ICAO

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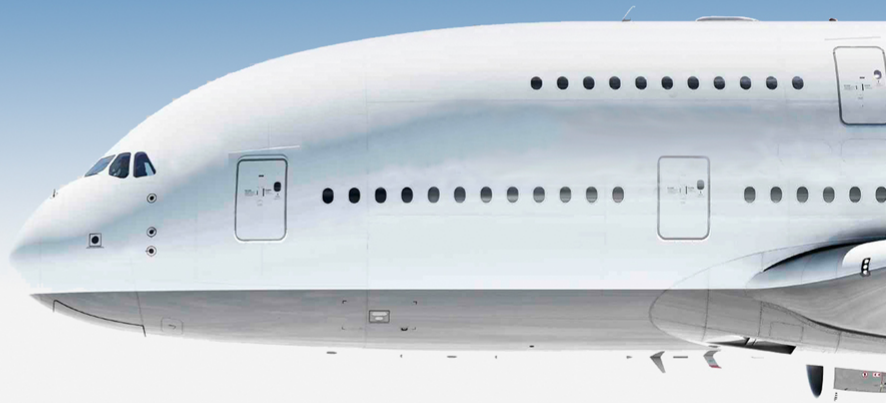
North American, Central American and Caribbean Directors of Civil Aviation

ARMS – Anti RPAS Multisensor System

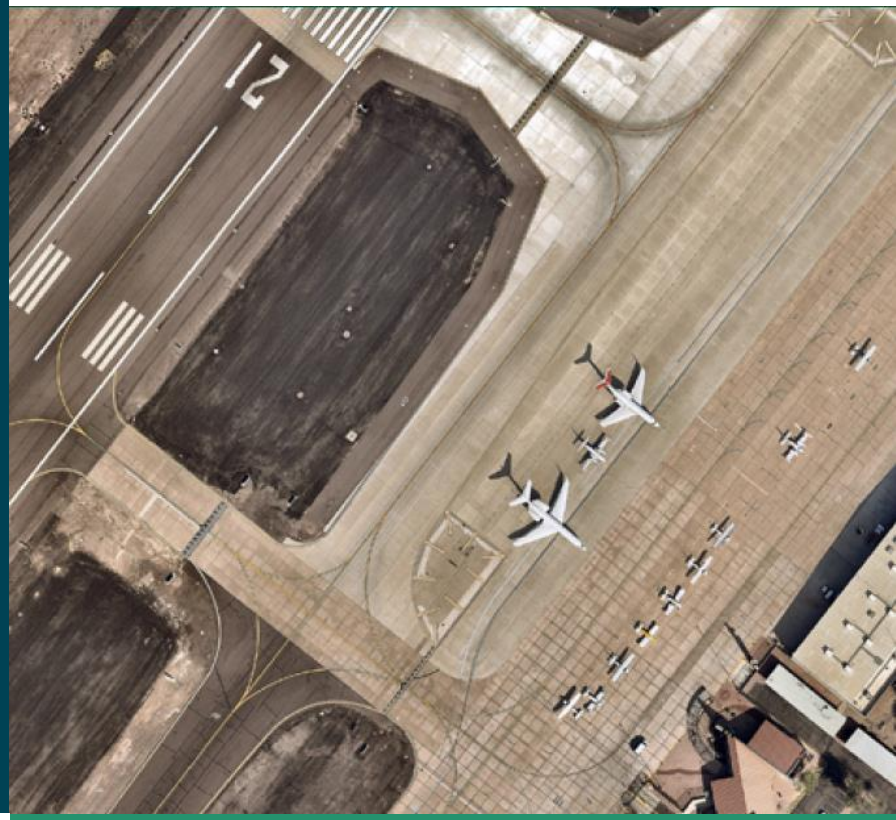
INDRA



Agenda Item 6.3 - P/08

ARMS

Anti RPAS Multisensor System



June 2019

Some concepts about drones, UAV, UAS, RPAS

Multiple terms, different categories and performance with multiple applications

Different UAS groups
classified by maximum weight, operating altitude, speed, etc (micro, mini, low and high end tactical, strategic)

	UAV Unmanned Aerial Vehicle	**UAS** Unmanned Aerial System	**RPAS** Remote Piloted Aircraft System
			
Weight	< 20 Kg	200 Kg	> 14 Tn
Altitude	40-150 m	< 3.600 m	< 18 kms
Speed	50-70 km/h	180 km/h	> 500 km/h
Autonomy	< 40 min	4-6h	> 20 h

Multiple applications

Ref – "Plan Estratégico para el desarrollo del sector civil de los drones en España 2018-2021", Ministerio de Fomento, España

… but not always so great

UAS/RPAS have become a **real and significant threat** for **infrastructures and people** due to their **malicious or errant use**

News › World news › Plane crash

Drone crashes into Boeing 737 jet plane coming into land at Mozambique airport

The aircraft belonging to Linhas Aéreas de Moçambique - LAM Flight TM136 - was approaching the capital of Tete with 80 passengers and six crew on board when the incident occurred

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Latest News
Web Date: July 15, 2016

U.S. Congress clears the way for limits on drone flights near chemical plants and refineries

Industry is concerned about potential accidents as well as espionage

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Man fined after flying drones over Premier League stadiums

15 September 2015 | Nottingham Share

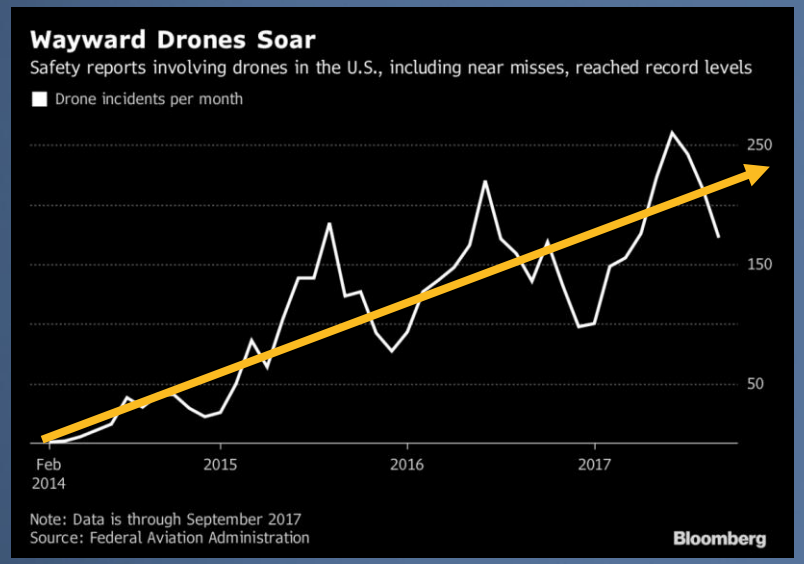
Civilian drone crashes into Army helicopter

By Danielle Furfaro, Larry Celona and Natalie Musumeci September 22, 2017 | 2:48pm | Updated

CNBC HOME INTL NEWS MARKETS

Mystery Drones Buzzing Army Base Near White House

We are facing a new kind of threat, and growing



Drone market is evolving fast

Technology improves and threat is increasing, **automation** and higher **sophistication** are the main challenge:

GPS-denied navigation

Swarm coordination

Extended range and duration

Heavier payloads

Multiple illegal and malicious uses

Espionage and Intelligence

Transport of explosive and biological payloads

Air Traffic Interruption

Security Systems must be adapted according to the **threat evolution**

Civil aviation is NOT immune to this threat

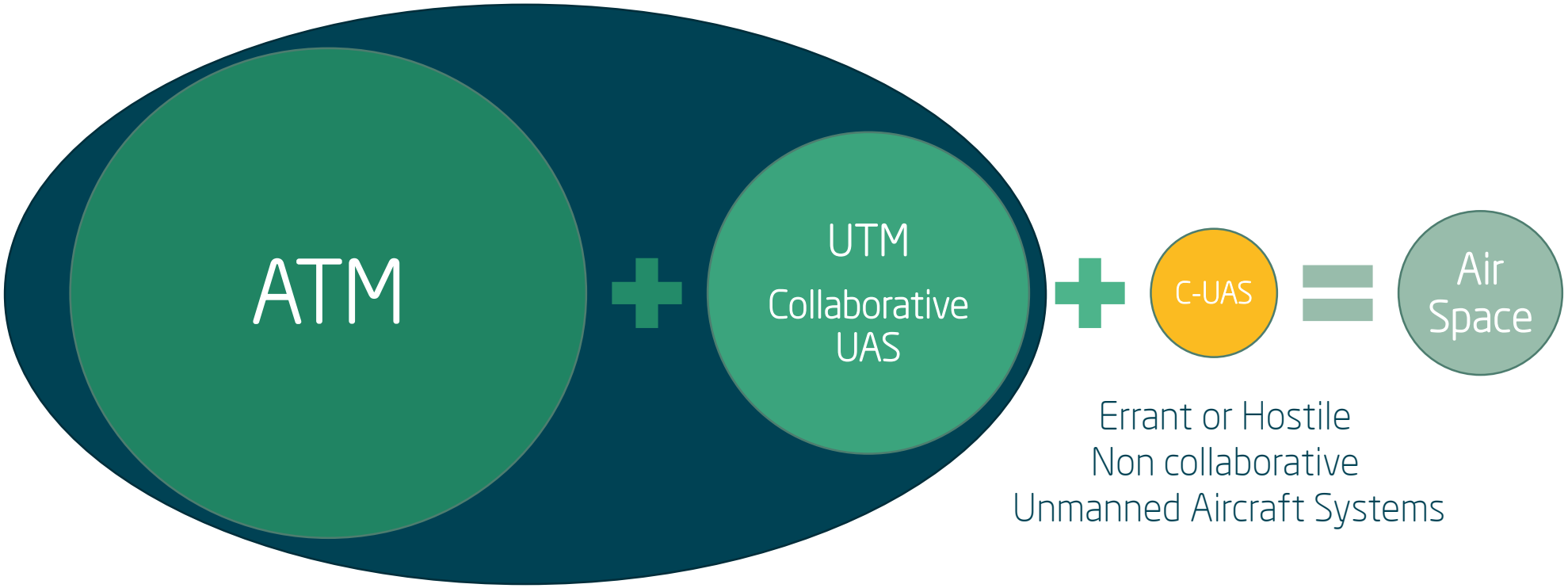
"The drone scare at Gatwick airport that closed the runway for 33 hours shortly before Christmas cost over £50m."

"Around 1,000 flights were cancelled during the busiest week of the winter for outbound departures from Gatwick"

https://www.independent.co.uk/travel/news-and-advice/gatwick-drone-airport-cost-easyjet-runway-security-passenger-cancellation-a8739841.html

Faced with this type of threat, **different weaknessess and deficiencies in procedures, operations and systems** were and are evident

And what is the role of an antidron systems (C-UAS)?



Operation Modes

Different operation modes implies different challenges to be faced

Remote Control

Piloted by one operator

(RF communications)

RF Datalink Control

Datalink Imágenes/ Video

Waypoints

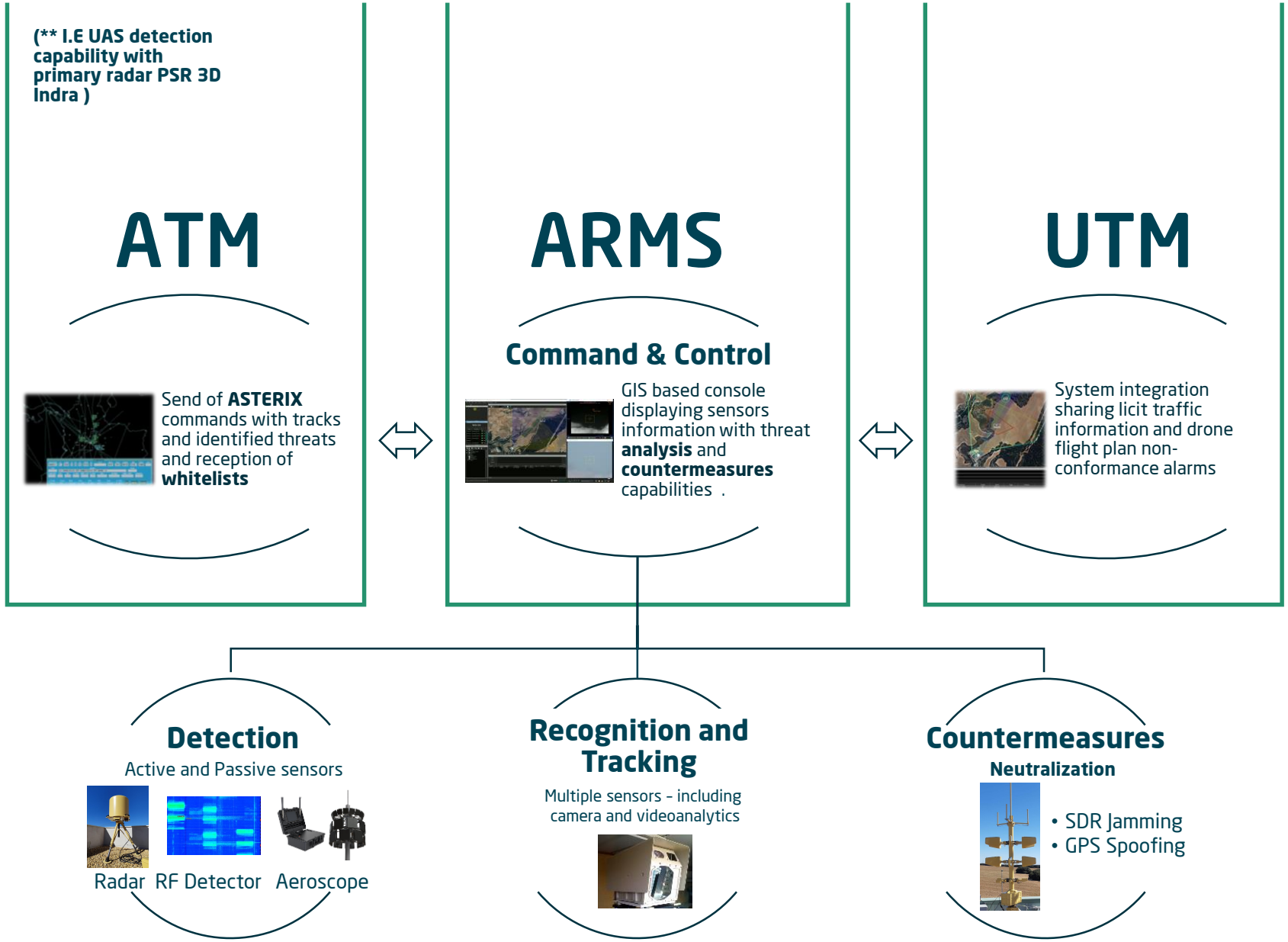
GNSS waypoints navigations (i.e.: GPS)

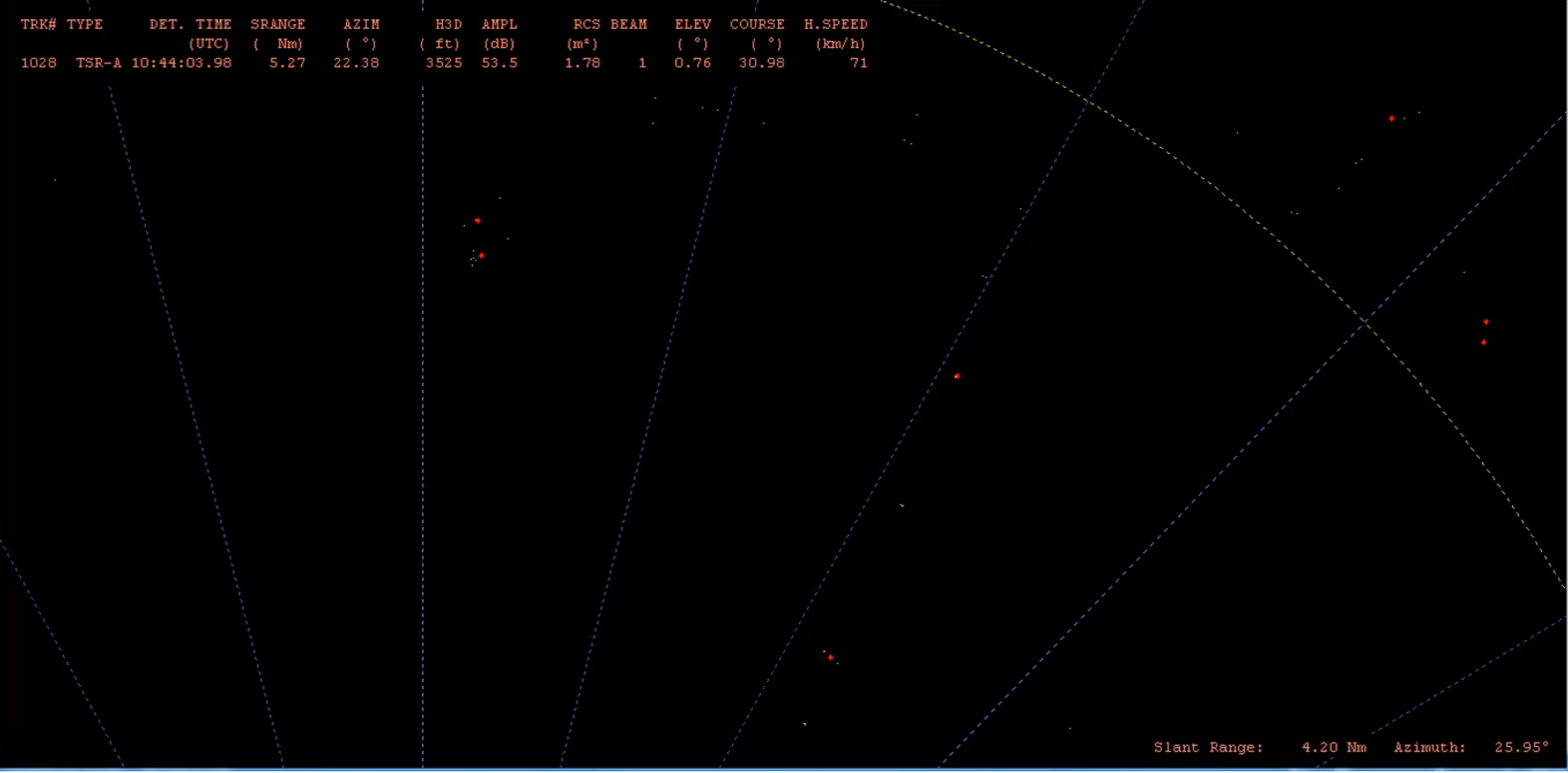
Waypoints GPS

C-UAS ARMS Operational Concept

ARMS is based on three key features: **Simple, Adaptable and Flexible**

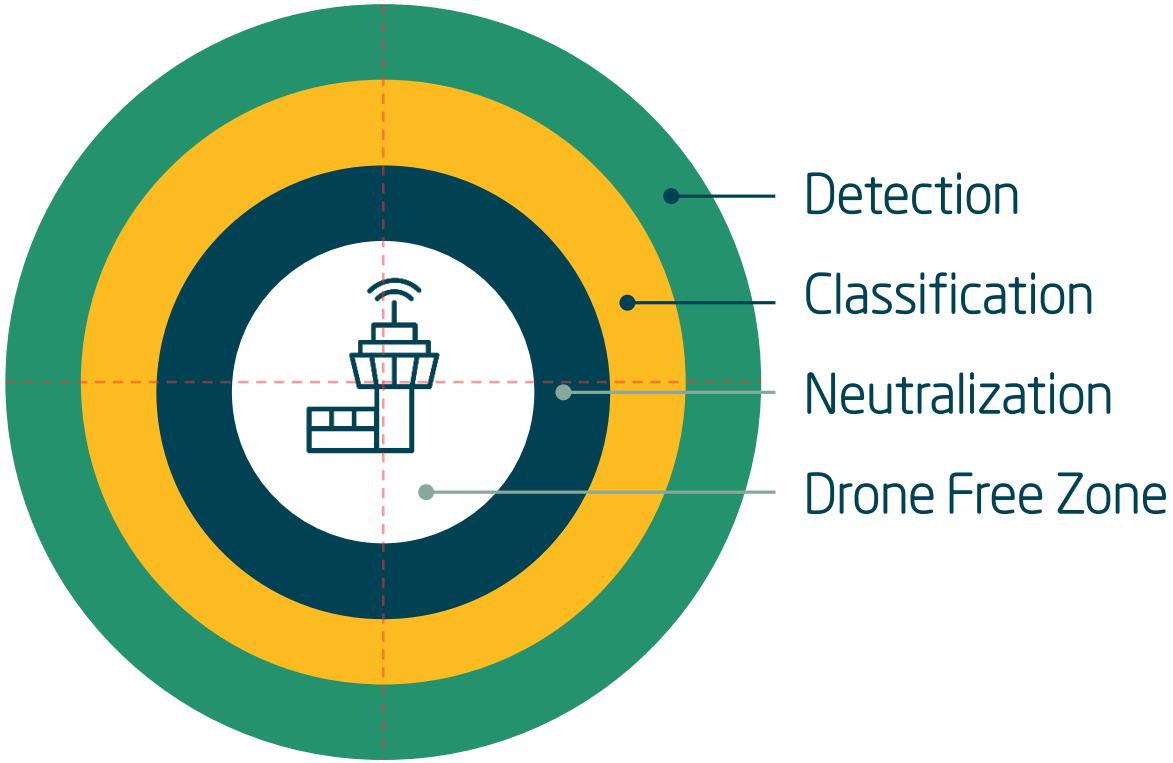
Ready to face present and future threats




TRK# TYPE DET. TIME SRANGE AZIM H3D AMPL RCS BEAM ELEV COURSE H.SPEED
(UTC) (Nm) (°) (ft) (dB) (m²) (°) (°) (km/h)
1028 TSR-A 10:44:03.98 5.27 22.38 3525 53.5 1.78 1 0.76 30.98 71
Slant Range: 4.20 Nm Azimuth: 25.95°

C-UAS ARMS Operational Concept

Each scenario **requires specific considerations**
(civil vs military, fixed / mobile / portable)

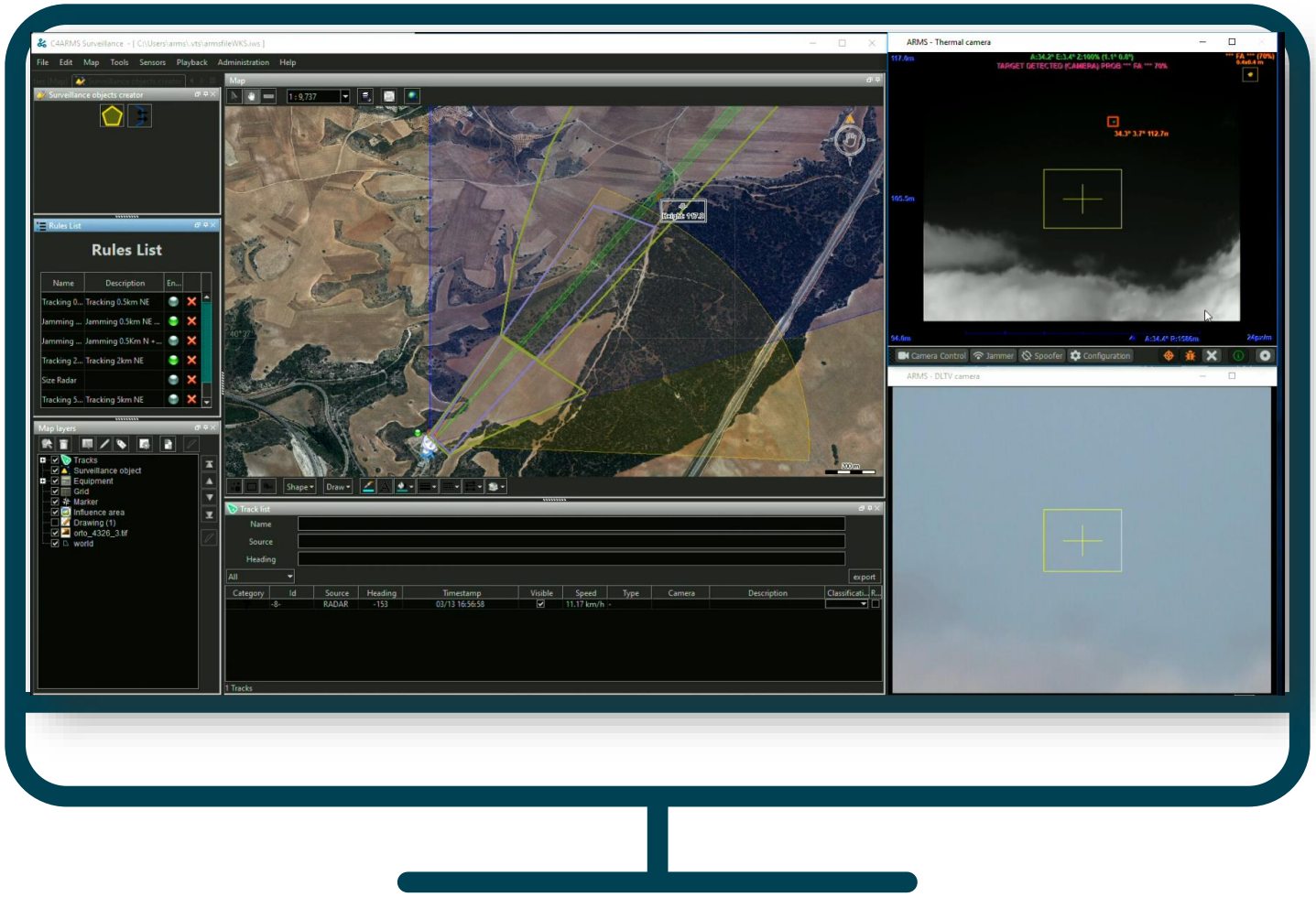


C4ARMS – Command and Control

Simple and intuitive interface		
GIS based Interface	**Ruled** based alarm and reactions	**Manual, timed or automatic** countermeasures
Multisensor data **fusion**	**Automatic and / or manual control** of optronics	**PlayBack** tool
Drawing tool to define areas	**Automatic** trace tracking	Events **log and reports**

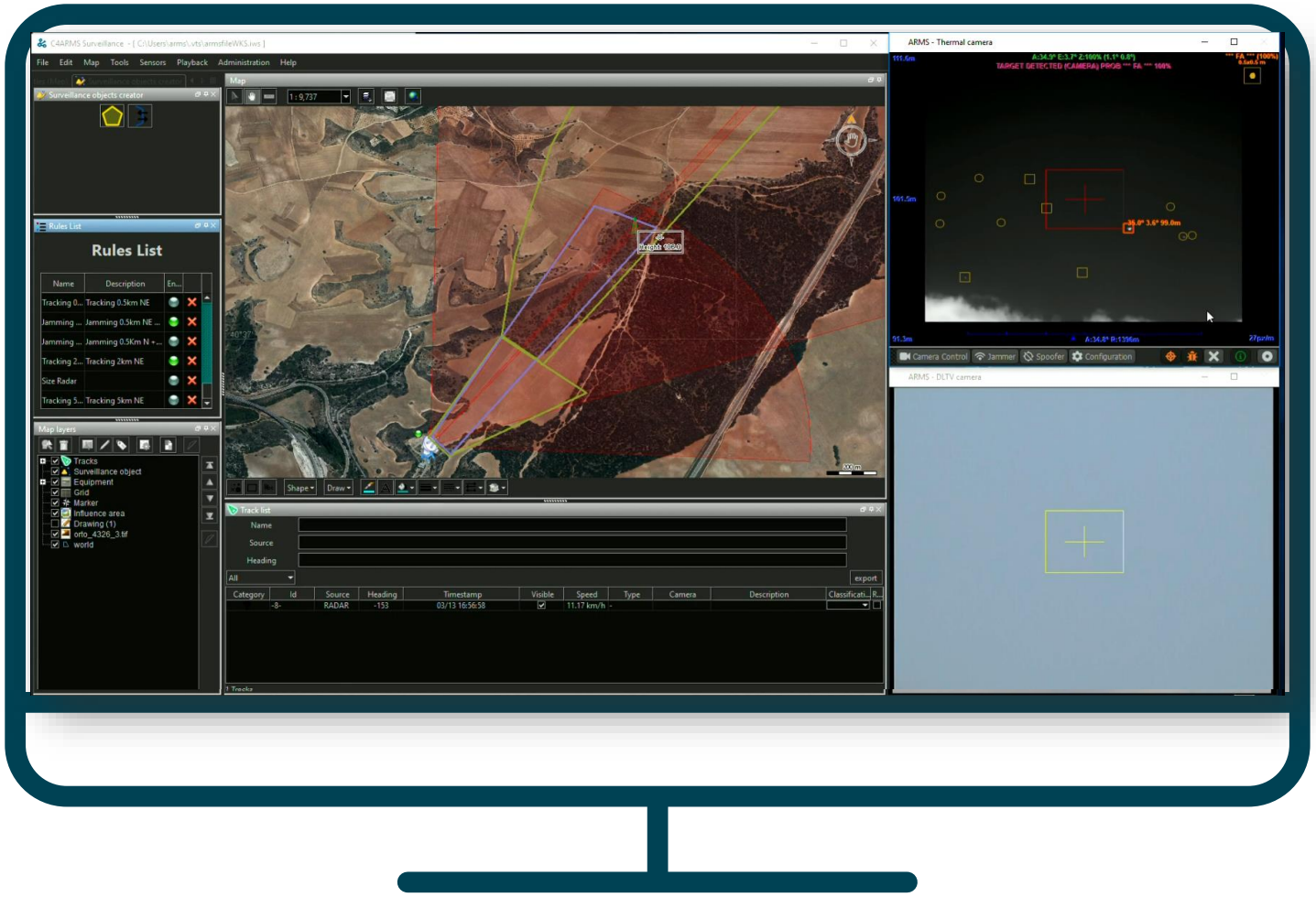
Powerful Command and Control system providing an **unified interface** for assets protection

C4ARMS – Command and Control



Powerful Command and Control system providing an unified interface for assets protection, supporting the complete C-UAS process from threat detection ...

C4ARMS – Command and Control



... until the activation of the available and suitable countermeasures

Detection

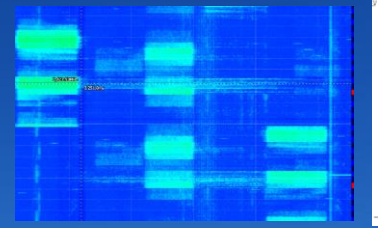
ACTIVE

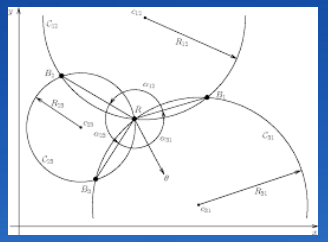
Radar based

- Detect **any** threat with high precision, both collaborative and non-collaborative, including **Non-RF emission** drones

PASSIVE

Radiofrequency analyzers, detection and location of RF datalinks. Specialized detector for DJI UAS





DJI AEROSCOPE

- **Multilateration and Goniometry** using technologies based on RF fingerprinting analysis. Geolocation of both UAS and operator

- **UAS Detector** specialized in DJI drones, providing information such as model, position, speed, heading, height, pilot location, ...

Active Detection: MidRange y LongRange Radars

Ku band radar

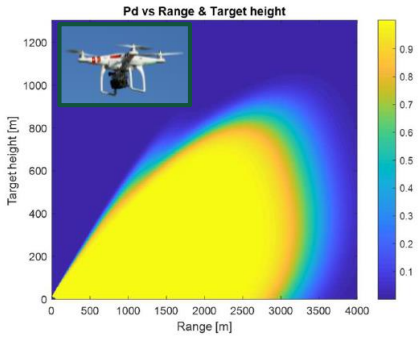
- FMCW low power
- 360º, 60 rpm
- International recognition

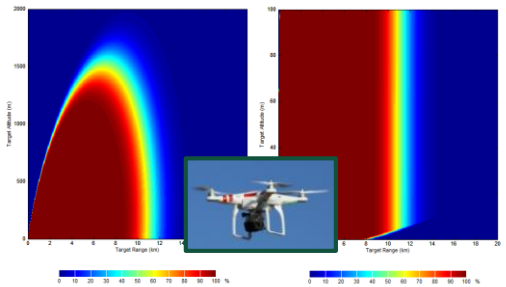
1ª position Mitre Challenge

Detection ranges

Micro UAS (RCS=0.01sqm)

3Km





Detection ranges

Micro UAS (RCS=0.01sqm)

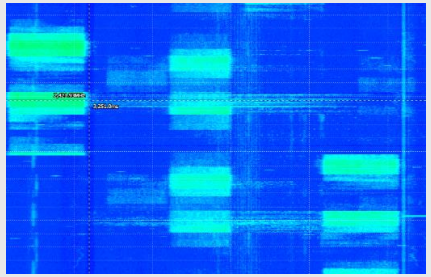
+5Km

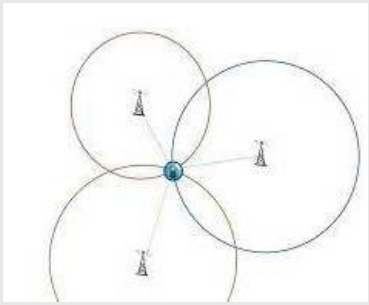
X band radar

- FMCW low power
- 360º, 30 rpm
- Extended range

Passive Detection

RF Detection





- Passive detection based on **radiofrequency analysis**
- Simultaneous detection of **Uplink and Downlink** communications
- **Goniometry and Multilateration**
- UAV and operator **geolocation**
- **Identification** of manufacturer and UAS model (**Data Base**)

- Full **integrated** in C4ARMS
- **100%** detection of DJI UAS: **75%** of marketshare
- Maximum detection ranges (aprox.): Suitcase (5Km), G8 (10Km), G16 (20Km)
- **UAS Information:** identifier, model, UAV and controller position, heading, height, etc

DJI Aeroscope

- DJI UAS Detection
- Full integration with ARMS

Recognition and Tracking

Electro Optical Surveillance System (EOSS)

- Based on high-quality and precision **Infrared (IR)** and **Daylight** cameras, IR based **videoanalytics**
- **Analysis and confirmation** (or doble confirmation) of detections provided by active and passive sensors
- **Selectable configuration,** several camera models, such as:
  - Indra CYCLOPS, advanced 3rd generation MWIR cooled
  - FLIR HRC family MWIR cooled
  - Other different uncooled models
- Positioner with 360º Azimuth range and wide elevation range

Optronics system

- Infrared and daylight
- 360º PTZ
- Wide FOV
- Day: Standard/HD

Countermeasures

Countermeasures are based on **jamming (disturbance) or deception** of signals used by dron in both communications and navigation

DATALINKS (C2, VIDEO) JAMMING

Fixed

Portable

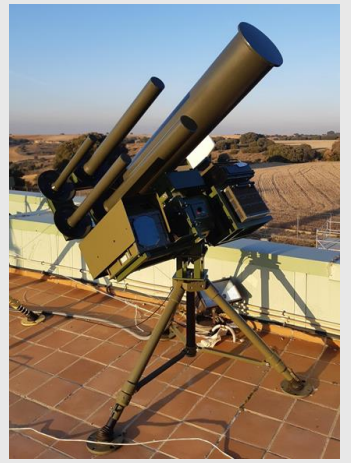
GPS JAMMING/SPOOFING

Countermeasures: Jamming

Software Radio Based (SDR) based Countermeasure System

- Inhibition focus on: RPAS **communications** (C2, datalinks) and **GNSS** bands.
- Different configurations: **Omnidirectional, Sectorial and Directive** Jamming.
- **Fixed**, **Mobile** (transport) and **Portable** versions.
- Highly adaptable thanks to its **SDR core**:
  - Jamming range: 70MHz to 6GHz.
  - Generation of fully programmable signals based on multiples types of waveforms (white noise, chirps, used-defined arbitrary, etc).
  - Highly configurable in number of signals and frequency bands to be jammed.
  - Configuration of multiple inhibition profiles (different waveforms, bandwidth, bands, etc). Power control to adjust the inhibition range.
- Rule based **automatic** and **manual** activation modes.

SDR Jamming



Sectorial & Omni Jammer

- Sectorial and Omnidireccional
- Fast switching
- Range: **+5Km**

Directive Jammer

- **High directive jammer with high performance camera** (Indra CYCLOPS)
- 360º coverage based on PTZ positioner
- **High** range: **+8Km**

Portable Jammer

- 2 sectorial antennas
- Fast battery replacement
- Range: **+3Km**

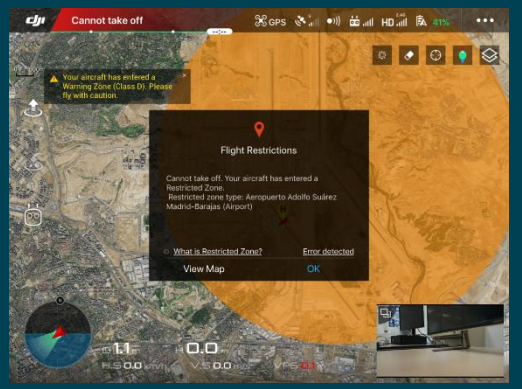
Countermeasures: GPS Spoofing

Deception based on fake GPS signal.

- Real-time GPS signal generator focused on supplanting **GPS L1 signal**.
- Capabilities:
  - Generation and transmission of **Civil C/A** (Coarse / Acquisition) code of GPS signal in L1 band (1575.42 MHz).
  - Emulation of real GPS **satellite constellation**.
  - Generation rate of **10 positions/second**.
  - **Inhibition of other GNSS** signals.
- Some features:
  - **Full interaction** with ARMS main detection sensors.
  - Omnidirectional or Directive antennas.
  - **Power control**.
  - Different **use strategies**.

GPS Spoofer

- GPS L1 C/A code
- GLONASS jammer
- Up to 16 satellites



Some ARMS Configurations

Elements for fixed deployment

Sectorial & Omni Jammer

Directive Jammer

Operational Experience

High-tech product with the aim of solving a global problem

Tested in operations area facing real threats.

Sold in Asian country (2018). Open leads in five continents

Validated with positive evaluation by Spanish Penitentiary Institutions

Participation in the spanish MoD C-UAS program (CONDOR)

Key ideas for Civil Aviation (1)

- Facing this challenge is not easy and requires to apply **the principle " The best is the enemy of the good".**
- The longer it takes to define and adopt solutions, the greater the risk becomes.
- Independently of the use case, unfortunately, **100% effective C-UAS technology does not exist,** it is necessary a **trade-off** between **performance and investment** considering the balance between **the most probable and the most dangerous threat.**
- The best C-UAS strategy is based on:
  - **Adaptation** – "One configuration does not fit all the operational scenarios".
  - **Colaboration** among different sensors/effectors.
  - **Redundancy** in number and location.
- Airport environments presents **multiple specific and unique challenges** to the use of C-UAS technologies.
- It is **necessary specific regulation,** overcoming **legal restrictions (including use of spectrum),** clarifying **scenarios, terms of use** and **authority** for supporting the deployment of C-UAS systems, both detection and countermeasures.

Key ideas for Civil Aviation (2)

- It is necessary to establish **common protocols and procedures** in order to face this kind of threat (Key for Seamless Sky Strategy).
- Under C-UAS Framework, **Situational Awareness and Neutralization demand different and complementary analysis** because their impact is clearly different.
- At least, as first step, let's consider **situational awareness** (threat detection, identification and tracking).
- UAS neutralization with jamming in an airport environment could be evaluated in scenarios with runway closed for ops. This action would permit an operation impact much lower in time compared to a scenario with an operations interruption without neutralization of the UAS.
- Multiple **key questions** demand deep analysis and answers, such as i.e:
  - What is the **trigger** to take a counter-UAS action?.
  - What counter-UAS **actions** could be authorized?
  - **Who** may decide and take these counter-UAS actions?.


indra
At the core