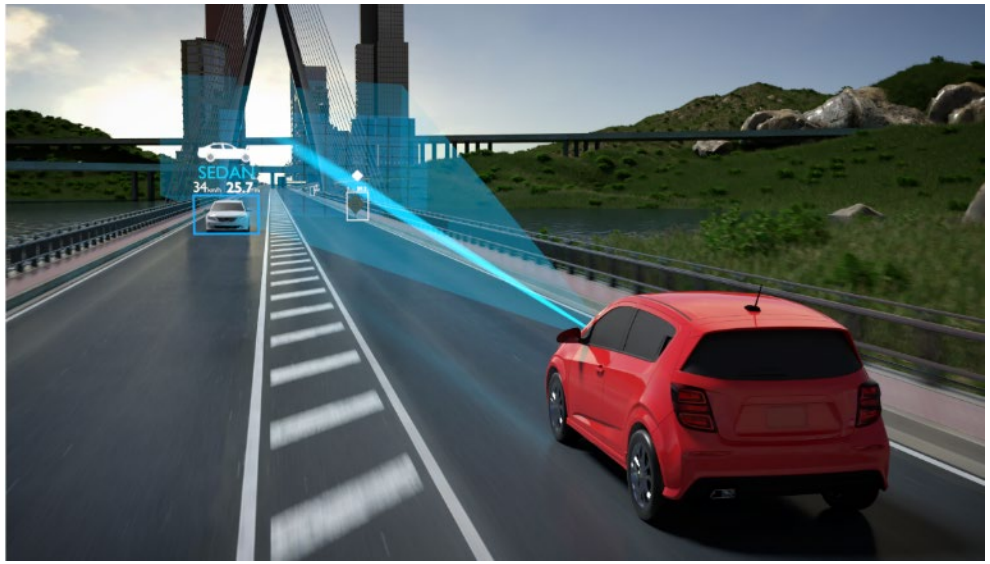
Logistics Obstruction detection

11,008 drones in UK alone Logistics by 2030+

* Goldman Sachs

+ PWC 2020 Future Flight Road Map 2021 UKK Innovate

micro-Radar is the right technology for long range, all weather, resilient sensing



Wide automotive use.
Advanced driver assistance systems (ADAS)

Why not for drones ?

State-of-the-art sensing

Long range, beyond line-of-sight capability giving perfect reassurance of task completion in any weather condition

GPS-Free Resilience

No sole reliance on satellites (GPS) which are not always available, particularly in built up ‘urban canyon’ areas

Complex Avoidance

Drones can operate in obstructed environments not suitable for pilots or else are expensive or impractical

Technology Overview

Proprietary Technology

- FMCW (Frequency Modulated Continuous Wave) methodology
- Unique patented “communication” between Primary and Secondary radar
- Delivered in ‘micro’ form factor (low SWaP)
- Measures 4D: range, bearing(azimuth), elevation, velocity
- Delivers pin-point ‘localisation’ and/or landing capability – accurate to 1cm resolution
- Sensoriis ARC can ignore ‘reflections’ and clutter from background infrastructure
- Operates in GNSS denied scenarios

Small and lightweight

Low powered, no moving parts

High resolution and long range

Highly effective in all conditions

Products

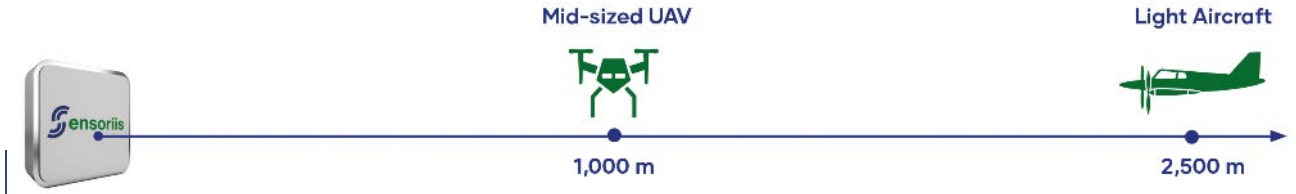
RadarAware™

RA1000

Performance enhancement:

- 1,000m small object detection
- SWaP circa 500gms
- Extend field-of-view
- Tracking
- Sensoriis Application Programming Interface (API)

RA1000 – Typical detection ranges for air targets

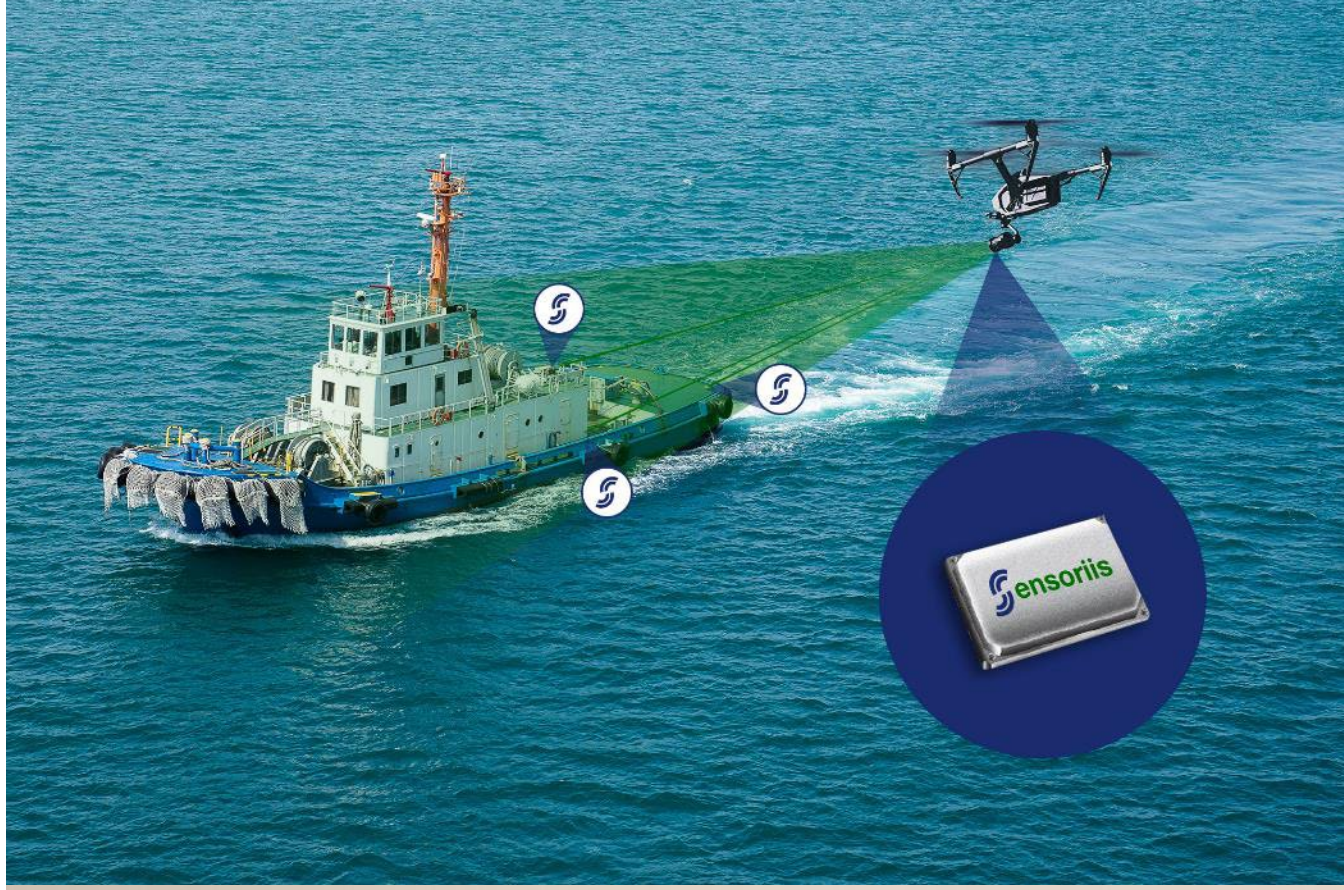


Products

ARC – Landing™

ARC™ radars supports resilient, all-weather, localisation and autonomous landing, in GNSS denied environments

- 120m detection range (extended range options available)
- Range measurement accuracy to within 1 cm.
- Default stealthy at the ship, negligible transmit power until compatible UAV radar detected
- SWaP: ≈ 300 grams (on Pad);
  ≈ 30 grams (OEM* board on UAV)
- 1 primary [drone] + 3 secondaries [vessel]



ensoriis

Spectrum

57-64 GHz

- High atmospheric attenuation, good for covert operation but limited detection range
- Airbourne use is permitted.
- Low 20 dBm eirp max transmit power
- Suited for **ARC** autonomous landing systems, where UAV & Drone are active

Interface / Notification number / Date	Application	Comments to application	Frequency band	Maximum transmit power / Power spectral density / Fieldstrength	Comments to Maximum transmit power / Power spectral density / Field strength	Channelling	Channel access and occupation rules	Informative Reference
IR2030/1/45	Non-specific short-range devices	Equipment may be used airborne.	57 - 64 GHz	100 mW e.i.r.p. 13 dBm/MHz e.i.r.p. 10 dBm transmitter power				EN 305 550

IR2030, License Exempt Short Range Devices

Spectrum

76-77 GHz

- Low Size Weight and Power (SWaP) radar is critical for onboard UAS sensors, where payload weights are limited.
- Atmospheric attenuation Window, for greater detection range
- 76-77 GHz is ideal for **RadarAware** BUT Airbourne use is NOT currently permitted.
- 55 dBm eirp peak max transmit power. Suited for Detect and Avoid, non-cooperative objects at sufficient distance to take avoidance action

Interface / Notification number / Date	Application	Comments to application	Frequency band	Maximum transmit power / Power spectral density / Fieldstrength	Comments to Maximum transmit power / Power spectral density / Field strength	Channelling	Channel access and occupation rules	Informative Reference
IR2030/14/9	Transport and Traffic Telematics	This set of usage conditions applies to terrestrial vehicle and infrastructure systems only.	76 - 77 GHz	55 dBm peak e.i.r.p. and 50 dBm mean e.i.r.p. and 23.5 dBm mean e.i.r.p. for pulsed radars				EN 301 091

IR2030, License Exempt Short Range Devices

Spectrum. Activity around drone use

OFCOM consultation - Spectrum for Unmanned Aircraft Systems. Dec 22

- The National Police Air Service and others submitted a response arguing that the omission of an authorisation mechanism and spectrum allocation for use of radar on a drone would delay development of BVLOS uses for UAVs in the UK.

Band coexistence

- Numerous Advanced Driver Assistance System (ADAS) radar safely share spectrum on highways. ADAS radar safely coexist with infrastructure radar on the UKs SMART motorways
- ECC issued report 222 **in 2014** regarding manned rotorcraft use of the band. Includes compatibility studies on other radio systems and services.: 222.

We seek use of 76-77GHz for UAS, rotorcraft, and eVTOLs, to the same power and eirp levels as permitted for terrestrial vehicles, and infrastructure radar.

and cooperation between Civil Aviation Authority, and OFCOM. Spectrum allocations, so industry can invest in product development for a national Drone capability.

Questions ?

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