Leonardo Electronics

CON-DR
Integrated COuNter- DRone Solution

FRONTEX INDUSTRY DAY on COUNTER-UAS

12/06/2024


Electronics


Helicopters


Aircraft

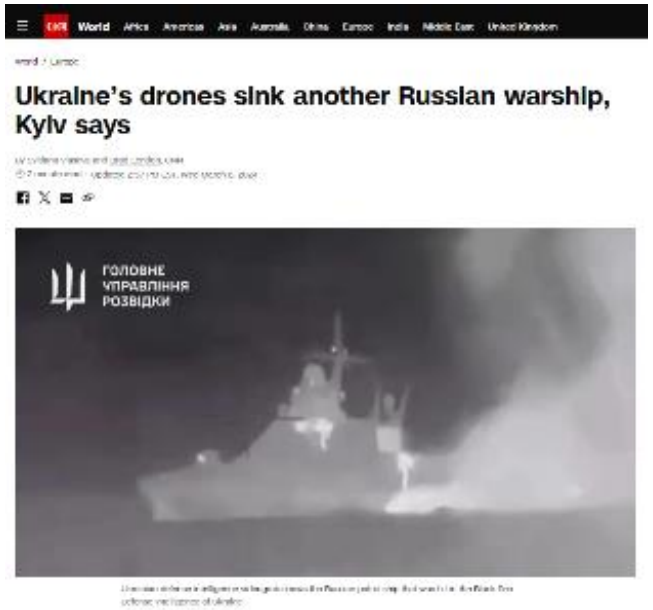

Cyber & Security


Space


Unmanned Systems


Aerostructures

The Scenario is changed…. Multiple threats shall be seamlessly contrasted – hostile drones included

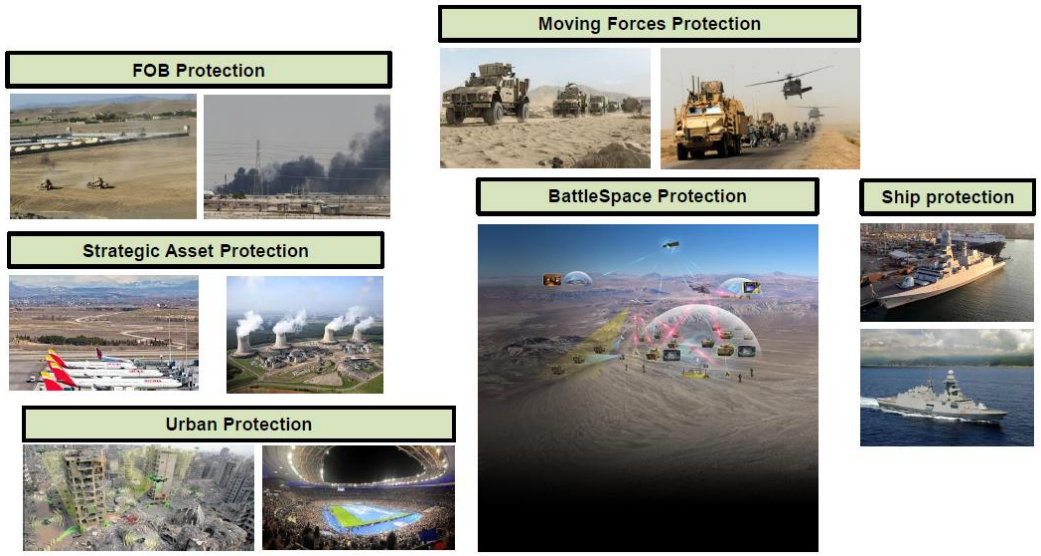


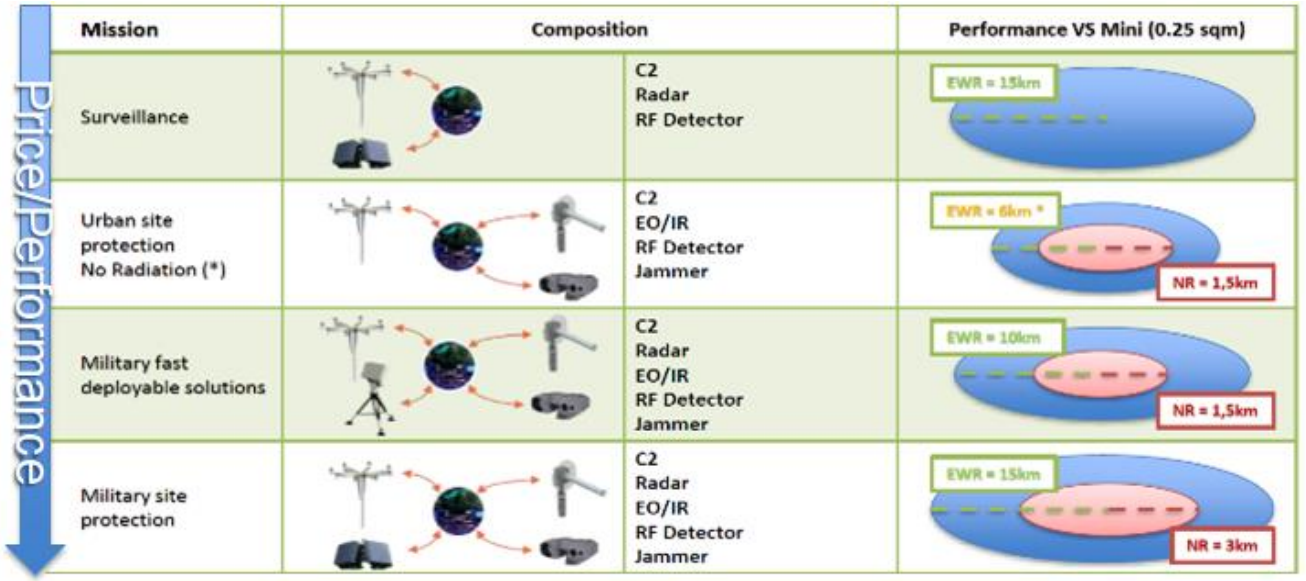
Leonardo Counter Uncrewed Approach

In the modern air, land and maritime scenarios, uncrewed/crewed small platforms represent insidious threats being capable of approaching furtively the targets by causing damages and/or collecting tactical information.

CON-DR multi domain solution – Deployable in every environment in multiple scenarios

Modular multi-sensor multi-effector system for the detection of, and defence, against drones. An highly modular, scalable and deployable architecture is the key factor to provide a flexible hardware and software solution to meet different operational needs.





The CON-DR counter drone is developed with holistic situational awareness paradigm, build for the effective, reliable and fast defence against drones for military, government and critical infrastructure customer needs. **A typical configuration of CON-DR system, in a fixed, sheltered or fast deployable solution.**

Continued investment ensures the availability of the breadth and depth of skills necessary to deliver and support any integrated, mission-ready solutions.

(*) Unless detection of «silent» drones

CON-DR solution – main features

- AI (**Artificial Intelligence**) and **Deep Learning** algorithms can optimize threat classification and identification times and therefore reduce the overall system minimum reaction time;
- **System scalability and sensor diversity** can enlarge scanned areas, so anticipating the detection of intruding rogue UxVs and consequently early activating the proper countermeasure;
- Effector diversity, advanced threat evaluation and weapon assignment algorithms can provide **decision support to the operator**, thus minimizing the man in the loop contribution to the overall system response time;
- **Mission planning** takes into consideration sensor and effector performance and characteristics and optimally deploys the available equipment in the specific operational scenario (urban environment, FOB, Maritime, etc.).
- A **Multi deployable C2 capacity** will enable to exchange information with remote users on the field and to provide them with support and enhanced situational awareness using AI, Augmented Reality and holographic rendering technologies.
- C-UxVs systems coping with **swarms** require a **distributed C2 system** capable of selecting the appropriate effectors and coordinating the effectors in flight.

CON-DR solution – OODA Paradigm Architecture

C-UxVs - Overall Architecture

OBSERVE

RADARs

E/O Sensors

Directive/DF Antennas

RF omnidirectional Antennas

ORIENT & DECIDE

C4IS

- modular and scalable
- effective against drones from class 1 (DJI Quad) to class 2 (1-way attack Fixed Wing)
- capable of countering multi-axis threats
- fixed, deployable or on-the-move

ACT

Jammers

Net Launchers

Interceptors

L-DEW

Kinetic Guns

(*) capable of being transported by road, air, rail, sea

CON-DR configuration to support defence domains

SURVEILLANCE/C2

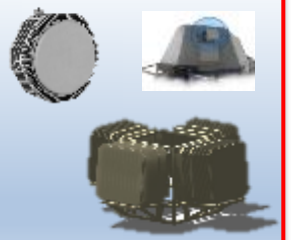
C2: AXIOS

- Reliable, interoperable, scalable, cyber resilience, fast hierarchical deployability, rugged & compact solution, powered by AI technology for total Situation Awareness at higher echelon

RADAR: TMMR &MHR

Detection:
- full 3D AESA panels
- detection of Class I drones
- detection probability: 90%
- pulsed Doppler

Tracking:
- multi-target radar tracking (TWS)



EO: NERIO ULR/JANUS D/L

- Day/night and all wheatear
- Sector and panoramic scanning
- Operator manual assisted or automatic slaved to other sensors
- Enhanced Image Processing

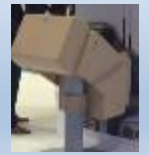
DIRECTION FINDER: THIRD PARTIES

- Discover drones through Radio Frequency links
- Track drone and Operator

SOFT KILL

RF JAMMER: GUARDIAN(UK) and THIRD PARTIES

- disturbs RF frequencies of radio link and of navigation systems (GNSS) typically used by mini and micro UAV



DRONE C-DRONE: DRONE CATCHING

Different drone counter drone systems can be integrated :

Killer/suicide drone;

Drone catcher.

HARD KILL

GUN: LIONFISH, HITFIST, HITROLE X-GUN

- gun systems respectively devoted to the land and naval domain.

LDEW: L-LEOSS/DRAGON FIRE or THIRD PARTIES

system's beam director, which is integrated into a turret to aid the advanced targeting of the incoming threat at various ranges and in varied weather conditions over land and water.

DEPLOYMENT OPTIONS

ON-THE-MOVE/TRANSPORTABLE

4x4 VEHICLE: MUV IVECO FREMM NAVY CLASS

FIXED/RELOCATABLE

FOB

URBAN

(*) CoN-DR solution can be configured (down-sized) to integrate third-party system to support any mission: Homeland Protection, Urban Protection, etc..
CoN-DR solution could be ITAR free in accordance with chosen configuration.

CON-DR solution – Command & Control Sub-System

Main Command and Control Capabilities

- **CENTRAL and ALTERNATE Control Centres based on AXIOS architectural framework (Because software is key)**
  - **CON-DR units control and monitoring**
  - **generation of the integrated picture**
  - **exchange of CON-DR data with external systems (e.g. remote CUAS units, Air Defence, ATM/UTM, etc.), in accordance to Sapient exchange protocol.**
- **Sensor Control & Management:**
  - **RADAR**
  - **Direction Finder**
  - **EO Camera**
- **Effector Control**
  - **Jammer**
  - **Hard kill effectors**
- **Local Data Fusion/Local Situation Awareness**
- **Threat Evaluation**
- **Advanced Video Analytics Technology**
- **Data Recording and Analysis Management System**
- **Cyber Protection/Resilience**
- **Communication Management**
- **Powered by Artificial Intelligence Leonardo BRAIN suite**

Vehicle Operator Console

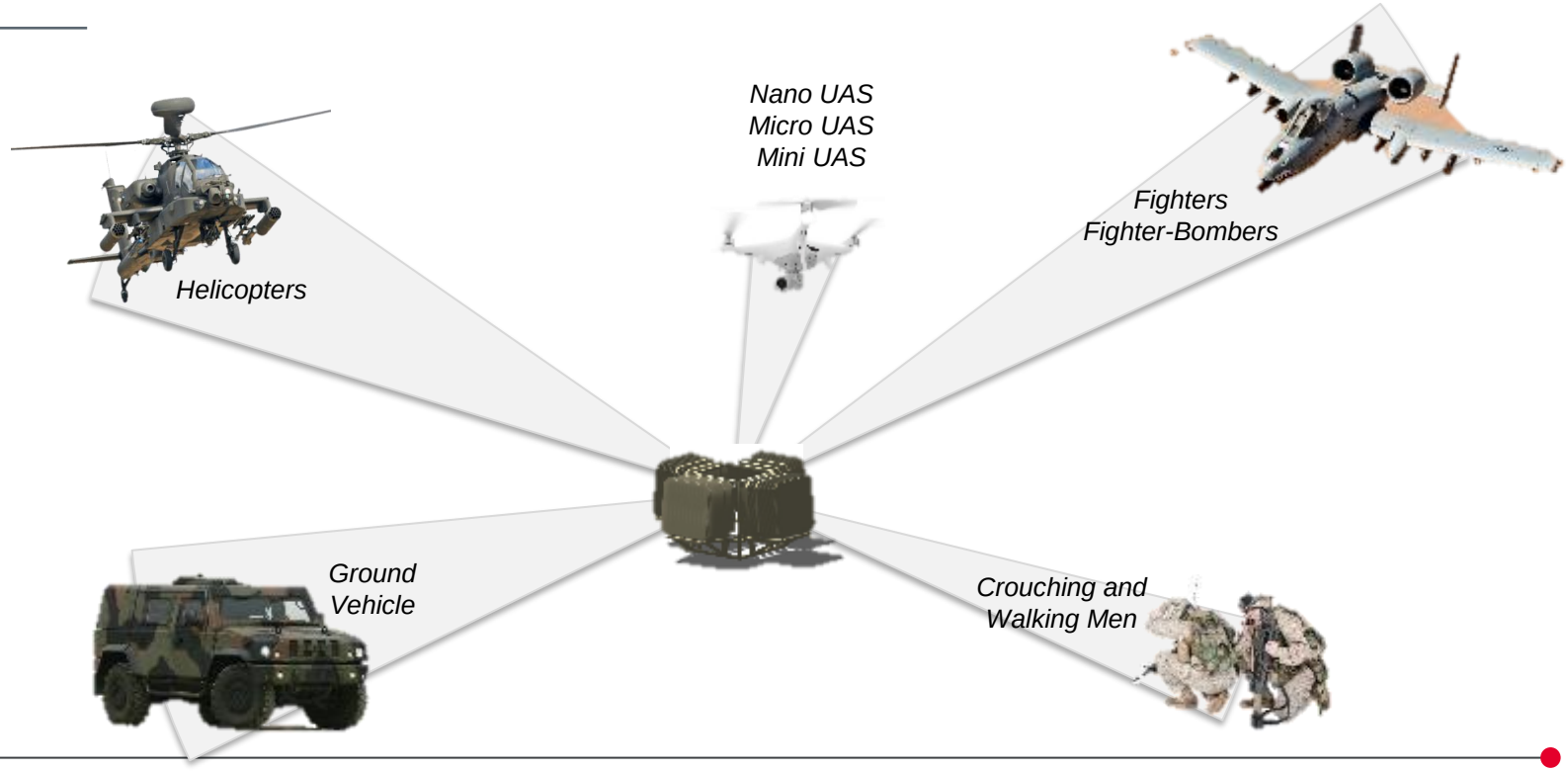
CON-DR solution – LEONARDO RADAR TMMR Sub-System

Leonardo's Tactical Multi-Mission Radar (TMMR) provides advanced force and border protection **through the detection, classification and tracking of aerial and surface intruders.**

TMMR is a C-Band full AESA (Active Electronic Scanned Array) Radar designed to be an **extremely compact "all-in-one"** and **light-weight** solution for battlefield applications**.** TMMR can be **easily integrated with any C4I system** using its standard Ethernet interfaces **to contribute to the tactical picture** of a large-scale surveillance system as well as to cue a defensive weapon.

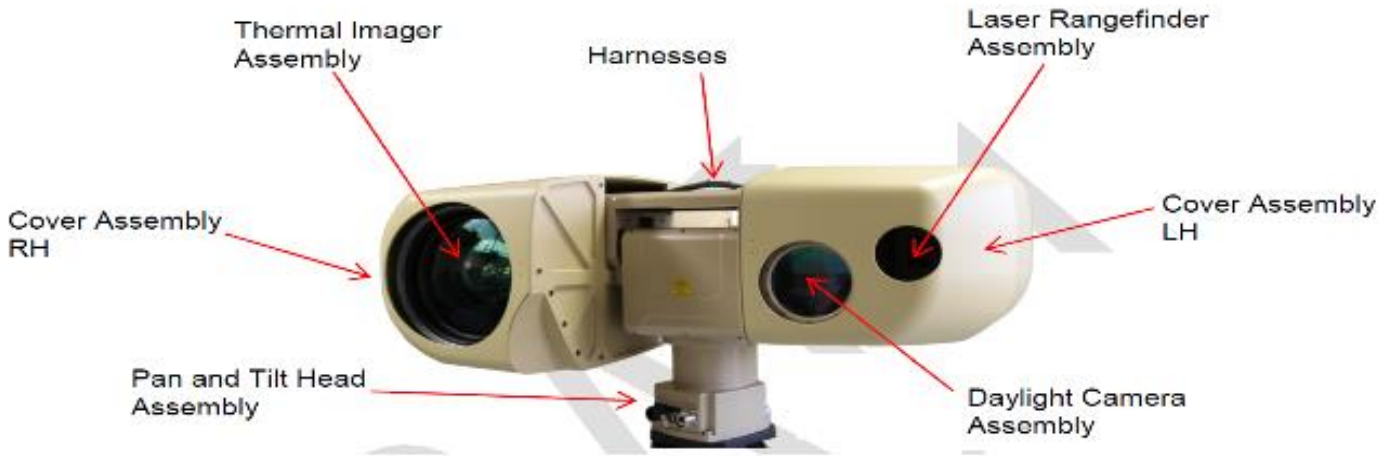
Mission

- C-UAS (Unmanned Aerial Systems)
- Comprehensive Border Surveillance
- Battlefield Surveillance
- Vehicles Protection
- Gap filler for V-SHORAD Applications
- Land Patrolling



CON-DR solution – Electro-Optical NERIO ULR Sub-System

Designed for long range surveillance, threat assessment and target identification.
Incorporates the latest Leonardo MW Horizon HD thermal imager and a color camera with a 1000mm focal length lens, Laser Range Finder (LRF) and GPS.
Robust two axis Pan and Tilt Head (PTH) allowing the user to steer the Sensors' Line of Sight in both azimuth and elevation. The pan axis is provided with a high reliability slip ring enabling full 360° rotation. The tilt axis provides for up to +/- 60° motion. It can also operate in a tracking mode utilizing an optional internal video auto-tracker.
Protective covers which provide protection against general environmental conditions such as rain, sunshine, hail, snow and dust.
Designed for installation on stable and static platforms. Gyro based servo's maintain sightline stability in the presence of low frequency variations as may be exhibited by tall mast structures.



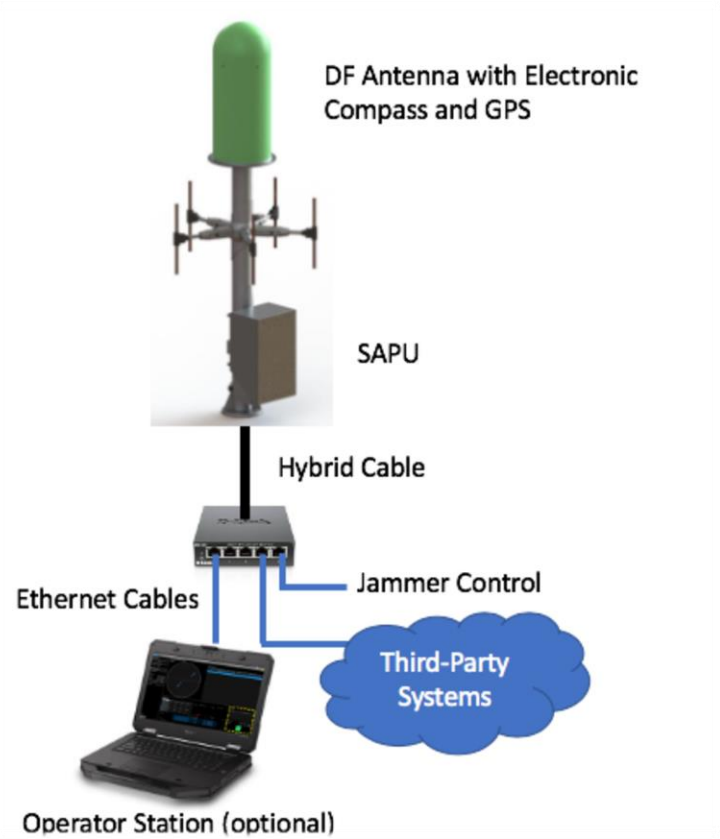
CON-DR solution – Electronic Warfare Unit

DF and Jammer

- Detect and locate transmission in the entire frequency range from 400 MHz to 6 GHz.
- Detecting and locating drones and their pilots.
- Technology for intercepting even the fastest drone control signals.
- Advanced algorithms for drone-classification and low false detection.
- Disrupt communication and radar signals on all available frequency bands.
- Jam enemy sensors and their communications.

CON_DR solution – Electronic Warfare Direction Finder Sub-System

- Real-Time RF automatic spectrum surveillance against multiple targets (drones and remote controllers)
- Measurement of bearing of the drones and the operators with the Radio Control
- Geo-localization and tracking of drones and the operators
- Automatic classification of Radio Control type through an internal library
- Integration with the Command & Control layer in order to manage the proper reaction
- Designed to operate in complex electro-magnetic environment with multiple threats, multiple RF sources of interference (e.g. WIFI)
- Top of the range RF performance provides virtually unlimited range of detection
- Automatic 300-6000 MHz spectrum surveillance based on mission libraries
- Detection and simultaneous DF of signals, including Low Probability of Intercept (e.g. Frequency Hopping, Burst, WIFI, etc.)
- High accuracy 2D and 3D Direction Finding based on the robust Correlative Vector Interferometry technique
- Performances increased by the receiver installed on the antenna



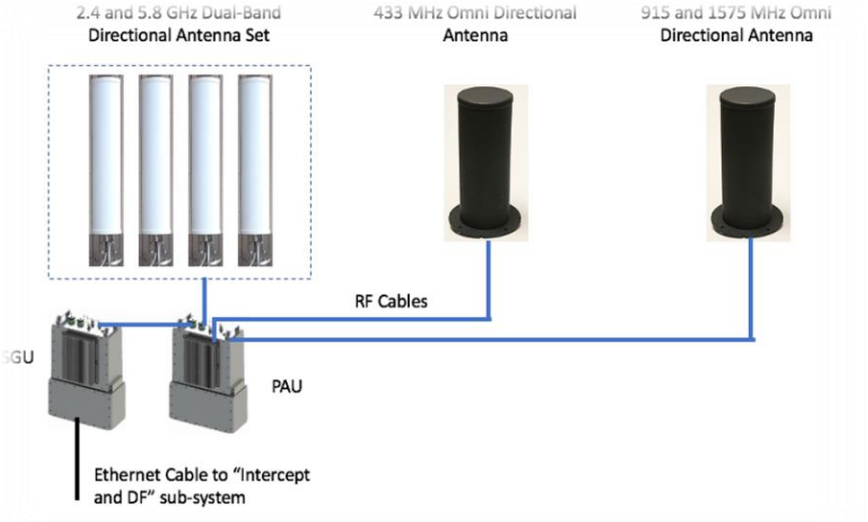
CON_DR solution – Electronic Warfare Jammer Sub-System

Jamming shall block:

- drone control
- video signals
- GPS

Main Features

- Designed to operate in complex electro-magnetic environment with multiple threats and to support extended range of operation
- Smart Jamming technique which concentrate the jamming power on the weakest parts of drone signals
- Reactive Jamming: the jammer is controlled by the DF in order to concentrate the power on drone(s)/remote controller(s) direction and on the frequency channels used by them
- Generation of virtually any waveform (i.e. jamming signal) in the 300-6000 MHz frequency range, against current and future drone models
- Amplifier integrated with the antenna for high continuous radiated power on all bands of interest (e.g. ISM) simultaneously
- Beam forming antenna (i.e. electronic antenna rotation) to concentrate the jamming power on one or multiple targets simultaneously



CON-DR solution – Effectors

LETHAL EFFECTORS

Depending upon the situation (environment) it could be possible to use effectors to destroy the threatening drone. CON-DR can integrate and designate lethal effectors that can be provided with the geo-referencing information of the threat.

INTERCEPTORS

To increase the effectiveness of the reaction it is possible to make use of cooperative drones to intercept the threat. In this case, CON-DR system can provide to the interceptor all necessary information to reach the threat and to minimize the intercept period.

NET LAUNCHERS

The soft kill actuator can launch a net in order to catch the approaching UAV. It offers the ability to physically capture an aircraft and control it’s descent to the ground.

CON-DR solution – LETHAL EFFECTORS (LDEW)

GUNS

Leonardo is developing a solution of an EO with integrated a High-Power Laser collimator.

The LASER is capable of delivering a power of 3 kW (an improved version with 10 kW is under development).

A test campaign on field has been started and is on going.

Third parties LDEW effectors can be integrated as well

CON-DR solution – Net Launchers

The system may be equipped with a kinetic actuator which can launch a net in order to catch the approaching UAV. It offers the ability to physically capture an aircraft and control its descent to the ground thanks to the combination of a compressed gas-powered smart launcher and an intelligent programmable projectile

Target Distance:	Min 10m (32ft) LOS Max: • 120m Horizontal (390ft) • 90m Vertical (290ft)
Max Radial Target Speed	Radial 15m/s + (34mph) Transversal 12.5m/s + (28mph)
Weight	12 Kg
Power	Battery 15V Litio Ion
Ammunition	Rocket SP40 with Net 8m^2 e Parachute Air compressed system
Air Tank	Rechargeable
Ballistic	Smartscope for ballistic compensation, IMU e LRF

It can be installed on mobile or fixed assets.

CON-DR solution – INTERCEPTORS

Two different drone counter drone systems can be integrated :

- Killer/suicide drone;
- Drone catcher.

Both the solutions foreseen that in the first phase the counter drone are guided by C2 system, when they acquire the target with their onboard sensor they continue their mission in autonomous way.

C2 operators can break the engagement at any time.

CON-DR solution – Deployment configuration

Sub-Systems	Item	Operative Temperature	Grado di Protezione in condizioni operative
RADAR	RADAR	[-40,+55]°C	IP65
EO/R	EO/IR	[-32,+55]°C	IP65
C2	Workstation Compatta Integrata	[0,+50] °C	IP40
	Joypad	[-20,+55] °C	IP64
	Tactical Switch	[-10,+49] °C	IP65
Electronic Warfare	Direction Finder	[-10,+49] °C	IP54
	Jammer	[-10,+49] °C	IP65
	Trailer	[-10, +49] °C	IP65
Electric Generator	Electric Generator	[-20,+49]° C	IP65 or more
Trailers	Trailers	[-20,+55] °C	IP65
Containers	Containers	[-40,+71] °C	IP65

SURVEILLANCE RADAR

- AESA Radar "all-in-one"
- Multi-panel operations
- Ground Surveillance
- multi-target radar tracking (TWS)

HIGH MOBILITY VEHICULAR PLATFORM

ULTRA LONG RANGE E/O CAMERA

- Day/night and all wheatear
- Sector and panoramic scanning
- Operator manual assisted or automatic slaved to other sensors
- Enhanced Image Processing

TRAILER

COMMAND AND CONTROL

- Command Post Solution
- Agile Command and Control for Information Superiority and Operational Advantage
- Advanced Monitor & Control features

DISMOUNTED

Leonardo sensors (such as TMMR Radar), components and sub-systems are by design conceived to be easily mounted and integrated on board of a wide range of vehicles and mobile platforms.

CON-DR - Main Reference

CON-DR – SYSTEM EVOLUTION

G20 – Rome 2021

Leonardo counter-drone technology has been used to protect the G20 Summit, held in Rome on 31st October 2021

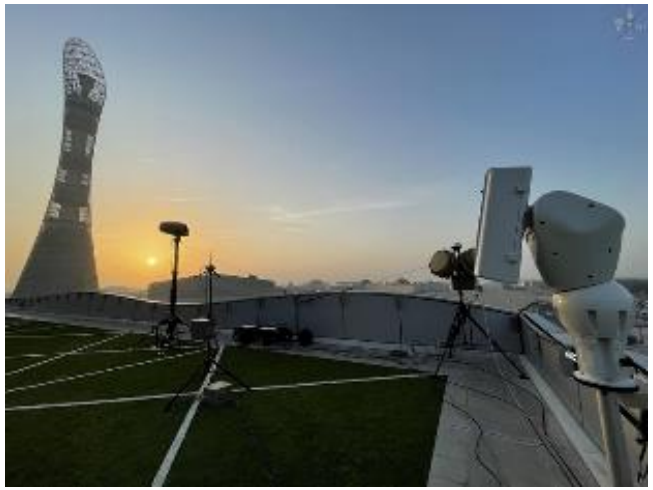
Roof Deployment

7km against micro-drones

QATAR – FIFA Arab Cup 2021

QATAR: FIRST OPERATIONAL USE OF THE COUNTER-UAS CAPABILITY
Air Force assets against the threat of drones

From 23 November to 20 December the Air Force was called to support the Qatar Armed Forces on the occasion of the 2021 FIFA Arab Cup competition, through the deployment of a Counter-Unmanned Aerial Anti-drone System (C-UAS) Task Group, as part of the Inherent Resolve – Prima Parthica mission. The support requested concerned the defense against the threat deriving from the so-called "mini and micro drones". For this eventuality, the Air Force has redeployed the fixed anti-drone system "ACUS" (AMI Counter UAS) together with portable jammer systems. The C-UAS capabilities include the acquisition of technologies for the sighting and possible neutralization of drones, even very small ones, flying over sensitive or forbidden areas such as military installations at low altitude, for the protection of the personnel who operate there and of the material goods stored there.



QATAR – NASR 2023

The "NASR 2023" exercise conducted by the Italian Army together with the Qatar Emiri Land Forces (QELF) concluded at the Al Qalail range in Qatar.

The activity was developed through an exercise aimed at training the fire support components of the units exercised (Italian and Qatari) and testing APR assets to be used for identifying objectives and guiding fire.

ROME – Ryder Cup 2023

The Italian Air Force (AMI), through specialized assets and personnel, is providing, together with the Army personnel, a precious contribution to guarantee the security framework of the 44th edition of the "Ryder Cup", one of the most prestigious international golf tournaments, taking place at the “Marco Simone & Country Club” in Guidonia Montecelio (RM).

In particular, to support the security device prepared by the Prefecture of Rome, the Air Force is using: a P-72A aircraft, a patrol aircraft that can be used for research, acquisition and identification of information on the ground, an aircraft remotely piloted MQ-9A Predator B for reconnaissance, surveillance and aerial image acquisition missions and a Counter-Unmanned Aerial System Anti-drone (C-UAS) team operated by personnel of the 16th Wing "Fucilieri dell'Aria" in a team joint forces with the Army, for the sighting and possible neutralization of drones, even very small ones, flying over sensitive or forbidden areas at low altitude.

CON-DR - Collaboration and R/D initiatives

EDIDP 2020 - JEY-CUAS

LEONARDO S.P.A. (COORDINATOR) of JEY-CUAS EDIDP2020, with the aim to project “Joint European sYstem for Countering Unmanned Aerial Systems” (JEY-CUAS) advance technologies at system and sub-system level to develop a new generation C-UAS system based on a modular and flexible plug'n'play architecture to address the emerging challenge of micro and mini drones increasingly used for defence purposes. The solution will contribute to an improvement of the situational awareness and reaction engagement to overcome the growing resilience of UASs to first generation C-UAS systems keep up with new LSS (Low, Small, Slow) aerial threats and reduce the minimum reaction time. The JEY-CUAS project has the primary objective of defining the specifications and preliminary design of a comprehensive counter-drone capability, focusing on the threat represented by micro and mini drones. This capability encompasses detection, tracking, classification, identification, risk assessment, and neutralization, addressing both single and multiple UAS units that may operate as uncoordinated entities, teams, or as a single "swarm" system. The demonstration held on April 11 2024, highlighted edge-computing platform simulations of JEY-CUAS sensing, neutralization, and C2 (Command and Control) services, along with a physical demonstrator based on a selection of mature yet innovative technologies among the wide set of JEY-CUAS developments. The integration of physical components has been achieved through standard interfaces. System tests showcased its C-UAS capabilities, from target detection, through tracking, classification, and identification to threat neutralization. The consortium, which was formed to oversee the activities, is coordinated by Leonardo and consists of 40 partners from 14 countries (Italy, France, Spain, Germany, the Netherlands, Belgium, Denmark, Sweden, Greece, Cyprus, Lithuania, Estonia, Romania, and Czech Republic). The demo was coordinated by Leonardo in the presence of representative of the European Commission, several European Ministries of Defence, and project partners.

The project is funded by the European Union from the European Defence Industrial Development Programme (EDIDP) 2020 under grant agreement No EDIDP-CUAS-2020-78-JEY-CUAS.

Co-funded by
the European Union

Disclaimer: *The contents of this document reflect only the authors’ view and the European Commission is not responsible for any use that may be made of the information it contains*

EDF2023 – E-CUAS (European Counter Unmanned Aerial System). Coordinator: LEONARDO SpA

E-CUAS

European Counter Unmanned Aerial Systems

SELECTED PROJECTS EUROPEAN DEFENCE FUND (EDF) 2023

CALL TITLE:	Development actions on air and missile defence
TOPIC TITLE:	Counter unmanned aerial systems
DURATION OF THE PROJECT:	42 months
TYPE(S) OF ACTIVITIES:	Studies, Design, System prototyping, Testing, Qualification

SHORT DESCRIPTION OF THE PROJECT:

E-CUAS aims to develop solutions to counter unmanned aerial systems including technologies such as include passive and active sensors, soft kill and hard kill effector technologies and others.

E-CUAS is a project aiming to develop counter unmanned aerial systems (CUAS) solutions for countering class I unmanned aerial systems (UAS), including military-grade UAS, by integrating multiple technologies. The proposed solutions include passive and active sensors, soft kill and hard kill effector technologies, command and control capabilities, networking and communications infrastructure, cybersecurity, and interoperability data models. The project is in continuity with the JEY-CUAS project and will study, harmonise, and consolidate concepts of operations, use cases, user needs, and operational requirements.

Co-funded by the European Union

The project is expected to be co-funded by the European Union under the EDF-2023 programme and after completing the Grant Agreement preparation phase.

NIAG Industrial Interface Group for Ground Based Air Defence

The Group conducted the following:

- Elements of commonality were identified between the separate Modular GBAD and CRAM KURs which resulted in a recommendation they be merged into a single KUR document
- Delivered regular interim progress updates to NATO and Nations (9 in total through VDC and FTF meetings)
- Compiled a series of further recommendations

LEONARDO S.P.A. partake to that NATO study group related to C-RAM and Modular GBAD.

CON-DR - AI for target recognition from kinematics in TMMR

Tactital Multi Mission Radar anti-drone system

Goal: recognize **true** targets **vs false** targets from **radar** measurements

The system is equipped with:

- Radar sensor (**discovery**)
- Electrooptic sensor (**confirmation**)

- The system rejects false targets, but a **percentage** of **false targets remains**

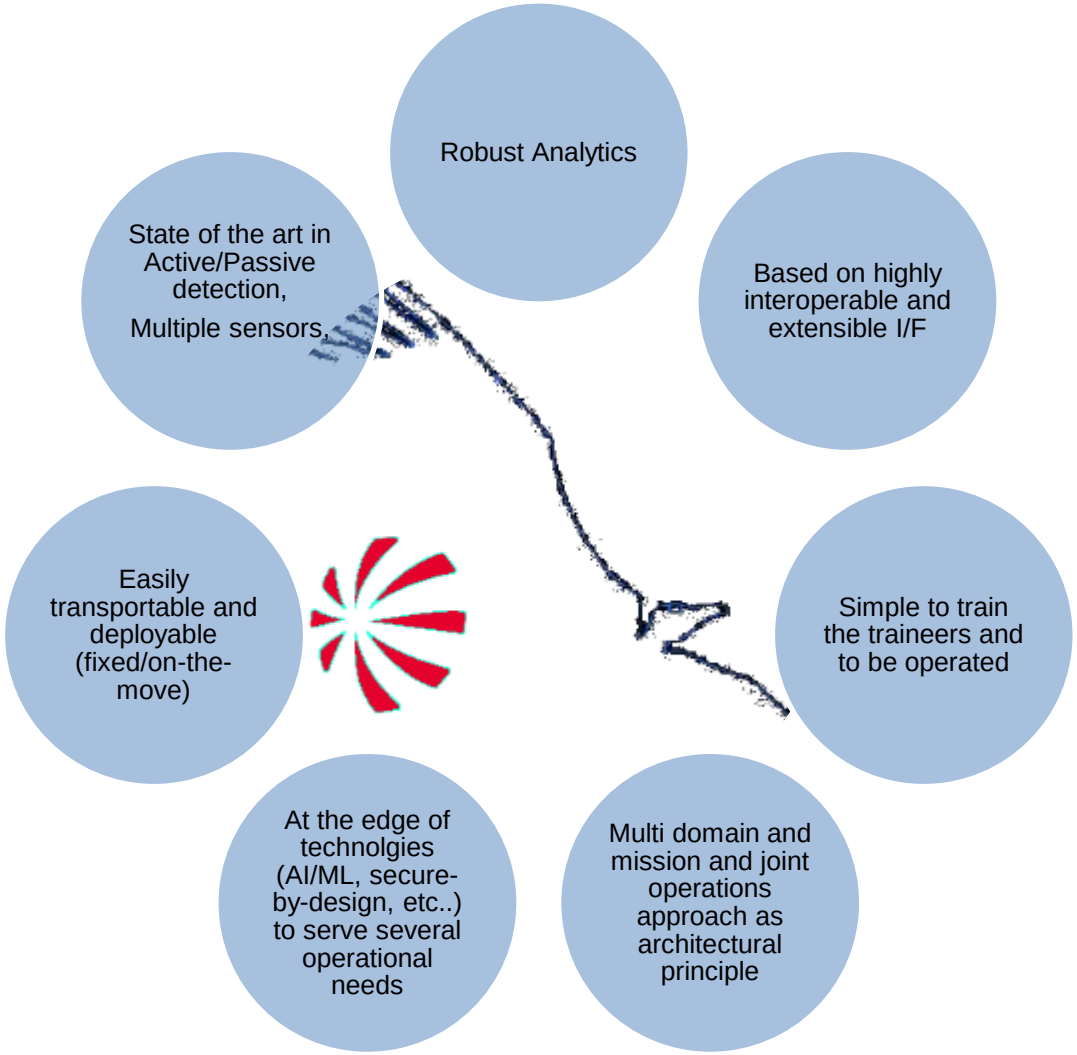
- **Idea**: reduce the number of false targets using **AI to limit the use of Electrooptic to true targets**, as much as possible

CON-DR C2 solution integrates technologies related to Artificial Intelligence (such as the Leonardo BRAIN suite) and Machine Learning which contribute to enriching its potential. Leonardo BRAIN (Box for Augmented Reality and Neural Intelligence) technology is developed and created in the Leonardo plant in Rome Tiburtina, a center of excellence for electronics, which consists in the application of Artificial Intelligence to video analysis to precisely identify threats.

The implementation of these technologies will guarantee:

- **enhancing video and image analysis capacity to identify and classify threats, including drones;**
- **improvement of precision and automation of numerous activities;**
- **important relief for the workload of operators in the decision-making**

CON-DR solution – Key Benefits



There is no silver bullet C-UAS solution to detect and mitigate all drone threats and there will not be solely one in the near future; however, LEONARDO CON-DR solution can effective against most current threats and can be adapted to future threats.

Leonardo supports customers to realize their success.