

# The Counter UAS Directory and Buyer's Guide

*The following directory is a listing of available counter-UAS systems, networks and components and is supplied free of charge to [www.unmannedairspace.info](http://www.unmannedairspace.info) website visitors for information purposes only. The directory is under constant review and will be updated and enlarged. Information is supplied directly by manufacturers, with data edited to remove unverifiable claims. The publisher accepts no responsibility for the information supplied. Website sources for the data plus further contact information are given alongside product and services descriptions.*

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*Image: Shutterstock*

## Capture

| Company   | Product             | Type    | Description   | Country         | Website  |
|---|---------------------|---------|---|-----------------|--|
| <b>Aerospace Science and Industry Corporation</b> | <b>C-UAS drone</b>  | Capture | China Aerospace Science and Industry Corporation has developed a drone which uses a net to bring down a rogue drone. The drone fires a 172 square foot net over its target causing it to lose power and fall to the ground. A camera is installed under the drone to locate its target enabling a ground operator to remotely activate the two launching cylinders which cast the net. The drone can also conduct surveillance, probe and bombardment missions in battles, according to press reports   | China           | <a href="http://www.uasvision.com/2019/09/09/chinas-drone-catching-net-drone/">www.uasvision.com/2019/09/09/chinas-drone-catching-net-drone/</a>                         |
| <b>Almaz-Antey</b>                                | <b>Volk-18</b>      | Capture | The Volk-18 (Wolf-18) interceptor drone developed by Almaz-Almaty will be used to protect civilian airports from intruder drones, Deputy CEO Dmitry Savitsky told the news service TASS in August 2021. The drone measures 60x60 cm, has a takeoff weight of up to 6 kg, and a flight time of about 30 minutes. Its armament includes three small rocket launchers that shoot nets at enemy drones, entangling them and bringing them down. If that fails, the drone rams the enemy UAV, breaking it up in mid-air.   | Russia          | <a href="http://www.almaz-antey.ru/en/">http://www.almaz-antey.ru/en/</a>  |
| <b>Delft Dynamics</b>                             | <b>DroneCatcher</b> | Capture | Project DroneCatcher started in 2015 when Dutch Police, Military Police and others called for solutions for the protection against UAS. DroneCatcher is a compact mechanically operated net system designed and integrated in small unmanned helicopter. From the flying platform a net is fired on a hostile drone. The net can be equipped with a parachute to avoid endangering people on the ground. The system is designed to manage potentially hostile drones in a controlled and safe way by capturing them and dropping them to safe location by parachute.                            | The Netherlands | <a href="http://www.delftdynamics.nl/index.php/en/">http://www.delftdynamics.nl/index.php/en/</a><br><a href="http://www.dronecatcher.nl">http://www.dronecatcher.nl</a> |
| <b>Drone Defence</b>                              | <b>NetGun X1</b>    | Capture | The Net Gun X1 is a simple to use, cost effective active deterrent that allows law enforcement officers to capture unwanted drones up to 15m. It can be specified with two different types of capture net allowing the user the choice depending on the situation they face. It is small, lightweight and compact meaning that more units can be deployed to tackle unwanted drones. Capturing the drone allows the security operative to regain control of the situation and ensures that it can be handed over to forensic experts who may be able to ascertain the identity of the operator. | UK              | <a href="http://www.dronedefence.co.uk/net-gun-x1">http://www.dronedefence.co.uk/net-gun-x1</a>  |

|                                 |   |         |   |             |   |
|---------------------------------|---|---------|---|-------------|---|
|                                 |   |         | <p><b>Partnerships</b></p> <p>In March 2021 Drone Defence and Scientel Solutions partnered to create a new C-UAS entity called Starlying Sky Security. The new company is now the sole distributor for North, South &amp; Central America of proprietary UAV security technology developed by Drone Defence and Scientel Solutions.</p>   |             |   |
| <b>Droptec</b>                  | <b>Dropster</b>   | Capture | <p>The Dropster is a non-lethal counter-UAV system. Due to its high mobility and quick preparedness, it is recommended for various tasks, such as personal and property protection. The red-dot sight combined with the high speed of the net also allows the operator to neutralize moving targets. The Dropster counter-UAV system uses gas pressure to shoot off a cut-resistant net onto civilian drones. At contact, the net entangles itself with the rotors of the aircraft and blocks its thrust. As a consequence, the target falls to the ground. It is also possible, to shoot the Dropster out of buildings and/or from rooftops.</p>   | Switzerland | <a href="http://www.droptec.ch/product">http://www.droptec.ch/product</a>   |
| <b>Skysec</b>                   | <b>Sentinel Catch/<br/>Sentinel Catch<br/>&amp; Carry</b> | Capture | <p>Sentinel's Catch CUAS intercepts and captures intruding drones using a net. It comes in two versions: Sentinel Catch which is launched from a mobile control vehicle and has a single propeller and 5km range, and Catch &amp; Carry which is larger, has four propellers and which also captures unwanted drones in a net, but can stay in the air to carry what it has caught to a safe location. The Sentinel Catch uses a parachute to ground the intercepted drone. Both variants have a modular design allowing for upgrades to laser or tv-guided mode; multiple flight modes such as take-off, cruise and interception; missions can be aborted at any time. Applications include urban defence and airport defence.</p> | Switzerland | <a href="https://www.skysec.ch/">https://www.skysec.ch/</a>   |
| <b>University of New Mexico</b> | <b>MARCUS</b>   | Capture | <p>A group from the University of New Mexico (UNM) is working with Sandia National Laboratories robotics experts on efficient ways to intercept enemy unmanned aircraft systems mid-flight, according to the UNM newsroom. This test has been part of a two-year Laboratory directed research and development project called Aerial Suppression of Airborne Platforms (ASAP). That demonstration led to funding for three years of continued research and testing for the Mobile Adaptive/Reactive Counter Unmanned System (MARCUS) project, which will address current and future national security threats posed by small unmanned aircraft systems</p>   | USA         | <a href="https://news.unm.edu/news/unm-sandia-collaborate-on-project-to-assess-threats-of-small-unmanned-aerial-systems">https://news.unm.edu/news/unm-sandia-collaborate-on-project-to-assess-threats-of-small-unmanned-aerial-systems</a> |

## Detector systems

| Company         | Product  | Type     | Description   | Country | Website  |
|-----------------|----------|----------|---|---------|--|
| 34 North Drones | NO-DRONE | Detector | <p><b>Partnerships</b></p> <p>34 North Drones in October 2019 announced it had partnered with IDS North America to offer the NO-DRONE radar counter drone system for the civilian market. Previously used in military environments, the NO-DRONE radar detection system is designed to recognize small objects such as incoming mortar, artillery and rocket fire, and to detect, locate and track both fixed wing and rotorcraft UAVs, and small drones. The system provides full 360° coverage, day or night, as well as in adverse weather conditions. The system can be upgraded with an optional “slew to cue” EO/IR turret and an RF detector to enhance drone tracking and identification capabilities.</p> <p>The NO-DRONE counter drone radar system utilizes a suite of EMC/EMI simulation tools for predictive assessment of possible interference between various radiating and receiving elements around the airport which models any potential interference with and from any existing nav aids and comms equipment.</p> <p>The partners have carried out demonstrations and tests at the China Lake Naval Air Weapon Station and internationally and the system has been installed at various airports and prisons. The NO-DRONE system is also available for rental with trained operators in a mobile platform for temporary use at facilities and events across the USA, and later, internationally for drone mitigation where permanent installation is not practical or needed.</p> | USA     | <a href="http://www.34northdrones.com">www.34northdrones.com</a> |

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| 42 Solutions | CUPS C2 App | Detector | <p>42 Solutions released a beta version of its App to secure airspaces against non-cooperative drones in October 2019. The development augments the drone detection and ATM situational awareness platform CUPS developed jointly with UK company Rinicom. When a drone is detected, the CUPS C2 App is used to assess whether this drone poses a threat. It does this automatically using pre-configured sensitive areas, and the location of aircraft and authorised drones that are obtained from the integrated ATM and UTM systems. The threat is forwarded to the airport tower and the security App when the CUPS C2 operator acknowledges the threat.</p> <p>The purpose of the App is to provide security forces with information to deal with the drone threats. It does this by providing the real time location of the threatening drone, its heading and history and (if available) its pilot. The situational awareness can be enhanced with further details about the drone, the location of cooperative drones registered in UTM applications and the location of responding team members. Through a reporting function the status of the action taken is communicated to all stakeholders knowing exactly when the situation is normalised again. Air Traffic Controllers are alarmed only when risks of collision are increasing and preventive action in final approach and/or take-off is needed.</p> <p>CUPS is a Eurostars project of 42 Solutions, Netherlands and Rinicom, UK and financed by the EU. The system detects non-cooperative drones, assesses threats, shares situational information among stakeholders, has a command and control working position and a 'human in the loop'-option. CUPS and the mobile App offer jointly enable an effective process to mitigate threats of non-cooperative drones.</p> | Netherlands | <a href="https://www.42solutions.nl/index.php/cups/">https://www.42solutions.nl/index.php/cups/</a> |
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| <b>Aaronia</b> | <b>RR Drone/radar detection system</b> | Detector | <p>The RF Drone or Radar Detection System is based on the Aaronia IsoLOG 3D Tracking Array Antenna, a rugged or remote-controllable Spectran V5 Real-time Spectrum Analyzer and a new Software Plugin for the RTSA Suite Software. All parts allow a 24/7 monitoring and recording (full gapless data-streaming with up to 4TB/day). Each Sector/Antenna gets its own real-time view and is based on RF and <math>\mu</math>W detection. All views are combined to a 360° view including a 360° picture or 360° live video of the surrounding area/landscape. This gives full control over any RF emissions happening around. The system can provide an optical or audio alert if critical values are exceeded and can collect data and compare them to find out irregularities. It can be used as a "single-spot" version, which is directly available. Or it is possible to combine several systems to monitor larger areas, governmental offices, military base camps, industrial areas etc.</p> <p><b><u>Partnerships</u></b></p> <p>In October 2019 Aaronia announced a partnership with ideaForge to offer a combined solution to provide an intrusion monitoring solution to track dynamic threats for markets. Indian company ideaForge manufactures drones for defence, homeland security and industrial applications and the two companies are offering a single solution to mitigate drone threats.</p> | Germany | <a href="http://www.aaronia.com/products/solutions/Aaronia-Drone-Detection-System/?gclid=Cj0KEQjw7dfkBRCdkKrvmfKtyeoBEiQAch0egblrt30bMy2GKvEK_J5HBtPnIHbcVsyCXJ380cPQnIQaAIYI8P8HAQ">http://www.aaronia.com/products/solutions/Aaronia-Drone-Detection-System/?gclid=Cj0KEQjw7dfkBRCdkKrvmfKtyeoBEiQAch0egblrt30bMy2GKvEK_J5HBtPnIHbcVsyCXJ380cPQnIQaAIYI8P8HAQ</a> |
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| <b>Accipter</b>                    | <b>NM1-8A Drone Radar System</b> | Detector | <p>The Accipiter® NM1-8A Drone Radar System is a software-definable, 2D surveillance radar designed to detect, track and alert to the presence of drones. The system includes one radar sensor integrated into a NEMA-4 rated environmental enclosure, which houses the radar sensor electronics, digital radar processors, radar remote controller, radar data manager, power management and data communications components. The system includes a high-resolution, X-band transceiver with 8’ array antenna with the sensitivity to detect and track drones as small as birds, and capabilities to identify behaviour and issue alerts. It is a software-definable surveillance radar specially designed to detect and track vessels from small pleasure craft to large vessels, as well as low-flying aircraft of all sizes, including small ultralights, drones and general aviation aircraft.</p> <p>The system includes one radar sensor integrated into a NEMA-4 rated environmental enclosure, which houses the radar sensor electronics, digital radar processors, radar remote controller, radar data manager, power management and data communications components. The radar sensor is selectable from leading X-band and S-band manufacturers, with antennas ranging from 4’ to 21’ in length. The Accipiter® NM1-8A is well suited for use along inland and coastal water borders for both maritime and air domain awareness, and land borders for air domain awareness applications</p> | Canada | <a href="https://www.accipiteradar.com/products/aviation-safety-security-2/drone-uas-detection-tracking-and-alerting/">https://www.accipiteradar.com/products/aviation-safety-security-2/drone-uas-detection-tracking-and-alerting/</a> |
| <b>Advanced Radar Technologies</b> | <b>Drone Sentinel</b>            | Detector | <p>ART Drone Sentinel is a high performance anti drone and sUAS integrated surveillance system. ART Midrange, a radar sensor, has been optimized for very low radar cross section airborne threat detection and tracking. The early detection, warning and tracking functionality provided by the radar is complemented by an optronic platform that features day and night classification capabilities. Both sensors are integrated in the same physical assembly that can be fast and conveniently deployed using a single mast. ART Drone Sentinel also includes an intuitive GIS-powered multi-sensor command and control software suite that provides a common operative picture for unsurpassed airspace situational awareness. The widespread availability of low cost fully automatic micro drones has redefined the security risks of critical infrastructures, national borders and military bases.</p> <p>ART Drone Sentinel is a single mast solution that provides round the clock, 360 degrees anti-drone surveillance with what the company says is the fastest</p>  | Spain  | <a href="http://www.advancedradartechnologies.com/products-services/art-drone-sentinel">http://www.advancedradartechnologies.com/products-services/art-drone-sentinel</a>   |

|                             |                        |          |  |                 |   |
|-----------------------------|------------------------|----------|--|-----------------|---|
|                             |                        |          | update rate in the market (1 Hz). ART Drone Sentinel performance has been experimentally validated with representative targets under the supervision of a key European end-user. ART Drone Sentinel detects, tracks and classifies micro quadcopters and micro fixed-wing UAVs with radar cross sections below 0.005 m <sup>2</sup> at 2000 meter range. In addition, the system can provide simultaneous ground based target detection & tracking. Designed to improve the efficiency of its end users. ART Drone Sentinel features fully automatic operation (suitable for non-trained operators), remote management and is cost effective both for large and small scale deployments.   |                 |   |
| <b>AEC Skyline/ForcePro</b> | <b>C-UAS system</b>    | Detector | AEC Skyline has been providing aerial services (close air support, electronic warfare, ISR) and critical data solutions (systems integration, IT networking) to the Netherlands and foreign armed forces, the defence industry and research institutes for many years. ForcePro is active in the C-UAS domain, representing DroneShield.   | The Netherlands | <a href="https://aec-skyline.com/news">https://aec-skyline.com/news</a> |
| <b>AeroDefense</b>          | <b>AirWarden TM</b>    | Detector | AirWarden is a patented drone detection technology that detects both drone and pilot (controller) simultaneously and does not require legal authorization to use. Its network of radio frequency (RF) sensors detects drones, controllers, and unknown signals using spectrum sensing technology, locates them via trilateration, and tracks their movement over time. Sensor electronics can be stored in a data center or weatherproof enclosure and connect back to the small, lightweight detection antenna up to 20 km away via a fiber connection or up to 45 ft away via a coaxial connection. AirWarden mobile drone detection configurations operate independently, as a patrolling group (patent pending), or in conjunction with fixed, permanently mounted networks. In July 2020 AeroDefense announced a new mobile deployment option. AirWarden mobile deployments operate independently, as a patrolling group (patent pending), or in conjunction with permanently mounted systems.<br><br>According to the company: "AirWarden is the first and only drone detection system to receive the Department of Homeland Security Support Anti-Terrorism by Fostering Effective Technologies (SAFETY) Act Developmental Testing and Evaluation Designation." | USA             | <a href="https://aerodefense.tech/">https://aerodefense.tech/</a>       |
| <b>Ainstein</b>             | <b>ULAB-D1/ULGB-D1</b> | Detector | In September 2018 Ainstein announced two new products in its Ultra Long Range UAV radar series; the Ultra Long Range Airborne (ULAB-D1) and Ultra Long Range Ground-Based (ULGB-D1) radars, capable of precise detection more  | USA             | <a href="https://ainstein.ai/news/">https://ainstein.ai/news/</a>       |



|                             |                                     |          |   |       |   |
|-----------------------------|-------------------------------------|----------|---|-------|---|
|                             |                                     |          | than 1,000 meters away. Available for customized integration with aerial vehicle manufacturers, the ULAB-D1 is optimized for air-to-air manned and UAVs beyond visual line of sight (BVLOS) operation. The ULGB-D1 is optimized for ground-to-air drone detection and monitoring and can be integrated and deployed by perimeter security solutions and service providers. Both feature Digital Beam Forming for highly precise elevation measurement and real-time processing for 3D detection, with speed measurement for more than 100 targets, bringing enhanced security capabilities to airborne and ground-based radar solutions.  |       |   |
| <b>Airspace Systems Inc</b> | <b>Drone security system/Galaxy</b> | Detector | The company uses machine vision and deep learning to detect anomalies in the sky and classify rogue drones. Once engaged, the flight system anticipates and reacts to a drone's every move, in real time. The capture system then safely disables and retrieves drones to limit collateral damage. In December 2018 Airspace Systems introduced Airspace Galaxy™, “the first family of fully-automated, always-on airspace security solutions that accelerate the integration of drones into cities and protects people and property — on the ground and in the air — from clueless, careless or criminal drone operators,” says the company. The Airspace Galaxy security platform combines input from multiple sensors to detect drone activity at long-ranges, instantly identifies authorized and unauthorized flights, assesses risk, and if necessary and permitted, deploys an autonomous mitigation system to safely capture and remove an unauthorized or malicious drone. | USA   | <a href="https://airspace.co/#home">https://airspace.co/#home</a>           |
| <b>Altitude Angel</b>       | <b>C-UAS system</b>                 | Detector | <b>Partnerships</b><br><br>In late 2019 UTM company Altitude Angel and UAS technology supplier Heliguy formed a strategic partnership to provide a UTM/counter UAV solution to aerodromes and strategic infrastructure owners across the globe.   | UK    | <a href="https://www.altitudeangel.com/">https://www.altitudeangel.com/</a> |
| <b>Anristu</b>              | <b>AeroShield</b>                   | Detector | In June 2020 Anritsu Company launched AeroShield™ MX280002A, a hardware and software solution for passive RF detection and tracking of drone activity. Consisting of a flexible Application Programming Interface (API) and demonstration program, the AeroShield tracking process uses Time Difference of Arrival (TDOA) for accurate drone positioning. Tracking speed and reliability are optimized by continuously adjusting the receivers' signal-to-noise (SNR) ratio during the drone's incursion. Typical drone detection and tracking range with   | Japan | <a href="https://www.anritsu.com">https://www.anritsu.com</a>               |

|   |  |          |  |         |   |
|---|--|----------|--|---------|---|
|   |  |          | three Anritsu Remote Spectrum Monitors (RSMs) is 500 meters but is scalable to cover wider areas with additional receivers. Alarms and reports are automatically generated for the user. The drone detection and tracking process is fully automated and active 24/7. The application continuously scans 2.4 GHz and 5.8 GHz ISM bands for drone activity. Additional custom bands can be added by the user. Proprietary algorithms have also been implemented to minimize false positives; a constant problem faced by C-UAS providers.   |         |   |
| <b>AntiDrone/<br/>Prime<br/>Consulting &amp;<br/>Technologies</b> | <b>Mini, short-<br/>range, medium-<br/>range and long-<br/>range counter<br/>UAV systems</b> | Detector | <p>The system includes the minimum set of equipment for detection of UAVs at short distances that do not exceed 200 meters. The mini anti-drone system includes a server, video cameras (the quantity may vary from four cameras for separately situated buildings to up to 32 cameras for large installations, for example, football stadiums) as well as proprietary software. The software is based on special algorithms that help to identify drones and distinguish them from birds to minimize false alarms. The system provides 24/7 perimeter monitoring and whenever a drone is detected it sends an alert by SMS or an application installed on the mobile devices of the security personnel. It is also possible to use the system with a perimeter surveillance radar. The radar provides the coordinates of the target, the camera points at it and the software determines whether it's a drone, a bird or any other object. The mini anti-UAV system can be upgraded and optionally used together with RF detectors (like DroneWatcher) to detect the drone control signals.</p> <p>Small-range anti-UAV systems provide protection from drones in the range from 200 m to 1 km. Medium-range counter-UAV systems include anti-drone solutions for drone detection and neutralization at distances from 1 km to 4 km. The system can be integrated with some optional equipment, such as RF detectors, perimeter surveillance radars, acoustic sensors, thermal cameras, illuminator, mobile tower (with integrated power system), mobile jamming system, pan-tilt mount, communications system, additional lighting system, anti-drone laser and drone capture net. Long-range anti-UAV systems include anti-drone equipment and solutions for drone detection and neutralization at distances from 4 km to 25 km.</p> <p>Anti-drone solutions used in the long-range systems provide drone detection at distances of up to 25 km and height of up to 7 km as well as neutralization at</p> | Denmark | <a href="https://anti-drone.eu/">https://anti-drone.eu/</a> |

|   |                 |          |  |        |   |
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|   |                 |          | distance of up to 4 km (depends of the size of the target). The standard set of equipment for long-range anti-UAV system consists of long-range drone detection radar, perimeter surveillance radars, RF detectors, long-range video tracking system, visual command centre software, computer with video analytics system, long range acoustic devices as well as stationary jamming system with pan-tilt mount.  |        |   |
| <b>AP Systems<br/>(Advanced Protection Systems)</b> | <b>Ctrl+Sky</b> | Detector | <p>Ctrl+Sky offers a scalable, multi-sensors approach to ensure a complete “dome” of protection from unwanted drone invasion. The combination of proprietary radar, acoustic, vision and RF sensors allows Ctrl+Sky to minimize false alarms and detects even small drones at distances up to 2000 meters. The FMCW radar sensor operates in the X band and uses MIMO technology to locate drones. Ctrl+Sky uses the most advanced radar tracker based on MHT algorithm. The system can distinguish drones from other flying objects, such as birds. The acoustic sensor is based on an 8-element microphone array that uses digital beam forming technique in the acoustic domain to accurately localize sound sources in 3D space.</p> <p>Advanced, machine learning based classification algorithms discriminate between drones and other objects. Video cameras register recordings of detected drones, so it is possible to present hard evidence of an intruder in a protected area. An RF Sensor detects radio-link between a drone and remote control-station by identifying radio frequency (RF) signatures of Wi-Fi signals. The RF sensor detects a targeted radio signal, identifies it and the software allows neutralization of the unwanted UAV. By using multiple RF Sensors the drone operator could also be localized. Ctrl+Sky Jammer is an optional element of the system, used to neutralize drones by overpowering the drone’s receivers. Its use is restricted to a group of customers with appropriate permissions.</p> <p><b><u>Partnerships</u></b></p> <p>At the start of 2022 APS signed a partnership agreement with ORLEN Security. APS’ SKYctrl anti-drone systems and FIELDctrl 3D MIMO radar family will be used to support a wide range of security activities by ORLEN Security to ensure the security of national critical infrastructure.</p> | Poland | <a href="http://apsystems.tech/en/">http://apsystems.tech/en/</a> |

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|                                      |                     |          | ORLEN Security focuses primarily on the safety of customers from the segment of strategic units for the national economy, facilities subject to mandatory protection and facilities whose business profile is associated with a high level of operational risk (refining and petrochemical industry).  |        |   |
| <b>ApolloShield</b>                  | <b>ApolloShield</b> | Detector | ApolloShield detects drones using multiple technologies - cameras, audio and radio sensors. ApolloShield estimates the location of the detected drones and their operators, allowing the security team to assess the risk. It finds the unique identifiers of most drones, allowing law enforcement agencies to hunt irresponsible operators. It then takes control of supported drones and sends them a "go home" command, disconnecting the original operator and forcing them to land safely.   | Israel | <a href="https://www.apolloshield.com/">https://www.apolloshield.com/</a>                     |
| <b>Applied Technology Associates</b> | <b>LOCUST</b>       | Detector | LOCUST is designed to detect and identify UAS threats using active and passive radio frequency (RF) and electro-optical infrared (EOIR) sensor subsystems, and it negates the threats using intelligent electronic attack (EA) and high energy laser (HEL) effectors. Each LOCUST delivers a layered detection and identification capability in a fixed emplacement configuration or on a mobile platform with HEL shoot-on-the-move capability. LOCUST is designed for the counter UAS mission, and the technologies and approach are scalable to provide a compact, rugged, and modular multi-mission system to conduct more effective and efficient detection, identification, management, and mitigation of Group 1 and Group 2 UAS threats. LOCUST is designed for installation on military or commercial platforms to defeat UAS and intelligence, surveillance, and reconnaissance (ISR) threats, as well as provide ISR capability. It can be rapidly inserted into integrated battle management, command, and control (BMC2) architectures as well. | USA    | <a href="http://www.atacorp.com">www.atacorp.com</a>  |
| <b>ArtSYS360</b>                     | <b>RS500</b>        | Detector | <p>The RS500 is an early drone notification system. It detects drone presence by analyzing signalling channel and radio transmission from the drone operator and triggers automatically a Jamming system which deactivates the drone by jamming the GPS signal.</p> <p>Early drone notification fits the following solutions:</p> <ul style="list-style-type: none"> <li>• Geo fence protection area as: airports, prisons, offices, campus, villas, and sensitive facilities.</li> <li>• On the go protection for cars, trucks and VIP transports</li> </ul>  | Israel | <a href="http://www.artsys360.com/product/rs500/">http://www.artsys360.com/product/rs500/</a> |

|                        |                             |          |   |        |   |
|------------------------|-----------------------------|----------|---|--------|---|
| <b>AT&amp;T</b>        | <b>Teaming with Dedrone</b> | Detector | <p><b>Partnerships</b></p> <p>In September 2018 AT&amp;T and Dedrone announced they were teaming up on a drone detection solution that helps protect military bases, venues, cities, and businesses, from malicious drones. The software-centric platform identifies approaching drones by means of radio frequency, visual, radar, and other sensor data. Analysis of sensor data then reliably classifies approaching drones and finds their locations. It then triggers alarms to alert security staff. It can also be integrated with other counter measures to help protect the public, such as building management and alarm systems.</p> | USA    | att.com/CommunicationsNews.   |
| <b>Aveillant</b>       | <b>Gamekeeper</b>           | Detector | <p>The Gamekeeper Holographic Radar is designed specifically for the detection of small UAS. Tracking in three dimensions allows effective target threat assessment. Detection at long range (7.5km) provides early warning, improves situational awareness and increases the available reaction time. Automatic classification differentiates UAS from other surface and air targets including birds.</p> <p>The company has been acquired by Thales.</p>  | UK     | <a href="https://www.aveillant.com/">https://www.aveillant.com/</a>   |
| <b>Byblos/Roboost</b>  | <b>SPID</b>                 | Detector | <p>The Systeme de Protection Integre anti-drones (SPID) is a research project of 18 agencies and organisations to develop a C-UAS system based on several sensors for the detection and the localization of drones and countermeasures. The solution – for military, government and civil applications – resulted in a scalable networked system, with a passive 360 degree detection system, with a weight less than 75kg, deployable in under 30 minutes.</p>   | France | <a href="http://www.gouvernement.fr/sites/default/files/contenu/piece-jointe/2016/12/161118_spid_demo_lad_final.pdf">http://www.gouvernement.fr/sites/default/files/contenu/piece-jointe/2016/12/161118_spid_demo_lad_final.pdf</a> |
| <b>Cambridge Pixel</b> | <b>SPx Tracker</b>          | Detector | <p>The SPx Tracker-3D is a primary/IFF radar tracker, with automatic track initiation that takes in plots (rather than video) from the sensor to create and maintain tracks, which can be output in ASTERIX format for external display or fusion processing. The software is capable of tracking up to 4,000 targets and allows users to configure target dynamics and heights appropriately, associating new plots with existing tracks, so that positions can be accurately updated using a Kalman filter.</p>   | UK     | <a href="https://cambridgepixel.com/site/assets/files/3613/spx-tracker-3d-datasheet-v1-1.pdf">https://cambridgepixel.com/site/assets/files/3613/spx-tracker-3d-datasheet-v1-1.pdf</a>   |
| <b>Capture Systems</b> | <b>ATID</b>                 | Detector | <p>Capture Systems unveiled its anti-threat intelligent detector (ATID) at ISDEF 2019 Defense and Security Exhibition in Tel Aviv in August 2019, aimed at protecting critical infrastructures, airports and prisons. Based on the company's Caracal</p>  | Israel | www.capture-sys.com   |

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|                                     |                       |          | positioner, ATID uses real-time image processing to detect up to five drones or any other threat simultaneously with both day and thermal cameras. The system can be assembled with a GPS in order to predict the drone direction using the Global Positioning System units, and includes an option to be fitted with weapons offering the possibility to destroy the threats. A jammer can be integrated to jam the threats at a range of up to 1 km.  |         |   |
| <b>Chenega International</b>        | <b>dronesafeguard</b> | Detector | dronesafeguard is a mix of layered C-UAV solutions that seek to interdict intruder drones as far out as possible from the facility, asset or person being protected. This is "protection in depth" and it relies on progressively interleaved C-UAV systems and sub systems to: detect, track, respond and then defeat the drone risk threat before physical, asset, cyber or reputational damage is inflicted. Developed with synergia.  | Ireland | <a href="https://chenegainternational.com/media/1195/counteruav_cic.pdf">https://chenegainternational.com/media/1195/counteruav_cic.pdf</a> |
| <b>Cobalt Solutions</b>             | <b>5G-PRT</b>         | Detector | <p>The Department of Homeland Security (DHS) Small Business Innovation Research (SBIR) programme in September 2021 awarded USD750,000 to Texas-based small business Cobalt Solutions to develop a detection and tracking sensor system that can identify nefarious small unmanned aerial vehicles (UAV) in an urban environment.</p> <p>The Phase II award follows a successful demonstration by Cobalt Solutions of its 5G Passive Radar UAS Tracking and Targeting (5G-PRT) sensor system in Phase I. Cobalt plans to develop its Urban Canyon Detection Tracking and Identification of Small UAV solution under Phase II to provide an affordable, passive and easily deployable system that leverages already available commercial 5G signals to detect and track small UAS in urban canyon environments.</p> | USA     | <a href="https://www.cobaltsolutions.net/">https://www.cobaltsolutions.net/</a>   |
| <b>Context Information Security</b> | <b>COPHORNE</b>       | Detector | <p>Context Information Security has developed a lightweight, low-cost drone detection system capable of detecting drones being used for surveillance, smuggling and drone enabled cyber-attacks against wireless networks.</p> <p>COPHORNE is a solar-powered passive, cloud-based sensor network, capable of detecting drones and their controllers within or around restricted areas. The solution is designed to help smaller organisations and individuals to detect unwanted drone activity in and around their premises and even on the move, due to its low size, weight and power (SWaP) requirements.</p> <p>The COPHORNE scanner looks for radio frequency signals in bands used by drones. The hardware-accelerated processing helps it to discriminate a drone</p>                                    | UK      | <a href="http://www.contextis.com">www.contextis.com</a>  |

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|                |                |          | <p>from benign wireless signals at a range up to two kilometres, even in noisy radio environments. Geo-location is performed once the signal is within range of two or more radios with the accuracy determined by the number of radios and local environment. Signal metadata is reported to a cloud-based server via a secure cellular VPN where it is analysed and the results checked against user defined rules. Alerts are then sent in real-time via a variety of channels. For a public area, for example, that could be as simple as messaging an on-site police officer so the pilot can be quickly located and the drone threat neutralised.</p> <p>A proprietary profiling algorithm enables precision fingerprinting as to the type of signal and any known hardware associated with it. The system is designed to distinguish between different models of drones and controllers from the same manufacturer and recognise frequency-agile encrypted video downlinks.</p> <p>A post-incident forensics interface enables the sharing of signal metadata for incident forensics to confirm or deny the presence of a recovered device based upon its radio footprint.</p> <p>System integration is enabled via a plugin framework with support for SMS, Telegram, Google Earth, XML, CSV and KML. With very low bandwidth requirements, the system can be deployed over IP radio, PoE/LAN or cellular. The server and interface also have a lightweight footprint and can be deployed on a single laptop for mobile events.</p> |        |   |
| <b>Controp</b> | <b>Tornado</b> | Detector | <p>The TORNADO air defence electro-optical/infrared system is able to conduct a 360° scan in one to two seconds to produce a panoramic image and is capable of tracking targets in close proximity of 100m, as well as at distances up to tens of kilometres away. It has a continuous zoom to provide a constant surveillance picture and can automatically detect moving targets and provide a track for each. The payload is man-portable and can be operated from moving platforms such as vehicles and vessels, or It can be mounted on a mast.</p>  | Israel | <a href="https://www.controp.com/news-events/in-the-media/counter-uav-technology-tornado.aspx">https://www.controp.com/news-events/in-the-media/counter-uav-technology-tornado.aspx</a> |

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| <b>DAT-CON</b> | <b>Lynx</b>                  | Detector | In September 2021 DAT-CON displayed its newly-enhanced Lynx integrated radar, long range observation system and high power radio frequency jammer, now capable of detecting small drones at 5km and larger drones at 20km ranges, according to company officials.  | Slovenia | <a href="https://www.dat-con-defence.com/">https://www.dat-con-defence.com/</a> |
| <b>Defsys</b>  | <b>Smartshooter</b>          | Detector | Defsys Integrated Systems reported in May 2021 it had delivered its Smartshooter long distance RF-based detection and jamming (soft kill) solution to a customer in India. Smartshooter is designed to provide a counter drone capability to the frontline in engaging with this emerging threat.  | India    | <a href="https://www.defsys.co.in/">https://www.defsys.co.in/</a>               |
| <b>DeTect</b>  | <b>Harrier/Drone Watcher</b> | Detector | DeTect is a leader in advanced bird radar technologies for real-time aircraft birdstrike avoidance, wind energy bird mortality risk assessment and mitigation, and industrial bird control with over 140 of its MERLIN bird radars operating in the US, Canada, Europe, Africa and Asia. The radar processing technology in MERLIN, developed specifically for reliable detection and tracking of small, non-cooperative, low radar-cross section, non-linearly moving targets, is also used in DeTect's HARRIER Security and Surveillance Radar for airspace and marine security applications including drone and UAV detection and defence, Ground Based Sense-and-Avoid (GBSAA) and virtual air traffic control. In 2012. In 2016, DeTect has expanded its drone surveillance capabilities with the launch of its DroneWatcher system that includes an Android application, DroneWatcher APP, that makes a smartphone or tablet into a short range drone detector. DroneWatcher also includes an advanced radiofrequency (RF) sensor, DroneWatcher RF, for longer range detection, tracking, identification and interdiction of drones and small UAVs. Combined, the HARRIER Drone Surveillance Radar and DroneWatcher APP and RF provide a high level of multi-layer comprehensive, multi-layer drone defence. | USA/UK   | <a href="http://www.detect-inc.com/">http://www.detect-inc.com/</a>             |



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| <b>DJI</b> | <b>Aeroscope</b> | Detector | <p>AeroScope is a comprehensive drone detection platform that rapidly identifies UAV communication links, gathering information such as flight status, paths, and other information in real-time. This monitoring data stream helps users make an informed response as soon as possible.</p> <p>Specifications:</p> <p>Model AS-F1800<br/> Ingress Protection Rating IP65<br/> Lightning Rating IEC61000-4-5 6KV<br/> Electromagnetic Compatibility This equipment meets electromagnetic compatibility requirements and also meets Europe: EN 55032: 2015, EN 55024: 2010+A1:2015, EN 61000-3-2: 2014, EN 61000-3-3: 2013</p> <p>United States: 47 CFR Part 15, Subpart B:2016</p> <p>Power Consumption * Approx. 70W<br/> Input Voltage Voltage range: 100V AC ~ 240V AC<br/> Operating Temperature -30°C to +50°C (without solar radiation)<br/> '-30°C to +45°C (with solar radiation)<br/> Relative Humidity 5% RH ~ 100% RH<br/> Absolute Humidity 1 g/m3 ~ 30 g/m3<br/> Atmospheric Pressure 70 kPa ~ 106 kPa<br/> Dimensions 310 mm(H) × 260 mm (W)× 100 mm (D)<br/> Weight 6.8 kg</p> <p>Support Aircraft Phantom series, Inspire series, Mavic series, Spark series</p> | China | <a href="https://www.dji.com/uk/aeroscope">https://www.dji.com/uk/aeroscope</a> |
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| <b>Dronefence</b> | <b>Dronefence</b>               | Detector | The detection system consists of modules that can be adapted and distributed over a wide range of territories. Ground-based and modular, it covers long-range areas such as airports or industrial plants. The Tracking Units can be also customized to narrow streets and obstructed alleys. The UAV Tracker is a multi-sensor system (Radio Frequency, Camera, Acoustic Technologies). It ensures a high certainty of detection by fusing multiple sensor information. This makes false-alarms by flying birds or aircrafts impossible. Each Unit has a high Range of up to 600m with a predominant directional angle of 120 Degree. This allows to detect small drones from a far distance, even at a point when they cannot be seen or taken notice by security personnel yet. The multi-sensor information enable the distinct identification of each UAV by a unique sensor footprint. This makes it possible to separate friendly drones from potential harmful rogue | Germany | <a href="http://www.dronefence.de/Solution.php">http://www.dronefence.de/Solution.php</a>         |
| <b>Drone Labs</b> | <b>Drone Detector</b>           | Detector | With a 360 degree detection radius of up to 1 kilometre (2km diameter), Drone Detector can provide ample early warning. It does not require Line-of-Sight to work properly and can detect drones behind trees, buildings, or other obstacles. The technology can even detect many drones when they are turned on. The Detector Stationary Units are meant to be deployed to a fixed location, such as a rooftop, to provide the maximum amount of threat protection up to 1 kilometre. The portable units, currently available as a beta product, can detect threats up to 500 meters and come in a convenient briefcase size form factor. For locations that don't have access to wired or WiFi connections there is an optional 3G cell phone or satellite uplink module to provide communication in remote locations for most countries.  | USA     | <a href="http://dronedetector.com/">http://dronedetector.com/</a>                                 |
| <b>DroneLess</b>  | <b>RF Sensors, DroneTracker</b> | Detector | Provides Dedrone products  | Spain   | <a href="http://www.droneless.net/en/droneless-en/">http://www.droneless.net/en/droneless-en/</a> |


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| <b>DroneSec</b>               | <b>Notify Threat Intelligence</b> | Detector | In June 2020 DroneSec released a new Software-as-a-Service (SaaS) platform for the drone, counter-drone, and UAS Traffic Management (UTM) system industries. The DroneSec Notify Threat Intelligence system combines traditional human threat intelligence gathering with machine learning and big data to deliver customised alerts alongside in-depth analysis reports. According to the DroneSec press release, the platform offers a searchable artefact database supported by a knowledgebase of whitepapers and industry reports. The platform receives updates daily from over 100 sources, curated and analysed by a team of drone security experts with backgrounds in cyber security, intelligence, and defence. DroneSec Notify is already utilised by organisations across the world operating in the drone space. Notify’s tracking engine combines Open-Source Intelligence (OSINT) techniques with DroneSec’s proprietary tracking software to enable operators to monitor locations for drone activity even if a physical counter-drone system is not in place. For prisons, airports or stadiums where defeating drone systems may not be regulatory approved, Notify combines Standard Operating Procedures (SOPs) with field-tested mitigation strategies. | Australia | <a href="https://dronesec.com/blogs/articles">https://dronesec.com/blogs/articles</a> |
| <b>Drone Security Defence</b> | <b>Counter UAS System</b>         | Detector | The Drone Security Defence counter-UAS system offers a 360 degree detection for small UAS up to 15km distance, using a wide range of sensors. Once the drone is detected the system identifies the operator’s profile, tracks the flight, gathers identification information for possible prosecution and then returns the drone to the take-off point. At the heart of the system, say the developers, is “search/identify/react” software which can be tailored to different organisational needs, including integration with other existing systems. The system is available as an automatic or semi automatic network which allows the operator to have as much or as little input as required.   | UK        | <a href="http://www.dronesecuritydefence.com">www.dronesecuritydefence.com</a>        |
| <b>DSNA Services</b>          | <b>UWAS</b>                       | Detector | See JCPX  | France    | <a href="http://dsnaservices.com/">http://dsnaservices.com/</a>                       |

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| <b>DSNA Services</b>   | <b>Hologarde</b>              | Detector | <p>Hologarde comprises:</p> <ul style="list-style-type: none"> <li>• A 3D innovative radar, that has already proven its ability to detect and track small (0.01m<sup>2</sup>) drones up to 5 km. The software developed for this radar analyses the movement signature of the target, to differentiate it against other objects in its range (like planes, helicopters, drones, and even birds).</li> <li>• Radio frequency sensor able to detect the protocol of data exchange between the drone and the remote-pilot. Combined with the radar, RF technology allows confirmation that the target is a drone and not a bird.</li> <li>• Long-range HD infrared cameras (full HD with thermal for night vision) use the geographical coordinates directly fed from the radar to target the mobile, and zoom at long distance in order to identify and provide visual confirmation of drones.</li> </ul> <p>These three accurate and proven technologies are connected to a Command Control Center (CCC).</p> | France | <a href="http://hologarde.com/">http://hologarde.com/</a>   |
| <b>Duke University</b> | <b>Rapsberry Pi</b>           | Detector | <p>In June 2019 engineers at Duke University in the USA announced they were teaming up with the North Carolina Department of Public Safety to develop an alerting system that uses microphones and thermal cameras to detect unwanted drones and the people flying them, says a Duke University news report. The Raspberry Pi is loaded with a machine learning algorithm that constantly processes the data collected from the microphone to isolate the sounds a drone makes from background noise. When it detects the buzzing whir of a drone's propellers, it sends a notification to an app loaded on smart phones carried by the prison's security personnel.</p>   | USA    | <a href="https://pratt.duke.edu/about/news/prison-drones">https://pratt.duke.edu/about/news/prison-drones</a>   |
| <b>Echodyne</b>        | <b>MESA radar, EchoShield</b> | Detector | <p>Echodyne's Metamaterial Electronically Scanning Array (MESA) radar operates just like a high-end phased array radar, instantly steering a high-resolution beam around a 3D field of view. MESA enables smaller, lighter, less expensive, higher performing imaging radars at commercial price points for industry and government.</p> <p>Features of EchoFlight's high performance radar include:</p>   | USA    | <a href="https://www.echodyne.com/news/echodyne-announces-fcc-certification-of-echoflight-radar/">https://www.echodyne.com/news/echodyne-announces-fcc-certification-of-echoflight-radar/</a> |

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|  |  |  | <ul style="list-style-type: none"> <li>• Precision beam-steering radar that minimizes collision risk by tracking aircraft locations at all times across a broad field-of-view, even in dense airspace or over cluttered environments;</li> <li>• Best-in-class, search while track radar that scans just like a phased array but at commercial pricing;</li> <li>• Compact design with low weight and low power for integration into a wide-variety of UAS platforms; and,</li> <li>• Long-range, all-weather detection and tracking for Beyond Visual Line Of Sight (BVLOS) missions.</li> </ul> <p>In October 2021 Echodyne released a new addition to its portfolio – Echoshield. EchoShield is an advanced software-defined multi-mission radar for a wide variety of commercial, defence, and government use cases.</p> <p>The radar’s architecture builds on Echodyne’s proprietary metamaterials electronically scanned array (MESA) radars that are in use across a wide range of applications, such as counter-UAS, border and base security, force protection, critical infrastructure security, intelligence, surveillance, and reconnaissance, UAV detect and avoid, and autonomous ground vehicles.</p> <p>A pulse-Doppler cognitive 4D radar, EchoShield combines electronically scanned array (ESA) beamforming and real-time dynamic waveform synthesis to deliver sub-degree tracking accuracy on hundreds of objects across a broad 3D field of view. EchoShield’s cognitive search capabilities integrate onboard or offboard data stores to adapt and direct radar resources when and where required, while EchoShield’s SDK is designed to enable deep integration and multi-sensor fusion. Based on market demand, the initial software release prioritizes a counter-UAS mission and detection, tracking, and classification of any uncrewed aircraft, including low slow and small drones even in dense urban environments. Further releases will match radar resources with customer demand in dozens of applications and markets.</p> <p>EchoShield is designed to operate in the Ku band, with radiolocation service at 15.7-16.6 GHz and radionavigation at 15.4-15.7 GHz, and is commercially exportable.</p> |  |  |
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|            |                |          | <p>Its features include:</p> <ul style="list-style-type: none"> <li>• 130° azimuth x 90° elevation field of regard (fully customizable)</li> <li>• 0.5° tracking accuracy in azimuth and elevation, with very low track splitting/dropping</li> <li>• Powerful UAV classification with low false-alarms and near-zero false-negatives</li> <li>• Cognitive search capabilities integrate onboard or offboard data</li> <li>• Average tracking ranges for counter-UAS mission:</li> <li>• Group 1 (-20 to -10 dBsm): 2.7 to 4.8 km</li> <li>• Group 2 (-10 to -5 dBsm): 4.8 to 6.4 km</li> <li>• Group 3 (-5 to 5 dBsm): 6.4 to 11.4 km</li> </ul> <p><b><u>Partnerships</u></b></p> <p>In March 2019 Echodyne reported that its security radar, EchoGuard, has been selected by Black Sage Technologies, Inc. as the preferred radar sensor for mid-range C-UAS security solutions.</p> <p>In early 2022 Northrop Grumman entered into a strategic agreement and minority investment in Echodyne. The initial collaboration area is focused on counter-UAS, where Echodyne’s radars offer performance and SwaP advantages that are expected to bring immediate mission value, says a joint press release.</p> |                |  |
| <b>ERA</b> | <b>VERA-NG</b> | Detector | <p>In July 2021 ERA reported successful testing at Czech military ranges of its VERA-NG passive ESM tracker technology using several types of drones. VERA-NG detected and tracked UAS broadcasting continuous wave (CW) signals. The ability “to see” and track drones from a distance of dozens of kilometres results from ERA’s development in the domain of multistatic surveillance systems.</p>   | Czech Republic | <a href="http://www.era.aero">www.era.aero</a> |

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| <b>ESG</b>          | <b>Guardion</b>                                 | Detector | <p>The GUARDION drone defence system combines the scalable solutions customized to very specific customer requirements to reliably detect and defend against threats posed by the unauthorized use of drones. GUARDION is offered as an integrated product. It has a proven track record of reliable protection in various applications. GUARDION focuses on integrating electronic detection, verification and countermeasures and connecting them to a position mapping and command and control tool. The HPEM counter UAS effectors from Diehl Defence, R&amp;S® ARDRONIS from Rohde &amp; Schwarz and the TARANIS® command and control and position mapping system developed by ESG have proven their capabilities in operational use.</p>   | Germany | <a href="https://www.esg.de/en/division/defence-public-security/drone-defence-and-unmanned-aircraft-systems-uas/">https://www.esg.de/en/division/defence-public-security/drone-defence-and-unmanned-aircraft-systems-uas/</a> |
| <b>FLIR Systems</b> | <b>Ranger HDC MR, R855-3D, Triton PT Series</b> | Detector | <p>FLIR Systems has launched a new high-definition mid-range surveillance system designed to detect illegal activities, for example by drones, even in degraded weather conditions. The Ranger HDC MR uses embedded analytics and image processing to reduce the cognitive workload, enabling operators to distinguish quickly between true threats and false alarms. The system is equipped with a high-definition thermal imager with a 1280 x 720 detector and a 1920 x 1080 HD color TV camera.</p> <p>The man-portable FLIR Ranger® R8SS-3D has the vertical coverage, low minimum detection velocity and algorithms to detect and track up to 500 drone targets simultaneously, while filtering bird detections. The R8SS-3D can monitor the coverage area four times per second, running 24/7, detecting all ground and aerial threats in virtually any climate, day and night. Compact and lightweight, it fits in a backpack, draws only 135W, while costing much less than its vehicle-sized counterparts.</p> <p>The FLIR Triton™ PT-Series HD is an advanced dual-sensor security system, combining a cooled or uncooled 640 × 480 resolution thermal sensor, a 1080p HD visible-light imaging sensor, and a high speed, precision pan/tilt system. The Triton PT-Series HD integrates easily with FLIR United VMS 8.0, as well as other major third party video management systems, making it an extremely versatile solution for critical infrastructure protection in total darkness, bright sun, and adverse conditions.</p> | USA     | <a href="https://www.flir.com/browse/security/counter-uas">https://www.flir.com/browse/security/counter-uas</a>   |


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| Frequentis | FALKE | Detector |  <p><b>Frequentis is an integrator and consultant for counter UAV solutions with an operational perspective. The company builds upon its 70-year history in safety critical domains and ensures common situational awareness and efficient coordination of drone incidents across all agencies: air navigation service providers, aerodrome operators, law enforcement units and other authorities. Frequentis consultants will help define roles, responsibilities, procedures, KPIs, operational requirements and best-fit third-party sensor/effector systems and technology, based on best practice developed with customers, regulators and authorities. Frequentis SWIM-based data exchange platform will integrate and fuse existing systems (surveillance, flight data management, communication and coordination tools) with new systems (UTM, Drone Detection, Incident Management). Frequentis incident and crisis management solutions will display and correlate all information in a geographic information system, which coordinates communications and collaboration across agencies.</b></p> <p><b>Frequentis' goal is to ensure an efficient management of drone incursions across all stakeholders. The solution creates the missing link between organisations (airports, ANSPs and law enforcement), existing infrastructure (ATC air situation, police and blue force tracking) and new systems (UTM and drone detection).</b></p> <p>Video link<br/> <a href="https://youtu.be/xgzUpRxVvFo">https://youtu.be/xgzUpRxVvFo</a></p> | Austria | <a href="https://www.frequentis.com/en">https://www.frequentis.com/en</a> |
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**FALKE is designed to provide the link between relevant stakeholders (airport, police, air traffic control, airlines), existing infrastructure (air situation, air traffic management, ground situation police) and new systems (Unmanned Traffic Management, drone detection) making it possible not only to detect drones, but also to distinguish cooperative from non-cooperative drones. Air traffic control will be supplied with safety alerts in relation to the current air situation. The ability to intercept drones that enter restricted airspace will make it possible to scale future technologies for drone detection and to optimise the cooperation and communication of stakeholders to guarantee a common understanding of the air situation according to Frequentis.**

**In December 2019 Frequentis and Hensoldt announced they will combine C-UAS competencies. Frequentis Comsoft will provide mature components in the areas of UTM/ATM/drone detection, data fusion and exchange (MosaiX SWIM), shared situational awareness and ATM-grade surveillance data automation (SDDS-NG, MSDF, PRISMA), cross-agency incident management (ICM), as well as operational requirement analysis (control room consulting).**

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|                         |                      |          | <p>The Hensoldt group will bring sensor solutions (XPELLER, SPEXER), effector and drone defence technology (XPELLER, VADR).</p>    |       |   |
| <b>Garuda Aerospace</b> | <b>4-layer C-UAS</b> | Detector | The company is developing a 4-layer counter drone system according to a September 2021 report by Indian Aerospace & Defence Bulletin.  | India | <a href="http://www.garudaaerospace.com">www.garudaaerospace.com</a>  |
| <b>General Atomics</b>  | <b>Fencepost</b>     | Detector | The GA-EMS Fencepost acoustic detection system is a covert, lightweight acoustic surveillance system for CUAS, port security, and high value asset, facility and base protection applications. Fencepost provides a range of tracking and data collection capabilities and visualizations, including early warning alerts with target bearings, multiple simultaneous threat detection and tracking, and 3D-track of targets. The system can be configured with multiple networked sensors to support a wide area of coverage, from remote field operations to congested urban environments. Captured data can be integrated into existing command and control software programs to support Intelligence, surveillance and | USA   | <a href="http://www.ga.com/general-atomics-acoustic-detection-system-successfully-performs-at-us-army-event">http://www.ga.com/general-atomics-acoustic-detection-system-successfully-performs-at-us-army-event</a> |

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|                         |                                      |          | reconnaissance, operations, and decision-support applications, according to the company.  |              |   |
| <b>General Dynamics</b> | <b>Counter-UAS Expeditionary Kit</b> | Detector | <p><b>Partnerships</b></p> <p>In September 2021 General Dynamics reported it had developed a new counter-Unmanned Aerial Systems Expeditionary Kit, providing highly mobile C-UAS coverage for remote security requirements, in partnership with Dedrone. “This ruggedized solution allows users to rapidly deploy and setup C-UAS detection to assess UAS threats within a mission Area of Responsibility (AOR) in less than an hour with no tools required,” according to a company statement. The Counter-Unmanned Aerial System Expeditionary Kit allows users to rapidly deploy and setup Counter-UAS detection to assess threats in less than an hour with no tools required. The full kit consists of an Operational Node, Hub Node, and Remote Nodes.</p>   | USA          | <a href="https://gdmissonsyst ems.com/electronic-warfare/counter-uas">https://gdmissonsyst ems.com/electronic-warfare/counter-uas</a>   |
| <b>GEW Technologies</b> | <b>SkyScan2</b>                      | Detector | The SkyScan2 is meant to be used by front-line security forces to detect threat emitters and provide real-time information to control centre commanders. This information can be critical in assessing the security scenario and gaining tactical advantage. While locating emitters, concurrent monitoring is also provided. The SkyScan2 can also be used for communication surveillance and information gathering during high risk events.   | South Africa | <a href="http://www.gew.co.za/spectrum-monitoring/products/skyscan-2/">http://www.gew.co.za/spectrum-monitoring/products/skyscan-2/</a> |
| <b>Gradiant</b>         | <b>Counter UAS system</b>            | Detector | <p>Gradiant’s technology aims to address traditional surveillance limitations using a solution based on the fusion of different sensors. At this moment, the system is working with two complementary technologies: radio frequency (RF) detection and video processing; but the system has been designed to have the opportunity to include new sensors in the fusion layer to increase the probability of detection (radar, acoustic, etc). This system is not only capable of detect, identify and locate the drone attacks but also neutralize it. The RF detection module is based on smart spectrum analysis using signal intelligence (SIGINT) techniques, which allow the detection and identification of the signals exchanged by the UAV and the ground station.</p> <p>This solution does not only locate the UAV but it also locates the ground station. The video processing module is based on commercial-of-the-self (COTS) both visible and infrared cameras and a video processing smart software tool for UAV</p> | Spain        | <a href="https://www.gradiant.org/">https://www.gradiant.org/</a>   |

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|                        |   |          | <p>detection and location. It is important to highlight that both systems are passive, this feature has some advantages as: it cannot be detected by the attacker, it does not generate electromagnetic pollution, and the power consumption is low compared with active solutions like radar, so it is feasible to board it into mobile units and powered with battery.</p>   |     |   |
| <b>Gryphon Sensors</b> | <b>Skylight, Mobile SkyLight, R1400 3-D Active Electronically Scanned Array (AESA) air surveillance radar, S1200 2-D Active Electronically Scanned Array (AESA) direction finder, SkyLight Airspace Monitor Interface</b> | Detector | <p>Gryphon Sensors SkyLight system uses multiple ground-based sensors to detect cooperative and non-cooperative targets in the airspace, providing intelligent situational awareness for integration and security. SkyLight combines multiple technologies to provide the most comprehensive, clear airspace picture. Featuring an array of self-contained sensors, it serves as a complete mobile command center for many applications. Contained in a van, Mobile SkyLight features 4x4 off-road capability and can be taken anywhere without a commercial driver's license.</p> <p>Gryphon Sensors R1400 is a 3-D Active Electronically Scanned Array (AESA) air surveillance radar designed specifically for the detection of small, low-flying targets. The R1400 provides rapid, precise detection and tracking of airborne targets, including small unmanned aircraft systems (UAS), general aviation, birds and other cooperative or non-cooperative targets of interest. It provides accurate target position and velocity in a configurable hemispherical volume of coverage: 360 degrees in azimuth and 90 degrees in elevation. The S1200 is a 2-D Active Electronically Scanned Array (AESA) direction finder that monitors the signals in the relevant frequency bands for the rapid and precise detection and tracking of small unmanned aircraft systems (sUAS). It uses an extensive library of drone control signal profiles in order to detect and classify these types of signals.</p> | USA | <a href="http://gryphonsensors.com/">http://gryphonsensors.com/</a> |

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|                 |                  |          | <p>This passive sensor reliably and automatically detects the remote control of a commercial microdrone within a 5 km radius. The company also offers a variety of high-resolution, slew-to-cue, optical tracking cameras used to get eyes on the target. Used for visual identification and optical tracking, this sensor is especially useful in the classification of non-cooperative targets like birds, general aviation, etc. It uses both thermal and EO lenses to view airborne targets up to 3km in range — with 360° pan and 180° tilt rotations. The SAMI (Skylight Airspace Monitor Interface) is the glue that brings the sensors together to give a complete airspace picture.</p> <p><b><u>Partnerships</u></b></p> <p>In February 2018 Gryphon Sensors agreed a partnership with WhiteFox Defense Technologies, so WhiteFox’s non-jamming, non-kinetic mitigation and analysis capabilities is now integrated within Gryphon’s Skylight system. The resulting RF-based sensor-driven system provides an unclassified and exportable counter-UAS system.</p> |         |   |
| <b>Heliguy</b>  | <b>AeroScope</b> | Detector | <p>Heliguy’s AeroScope is an intelligent platform which integrates multiple data sources, based on DJI technology. Heliguy has installed drone detection technology at a number of UK airports and prisons and works with partners including UTM specialist Altitude Angel, and Operational Solutions.</p>  | UK      | <a href="https://www.heliguy.com/blog/">https://www.heliguy.com/blog/</a>   |
| <b>Hensoldt</b> | <b>PreciSTRM</b> | Detector | <p>Hensoldt is developing an airborne multi-mission surveillance radar which will provide armed forces and border protection authorities with new levels of situational awareness and extremely short reaction times. The software-defined radar named PreciSRTM (derived from ‘precise’, pronunciation: ‘pri’saiser’) incorporates active array and digital receiver technology into a scaleable high-performance sensor which can be installed aboard helicopters, UAVs and fixed-wing mission aircraft carrying out surveillance of large sea and coastal areas against piracy, trafficking or illicit intrusion.</p> <p>Due to its software-defined radar modes and electronic beam steering, PreciSR can fulfil different tasks virtually at the same time. It is able to detect, track and classify thousands of objects and thus literally find the ‘needle in a haystack’.</p> <p>Because of its compact design and the fact that all power consuming parts are</p>   | Germany | <a href="https://www.hensoldt.net/press/press-release/news/detail/News/hensoldt-brings-new-airborne-surveillance-radar-onto-market/">https://www.hensoldt.net/press/press-release/news/detail/News/hensoldt-brings-new-airborne-surveillance-radar-onto-market/</a> |

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|                             |               |          | <p>located outside of the airframe, the airborne platform integration of PrecISR is simplified significantly compared to other radars, according to the company. PrecISR is in the full-scale development phase</p> <p>Xpeller Rapid combines a radar system, a camera, radio detectors and jammers. The system can either be integrated into a vehicle or can be used in a transport container for rapid deployment.</p> <p><b><u>Partnerships</u></b></p> <p>In December 2019 Frequentis and Hensoldt announced they will combine C-UAS competencies. Frequentis Comsoft will provide mature components in the areas of UTM/ATM/drone detection, data fusion and exchange (MosaiX SWIM), shared situational awareness and ATM-grade surveillance data automation (SDDS-NG, MSDF, PRISMA), cross-agency incident management (ICM), as well as operational requirement analysis (control room consulting). The Hensoldt group will bring sensor solutions (XPELLER, SPEXER), effector and drone defence technology (XPELLER, VADR).</p> |        |   |
| <b>HGH Infrared Systems</b> | <b>Spynel</b> | Detector | <p>HGH Infrared Systems has developed an improved version of the Spynel-S and Spynel-X long-range detection systems to meet the high demand for drone and micro-drone detection. The units can now be equipped with a Visible Channel, a Laser Range Finder, or both. This option is called V-LRF and aims to facilitate the recognition phase of the threat detected by the sensor's panoramic detection system. The user will be able to use a x30 continuous optical zoom thanks to the full HD Visible Channel to detect very small flying objects. The other option is an eyesafe Laser Range Finder, which provides the user with accurate data regarding the distance of the detected threat, on land, sea or in the air.</p>  | France | <a href="https://www.hgh-infrared.com/News/News/HGH-Infrared-Systems-to-launch-Spynel-s-Visible-Channel-and-Laser-Range-Finder-at-DSEI-2017-in-London">https://www.hgh-infrared.com/News/News/HGH-Infrared-Systems-to-launch-Spynel-s-Visible-Channel-and-Laser-Range-Finder-at-DSEI-2017-in-London</a> |

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| <b>Hidden Level</b> | <b>Airspace Monitoring Service (AMS)</b> | Detector | <p>Hidden Level’s Airspace Monitoring Service (AMS) is a scalable and cost-effective solution to provide persistent low altitude airspace detection and tracking capabilities for UAS across large volumes of airspace. AMS is offered as a cloud-based data subscription service aggregating pre-processed data from its distributed HL1000 sensor network, as well as external airspace data sources such as UTM Systems, ADS-B, and Remote ID, producing 3D real time positions of UAS. Hidden Level owns, operates, and maintains its sensor network for most of its customers, greatly reducing the cost of ownership and barrier to entry. Sensors are strategically installed on existing infrastructure such as buildings, rooftops, and cell towers throughout a metropolitan area.</p> <p>AMS provides actionable data to its customers by integrating into their existing Video Management Systems, Security Operations Centers, and UAS Service Supplier platforms. The data provided by AMS is subscribed to based on the volume of airspace, custom automated insight reports, and integrations required by the customer’s operations.</p>   | USA   | <a href="https://hiddenlevel.com">https://hiddenlevel.com</a>                                   |
| <b>IDS</b>          | <b>Black Knight</b>                      | Detector | <p>The Black Knight UAV detection radar is able to detect and locate both fixed wing and rotorcraft UAVs of Class I (mini or small) and larger. It can either be installed in a fixed location to provide permanent or semi-permanent protection or it can be mounted on a trailer for quick to set up mobile use. Black Knight provides full 360° coverage, day or night, as well as in adverse weather conditions. The Black Knight radar system can also incorporate an optional EO/IR turret and a multiband jammer. These additions, which are fully integrated as part of the system, provide enhancements to the tracking and identification capabilities of the system as well as a countermeasure option.</p> <p><b><u>Partnerships</u></b></p> <p>34 North Drones in October 2019 announced it had partnered with IDS North America to offer the NO-DRONE radar counter drone system for the civilian market. Previously used in military environments, the NO-DRONE radar detection system is designed to recognize small objects such as incoming mortar, artillery and rocket fire, and to detect, locate and track both fixed wing and rotorcraft UAVs, and small drones. The system provides full 360° coverage, day or night, as well as in adverse weather conditions. The system can be upgraded</p> | Italy | <a href="https://www.idscorporation.com/about-us/">https://www.idscorporation.com/about-us/</a> |

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|                  |                    |          | with an optional “slew to cue” EO/IR turret and an RF detector to enhance drone tracking and identification capabilities.   |             |   |
| <b>Involi</b>    | <b>Involi.live</b> | Detector | involi.live collects real time LAATD (Low Altitude Air Traffic Data) from ADS-B (Automatic Dependent Surveillance & Broadcast) and aircraft transponders, processes it and transmits it to the UTM system so anyone flying and connected to the system can have that information on-board in real time. The solution is to scale-down and adapt the concept of the control tower to the use case of drones, by creating unmanned micro control towers to detect the position of aircraft. This has the advantage of enabling integration of all latest technologies in such devices, while taking out from the loop the weakest element of the equation: the human. The data gathered from a network of micro control towers will be made available in real-time on a platform. In this way, the information on surrounding air traffic could be used by any air traffic connected to it, to automatically and efficiently.   | Switzerland | <a href="http://www.involi.com/how-it-works.html">http://www.involi.com/how-it-works.html</a>               |
| <b>Kaspersky</b> | <b>Antidrone</b>   | Detector | <p>Kaspersky Antidrone is a new standalone solution that uses a trainable neural network to detect and classify civilian drones automatically. The system uses sensors, chosen to reflect the required environment, together with advanced technologies based on a neural network to inform the controller of drones approaching the designated zone. If necessary, Kaspersky Antidrone turns on a module which sends permitted radio interference signals, sending the approaching drone back to base or forcing it to land safely.</p> <p>Kaspersky uses a patented laser scanning technology for primary detection of civilian drones. Solution is also designed to work with video and audio sensors, as well as radar, if applicable. A trainable neural network classifies drones by type and model. In many cases, the drone’s type and model dictate the choice of neutralization paradigm. A specially designed system generates a narrow interference beam to break the drone’s connection with either a GPs satellite or</p> | Russia      | <a href="https://go.kaspersky.com/antidrone.global.html">https://go.kaspersky.com/antidrone.global.html</a> |



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|   |                              |          | the remote controller. Once the connection is broken, the drone will either return to base or slowly descend.   |             |   |
| <b>Kelvin Hughes</b>                                      | <b>SharpEye</b>              | Detector | <p>Kelvin Hughes SharpEye™ SxV radar is highly sensitive and has been optimised for the detection of drones, quadcopters, UASs and UAVs. The company provides complete radar based solutions for border and perimeter security and SharpEye™ with its ability to detect small low aerial targets even in clutter conditions makes it the ideal sensor to detect and provide early warning of the operation of drones. Systems can be a single SharpEye™ SxV mobile radar or part of a multi radar and electro optic camera system deployed via the company's Single Mast Solution (SMS) for mobile and semi-permanent requirements. With a SharpEye™ radar as the primary detection sensor, security agencies are able to monitor and intercept threats from drones in remote and difficult to access locations and also easily move locations. Complete single or multi node situational awareness can be developed through a Detect, Recognise, Identify and Classify methodology and the evolving picture controlled using the Kelvin Hughes control and interface software CxEye™. At DSEI 2017 Kelvin Hughes demonstrated the next evolution of its drone detection and tracking technology. The SMS-D ('D' meaning drone) is a dedicated drone detection and tracking system now featuring a thermal camera and video tracker that acquires the drone target using the initial radar detection information. The benefit of this is once the thermal camera and video tracker has acquired the target it will enable a visual identification and track. Further benefit comes from the combination of the camera mounted on a pan and tilt system that provides a means to precisely calculate the altitude of the UAV. The SMS-D therefore is able to operate as a 2D sensor system providing 3D target information whereby the radar provides the range and bearing. This data can be outputted to a third party counter measure system.</p> | UK          | <a href="https://www.kelvinhughes.com/security/uav-drone-detection">https://www.kelvinhughes.com/security/uav-drone-detection</a> |
| <b>Korea Advanced Institute of Science and Technology</b> | <b>Drone detection radar</b> | Detector | <p>South Korea's Korea Advanced Institute of Science &amp; Technology (KAIST) has developed and deployed a new drone detection radar system which has been deployed around the stadium and athlete village of the 2018 Winter Olympic Games.</p>  | South Korea | <a href="http://www.kaist.edu/html/en/index.html">http://www.kaist.edu/html/en/index.html</a>                                     |

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| <b>L3</b>           | <b>Drone Guardian</b> | Detector | Drone Guardian is hardware-agnostic and scalable. The base system sensors include radar, camera and RF detection, but existing sensors and effectors, or more appropriate alternatives, can readily be integrated to suit specific threat profile.   | USA/UK | <a href="https://l3-droneguardian.com/">https://l3-droneguardian.com/</a>   |
| <b>Leonardo</b>     | <b>Falcon Shield</b>  | Detector | Falcon Shield provides users with a multi-spectral threat sensing capability and, through the integration of an electronic attack capability, a multi-layered threat response. This response introduces a capability to take control of a remotely-piloted drone and land it safely (a command-link control intervention capability) prior to the need to defeat the threat by simple jamming or kinetic solutions. Consequently, the potential for undesired collateral effects is greatly minimised. Falcon Shield is derived from Selex (now Leonardo) ES's heritage associated with the provision of short-range defence solutions against a variety of airborne threats. Falcon Shield makes use of Selex ES's high-performance, passive electro-optical and electronic surveillance sensors, combined with scenario specific radar. These provide a fully integrated threat detection, identification and tracking capability which enables Falcon Shield to operate in environments that range from wide area through to high-clutter, 'urban canyons'. Incorporated within the Falcon Shield system is Selex ES's electronic attack capability that provides users with the ability to disrupt or take control of the threat. Because Falcon Shield is inherently flexible, this electronic attack capability can be complemented by the integration of additional, optional kinetic effectors. Ease of use is provided through use of the Selex ES Vantage Command, Control & Situation Awareness (C2SA) framework. This delivers an intuitive user interface and automated threat detection & tracking functions, including automated handover between detection and identification sensors. | Italy  | <a href="http://www.leonardocompany.com/en">http://www.leonardocompany.com/en</a>   |
| <b>Leonardo DRS</b> | <b>MLIDS</b>          | Detector | Mobile Low, Slow Unmanned Aerial Vehicle Integrated Defense Systems, or MLIDS is a collection of different sensors and weapon systems that have been integrated by DRS to fill the counter-UAS mission, and mounted on top of two separate all-terrain mine resistant ambush-protected vehicles, or MATV.<br><br>In July 2018 the U.S. Army has selected Leonardo DRS, Inc. to provide the Interim, Mobile Short Air Defense (IM-SHORAD) system Mission Equipment Package (MEP) for installation Stryker A1 vehicles. The package includes Moog's Reconfigurable Integrated-weapons Platform (RIWP), Raytheon's Stinger missiles and Rada's Multi-mission Hemispheric Radar (MHR) to provide a "detect-identify-track-defeat" capability required to defeat UAS, rotary-wing and fixed-  | USA    | <a href="https://www.c4isrnet.com/digital-show-dailies/ausa/2017/10/09/army-to-test-counter-drone-matv-upgrade-in-combat-next-year/">https://www.c4isrnet.com/digital-show-dailies/ausa/2017/10/09/army-to-test-counter-drone-matv-upgrade-in-combat-next-year/</a> |

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|                                  |                               |          | wing threats. According to Leonardo DRS the IM-SHORAD solution provides both hard and soft kill capabilities to the warfighter while minimizing impacts on the mobility of the Stryker. The RlwP turret supports multiple weapon configurations to give tactical commanders flexibility in various combat scenarios. The Leonardo DRS solution has the mobility, firepower and soldier protection required to fight forward at the lowest tactical levels. When fielded, this IM-SHORAD capability will provide tactical level commands the precision ground-to-ground and ground-to-air lethality necessary to fight and win across a multi-domain battlefield. This down-select decision is part of the Army's IM-SHORAD effort to deliver prototypes in 2019.  |     |   |
| <b>Lockheed Martin/ Procerus</b> | <b>Indago</b>                 | Detector | Lockheed Martin/Sikorsky's Indago quadrotor will be paired with the MyDefence Communication KNOX C-UAS system. Collaborative development will take place at MyDefence in Denmark. The project is part of an industrial cooperation programme in Denmark with Sikorsky, a Lockheed Martin company. Project goals include pairing the Indago with the KNOX system to achieve rapid response aerial surveillance capabilities. This solution will allow users to quickly and effectively detect adversaries and record evidence that could be used for prosecution. The pairing of the KNOX and Indago systems would be especially useful to secure areas such as critical infrastructure, prisons and private property.   | USA | <a href="http://www.lockheedmartin.com/us/products/procerus/indago-uas.html">http://www.lockheedmartin.com/us/products/procerus/indago-uas.html</a> |
| <b>Lockheed Martin</b>           | <b>AN/TPQ-53 radar system</b> | Detector | The solid-state phased array AN/TPQ-53 radar system, or, Q-53, detects, classifies, tracks and determines the location of enemy indirect fire in either 360 or 90 degree modes, according to the company. The Q-53 is replacing the aging AN/TPQ-36 and AN/TPQ-37 medium-range radars in the U.S. Army's inventory. "Compared to the Q-36 and Q-37, the Q-53 provides enhanced performance, including greater mobility, increased reliability and supportability, lower life-cycle cost, and reduced crew size. The Q-53's active electronically scanned array (AESA) provides the foundation for multi-mission capabilities. The Q-53 has demonstrated the ability to identify and track unmanned aerial systems (UAS), showing the capacity to incorporate air surveillance simultaneously with counter target acquisition in a single sensor." | USA | <a href="http://www.lockheedmartin.com">www.lockheedmartin.com</a>  |
| <b>METIS Aerospace</b>           | <b>SKYPERION</b>              | Detector | SKYPERION is a highly proven, cost effective, fully integrated, scalable, passive RF Drone Detection System that provides a capability against all known commercial drones as well as hybrid 'home-builds'. It can be used to protect a wide variety of situations and/or facilities including Prisons, Stadiums/Events, Critical   | UK  | <a href="http://www.metisaerospace.com">www.metisaerospace.com</a>  |

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|  |  | <p>Infrastructure, Airports, VIP protection and Defence. SKYPERION is compliant with UK/US communication and privacy acts, can be constructed to MIL-STD-810F if required and is export cleared.</p> <p>Designed as a full spectrum multi sensor solution that can provide operators with a timely, high confidence and actionable understanding of drone activity within a defined area, the system comprises two major sub-systems; a mast mounted RF Sensor/Antenna unit and a Control Station. Utilising Edge Computing, the RF Sensor carries out the function of acquiring and digitising RF activity as well as generating the direction of arrival. The Control Station, which runs proprietary licenced software, reports the sensor output through a generic workstation and GUI. Alternatively, the sensor output can be distributed via a mesh network, copper or fibre link and integrated into a remote Command and Control (C2) solution that hosts the SKYPERION software.</p> <p>As a single sensor, SKYPERION can provide a line of bearing indication; the addition of a second sensor (or more) enables 'cross-cut' intercept bearings to provide a more defined threat geolocation. The SKYPERION system can be installed in a ruggedised or lightweight configuration, as a land-based static permanent/semi-permanent installation, a mobile vehicle mounted unit, or as a marinised version with the RF sensor housed in a radome. A body-worn version for dismounted personnel will be introduced later in 2021.</p> <p>SKYPERION is designed to work independently or it can be integrated with Jammers, Radar and/or Electro-Optical systems to form an enhanced counter drone capability; a COTS integrated RF detection/jammer solution is available (SKYPERION Max).</p> <p>Intended for 24/365 operations and in all weather conditions, the simple to interpret GUI and autonomous alert system is aimed at the 'distracted operator' who is multi-tasking and has no specialist knowledge. SKYPERION can be delivered on a purchased or managed service, permanent or temporary basis. If purchased, METIS aims to work with the client to ensure that SKYPERION is fully integrated with new and existing systems, processes and procedures. Alternatively, a fully managed service can be provided with METIS offering 24/365 remote or local monitoring.</p> |  |  |
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|                         |                                  |          | <p>Support contracts are available which would include periodic software upgrades.</p> <p>In September 2021 METIS introduced the SKYPERION marine drone detection system, which provides early warning of drone incursions by identifying and locating RF data signals on vessels at sea, anchorage or in port. The system features autonomous detection, alerting tracking and identification; advanced warning of multiple threats with low false alarms; a simple user interface; remote monitoring and integration with an RF jamming module.</p>   |             |   |
| <b>Microflown AVISA</b> | <b>SKYSENTRY</b>                 | Detector | <p>The AVISA Skysentry acoustic vector sensor array is claimed to be “the only acoustic sensor solution to provide reliable multi-platform drone detection in a single system”. It provides round-the-clock surveillance against aerial threats, and can detect, locate and track a variety of drones from toy-shop multi-copters to larger, fixed-wing propeller UAVs. Detection for small, low-noise drones is 400 m. The system is suited to urban environments characterised by lack of line-of-sight, as it can separate the acoustic signature from a drone from other sound sources. It can be upgraded to monitor gun shots and blasts.</p> | Netherlands | <a href="http://microflown-avisa.com/capabilities/counter-uavs/">http://microflown-avisa.com/capabilities/counter-uavs/</a>   |
| <b>Milrem Robotics</b>  | <b>Autonomous C-UAS platform</b> | Detector | <p>Milrem Robotics and Marduk Technologies have jointly launched a mobile autonomous C-UAS platform designed to offer protection against loitering munition and surveillance drones, according to a press release.</p> <p>The jointly developed system features the electro-optical C-UAS platform Marduk Shark and the THeMIS unmanned ground vehicle (UGV). This mobile solution provides frontline forces with an independent ability to accurately detect, classify and target loitering munition and other flying objects. It uses advanced Artificial Intelligence and Machine Learning models.</p>   | Estonia     | <a href="https://milremrobotics.com/">https://milremrobotics.com/</a>   |
| <b>Miltronix</b>        | <b>Multi-mode radars</b>         | Detector | <p>The company’s range of multi-function, multi-mode radars have the capability to effectively and efficiently detect and track all kinds of UAVs, including those with low RCS. They can detect a UAV with an RCS of 0.1 m Sq at 25 Km. These radars are equally capable of detecting and tracking fixed wing and rotary wing aircraft targets with an RCS of 2 m Sq at 50 Km.</p>   | UK          | <a href="http://miltronix.co.uk/portfolio/4d-multi-function-multi-mode-uav-detection-tracking-air-surveillance-radar-system-2/">http://miltronix.co.uk/portfolio/4d-multi-function-multi-mode-uav-detection-tracking-air-surveillance-radar-system-2/</a> |

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| <b>Moog</b>    | <b>Gauntlet</b>                             | Detector | Gauntlet, connected over a secured VPN network, is a transportable, relocatable solution used for 360-degree, long-range airspace protection. This system offers evidence capture and retention capabilities similar to that of cameras utilized in physical security. Gauntlet is often employed as part of larger solutions to protect civilians, law enforcement, and other high-value assets at Special Event Assessment Rated (SEAR) events   | USA    | <a href="https://www.moog.com/content/sites/global/en/markets/security/counter-uas.html">https://www.moog.com/content/sites/global/en/markets/security/counter-uas.html</a> |
| <b>NASA</b>    | <b>Safeguard</b>                            | Detector | The Safeguard system monitors and enforces conformance to a set of rules defined prior to flight (e.g., geospatial stay-out or stay-in regions, speed limits, altitude limits). Safeguard operates independently of the UAS autopilot and is strategically designed in a way that can be realized by a small set of verifiable functions to simplify compliance with regulatory standards for commercial aircraft. A framework is described that decouples the system from any other devices on the UAS as well as introduces complementary positioning source(s) for applications that require integrity and availability beyond what the Global Positioning System (GPS) can provide. Additionally, the high level logic embedded within the software is presented, as well as the steps being taken toward verification and validation (V&V) of proper functionality. | USA    | <a href="https://ntrs.nasa.gov/search.jsp?R=20160012239">https://ntrs.nasa.gov/search.jsp?R=20160012239</a>   |
| <b>NNIIRT</b>  | <b>1L121-E radar</b>                        | Detector | Air defence radar  | Russia | <a href="http://www.nniirt.ru/">http://www.nniirt.ru/</a>   |
| <b>Noology</b> | <b>Bi-static Spherical View Radar (SVR)</b> | Detector | In August 2021 Noology announced full commercial development of its bi-static Spherical View Radar (SVR). SVR is a new counter-drone and UTM surveillance radar that can detect, track, and identify small, stealth, and autonomous drones with sensitivity and accuracy, even in cluttered environments. Features include: <ul style="list-style-type: none"> <li>• True spherical field of view – 360 degrees azimuth and elevation (straight up, straight down, and all the way around) – with no “cone of silence”</li> <li>• Detection and tracking of small airborne targets with radar cross section (RCS) of 0.001 square meters</li> <li>• 3D target accuracy of 1 cubic meter, from 3 m to 3 km, day or night, and in all weather</li> </ul>   | USA    | <a href="http://www.noology.com">www.noology.com</a>  |

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|                         |                   |          | <ul style="list-style-type: none"> <li>• Low-Slow-Small (LSS) target detection: 1.0 m above ground from 0 km/h up to 500 km/h</li> <li>• Simultaneous detection and tracking of up to 100 targets with 0.5 m target separation</li> <li>• Compact form factor, easy to install and safe to operate.</li> </ul>   |     |   |
| <b>Northrop Grumman</b> | <b>MAUI/DRAKE</b> | Detector | <p>In early 2022 Northrop Grumman entered into a strategic agreement and minority investment in Echodyne. The initial collaboration area is focused on counter-UAS, where Echodyne’s radars offer performance and SwaP advantages that are expected to bring immediate mission value, says a joint press release.</p> <p>Northrop Grumman’s Mobile Application for UAS Identification (MAUI) is a mobile acoustic sensor that operates on Android cell phones and uses the phone’s microphone to detect Group 1 drones, defined as UASs weighing less than 20 pounds, flying lower than 1,200 feet and flying slower than 100 knots. The MAUI software-based approach leverages commercial off-the-shelf mobile devices to provide beyond-line-of-sight detection and identification of UAS threats in high noise environments. The company’s Drone Restricted Access Using Known EW (DRAKE) is a radio-frequency negation system that delivers a nonkinetic, selective electronic attack of Group 1 drones. DRAKE demonstrates the feasibility of repurposing mature counter-improvised explosive device technology for interoperable, counter-UAS missions while protecting friendly force communications.</p> | USA | <a href="http://news.northropgrumman.com/news/releases/northrop-grumman-demonstrates-counter-uas-technologies-at-black-dart-exercise">http://news.northropgrumman.com/news/releases/northrop-grumman-demonstrates-counter-uas-technologies-at-black-dart-exercise</a> |
| <b>Northrop Grumman</b> | <b>G/ATOR</b>     | Detector | <p>A highly mobile multi-mission radar system designed to fully support worldwide expeditionary requirements, Northrop Grumman's AN/TPS-80 G/ATOR system provides multi-faceted detection and tracking capabilities to enable engagement of a wide range of hostile threats, and offers robust air traffic control capabilities to ensure the safety of Marines worldwide. Operational capabilities enhanced by Northrop Grumman's proven Active Electronically Scanned Array (AESA) radar technology give the AN/TPS-80 G/ATOR system the ability to perform multi-mission tasks at significantly lower operation and maintenance costs compared to existing radar systems. In addition to providing a broad range of optimized radar capabilities, AN/TPS-80 G/ATOR provides automatic adaptability via a scalable open system architecture. G/ATOR's multi-network capability ensures</p>   | USA | <a href="http://www.northropgrumman.com/Capabilities/gator/Pages/default.aspx">http://www.northropgrumman.com/Capabilities/gator/Pages/default.aspx</a>   |

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|                         |  |          | compatibility with additional U.S. Department of Defense command and control systems.   |     |   |
| <b>Northrop Grumman</b> | <b>M-ACE</b>   | Detector | In April 2020 Northrop Grumman Defense Systems announced it was conducting validation testing of its latest C-UAS, the Mobile Acquisition and Cueing Effector (M-ACE) concept. The unit features an extended SDS-12 stabilised aluminium tower mounted on a dedicated Ford F250 platform. The company expects to field a prototype demonstrator capability in the near term.  | USA | <a href="https://www.unmannedairspace.info/counter-uas-systems-and-policies/northrop-grumman-tests-new-mobile-counter-uas-concept/">https://www.unmannedairspace.info/counter-uas-systems-and-policies/northrop-grumman-tests-new-mobile-counter-uas-concept/</a> |
| <b>Numerica</b>         | <b>Track Manager, Python Simulator, Spyglass™ 3D Radar</b> | Detector | <p>Numerica Track Manager provides real-time correlation and fusion of measurement and track data for superior situational awareness in benign and electronic attack environments.</p> <ul style="list-style-type: none"> <li>• Integrates all data sources into one track file, minimizing dual tracks, swaps and spurious tracks.</li> <li>• Supports most radars, including primary and secondary surveillance, 3D air defence and approach radars.</li> <li>• Easily scales up from one sensor to many sensors and very large track loads.</li> <li>• High-performance, multi-hypothesis algorithms provide highly accurate, real-time integrated track outputs.</li> <li>• Adaptable architecture can be expanded through add-on modules that provide enhanced capabilities for diverse missions and use cases.</li> </ul> <p>The company's Python simulation infrastructure with high fidelity radar models for rapid performance assessment of complicated network-centric tracking systems is an open architecture, distributed discrete event simulation environment used for conducting Monte Carlo simulations of various multi-component systems. Scalable in that it supports parallel computation across multiple processes, cores, and nodes within a computing framework.</p> | USA | <a href="http://www.numerica.us/defense/unmanned-systems/#collision-avoidance-system">http://www.numerica.us/defense/unmanned-systems/#collision-avoidance-system</a>   |



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|                                  |             |          | <p>Provides the middleware for constructing simulations, including both publish/subscribe and service request/response messaging patterns. Enables simulations to be broken down into the smallest logical components, allowing components can be reused and integrated using minimal interfaces. Supports existing models for DoD radars, tracking components, and truth target generators, to enable various multi-target, multi-sensor, multi-platform tracking studies. Distinguished from other simulators in its lightweight, flexible, interfacing capability. The Python infrastructure allows components in various software languages to be integrated.</p> <p>According to a company press release, the MIMIR software suite enables users to operate multiple sensors and defeat technologies through an integrated user interface, enabling a faster and more effective response to threats.</p> <p>The Spyglass™ 3D Radar is designed and manufactured by Numerica Corporation and is designed to detect ground threats and track small, autonomous, UAS beyond three and a half kilometers with precise measurements to support a range of mitigation techniques. Spyglass™ has been built with embedded C2 and AI software to enable broad-area autonomous sensor networks and seamless integration into layered defence systems.</p> <p><b><u>Partnerships</u></b></p> <p>Liteye and Numerica are jointly marketing C-UAS radars</p> |    |   |
| <b>Operational Solutions Ltd</b> | <b>FACE</b> | Detector | <p>In February 2020 Operational Solutions Ltd (OSL) signed a Memorandum of Understanding with Airways New Zealand to jointly develop a counter drone detection system. OSL's Command and Control/Intelligent fusion software (F.A.C.E) is currently being trialled at Auckland Airport along with Aveillant Gamekeeper holographic radar and AI enabled camera technology. According to a press release from OSL "As the system evolves it will be capable of detecting drones entering airspace that pose potential threats to airport operations, including the ability to identify the nature of the threat. By combining this C-UAS capability with a UTM project, in this case the Airshare system from Airways</p>  | UK | <a href="https://operationalsolutionsltd.co.uk/contact">https://operationalsolutionsltd.co.uk/contact</a> |

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|                  |                     |          | <p>New Zealand, it will also be possible to facilitate and authorise drone flights to operate safely in the airspace around airports.”</p> <p><b>Partnerships</b><br/> In July 2021 Thales and Operational Solutions Limited (OSL) signed a cooperation agreement to further develop and deliver joint opportunities and solutions in the areas of civil C-UAV and unmanned traffic management (UTM). Under the agreement, Thales will incorporate OSL’s FACE command and control software platform into its civil C-UAV and UTM solutions.</p>   |         |   |
| <b>Panasonic</b> | <b>Drone Finder</b> | Detector | <p>Drone-finding technology developed to mitigate the threats of drone accidents and terrorism. The system uses a 32-microphone array and a Pan Tilt Zoom CCTV camera, with each sensor able to detect distances of up to 300m through a 150-degree field of view. It also analyses benign surrounding noises to eliminate them from detection.</p>   | Japan   | <a href="http://www.securitynewsdesk.com/panasonic-develops-drone-finder-technology/">http://www.securitynewsdesk.com/panasonic-develops-drone-finder-technology/</a> |
| <b>Patria</b>    | <b>MUSCL</b>        | Detector | <p>At Eurosatory 2018 Patria launched its MUSCL (Multi-Static Coherent Location) passive sensor drone detection system. According to the company: “Passive sensor systems do not transmit signals themselves, but use radio signals transmitted or reflected by the targets. Because passive systems are extremely difficult to detect and small in size, they actually perform better than active radars in various surveillance tasks... MUSCL offers a modular and highly mobile passive air surveillance system. Its range extends to several hundreds of kilometers with a 360-degree directional coverage, and it can track more than 100 objects simultaneously. MUSCL’s operating principle allows it to detect small and low flying targets, and to pick up stealth targets even better than active radar systems. The MUSCL system is mainly designed for air surveillance by governmental authorities, but it can also be used to protect critical infrastructure, such as nuclear power plants, and major sporting events.”</p> | Finland | <a href="http://www.patria.fi/en">www.patria.fi/en</a>  |

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| <b>Pierce Aerospace</b>           | <b>Flight Portal ID</b>                 | Detector | The company's Flight Portal ID (FPID), compliant with the ASTM F38 Workgroup "UAS Remote ID and Tracking" standard, delivers Identification Friend or Foe (IFF) information to C-UAS operators. According to Pierce, FPID is a dual-use Remote ID technology suite designed to serve commercial UTM and C-UAS systems.   | USA    | <a href="http://www.pierceaerospace.net/">http://www.pierceaerospace.net/</a>  |
| <b>Quantum Aviation</b>           | <b>Drone Protect</b>                    | Detector | DroneProtect® offers clients a tailored and scalable capability to enhance situational awareness using technology specifically targeting the unique signature of drones and delivered at price points to suit all budgets. Using a combination of radio and wi-fi signal detection with electro-optical cameras and if required, bespoke radar, DroneProtect® provides detection, alerting and when suitably specified, tracking of threats using a simple and intuitive operating system, pushing alerts to any remote smart device, laptop or PC. DroneProtect® detects analogue and digital control signals including encrypted systems such as DJI Lightbridge. The system blends RF, optical and radar data to offer a holistic threat picture. | UK     | <a href="http://quantumaviation.co.uk/drone-protect/">http://quantumaviation.co.uk/drone-protect/</a>  |
| <b>QinetiQ</b>                    | <b>Obsidian</b>                         | Detector | The Obsidian radar system detects, identifies and tracks small/micro UAVs that could pose a threat to operational security. By combining staring antenna array technology and QinetiQ's Pallisade™ surveillance management system, complete information on UAS threats can be collected, analysed quickly and then distributed to key personnel through secure wifi distributed channels. The antenna array detects potential threats instantly, without having to scan, while also being able to distinguish very slow moving objects and filter out objects such as bird, ensuring information is unequivocal.   | UK     | <a href="https://www.qinetiq.com/en/sectors/aviation-and-aerospace/counter-drone-systems">https://www.qinetiq.com/en/sectors/aviation-and-aerospace/counter-drone-systems</a>  |
| <b>Rada Electronic Industries</b> | <b>Multi-mission hemispheric radars</b> | Detector | RADA Electronic Industries Ltd. specializes in the development, production, and sales of tactical land radars for force and border protection, and avionics systems (including Inertial Navigation Systems) for fighter aircraft and UAVs. RADA offers advanced pulse-Doppler, multi-mission, AESA radars for land-based tactical applications such as Active Protection Systems (APS) for combat vehicles, Very Short Range Air Defence (VSHORAD) solutions for the maneuver force (including Counter-UAV), Counter Rockets/Artillery/Mortars (C-RAM) systems, and more. These software-defined radars introduce hemispheric spatial coverage with an excellent performance-to-price ratio.   | Israel | <a href="https://www.rada.com/">https://www.rada.com/</a><br>< <a href="https://eur02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.rada.com%2F&amp;data=02%7C01%7CTzachi.Yaffe%4Orada.com%7C69b68f3f7aec46b895a808d714cf475d%7C7b6fc2">https://eur02.safelinks.protection.outlook.com/?url=https%3A%2F%2Fwww.rada.com%2F&amp;data=02%7C01%7CTzachi.Yaffe%4Orada.com%7C69b68f3f7aec46b895a808d714cf475d%7C7b6fc2</a> |

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| <b>Rinicom</b> | <b>SkyPatriot</b> | Detector | <p>SkyPatriot is a family of early warning optical drone detection systems. They use powerful AI video analytic software to rapidly and reliably detect, track, and classify multiple drones located kilometres away, in real-time. The SkyPatriot family includes:</p> <ul style="list-style-type: none"> <li>• SkyPatriot Sector is the entry-level optical system; incorporating a high-resolution detection camera that operates in combination with a 360° PTZ camera. The detection camera continuously scans its preset field of view for multiple objects, directing the PTZ camera to zoom-in on candidate targets.</li> <li>• SkyPatriot Sector180/Sector360 systems build on the base SkyPatriot Sector setup but extends it to monitor 180° or 360° of coverage using multiple integrated detection cameras.</li> <li>• SkyPatriot Hunter works on the same principle of combining a detection camera with a scrutinising PTZ camera but is enhanced by exploiting detection inputs from radar or RF tracking systems to direct the sector detection camera.</li> <li>• SkyPatriot InSight supplements these systems by introducing a powerful AI-derived classification module, which incorporates an extensive catalogue of UAV signatures that can be used to identify specific drone types.</li> </ul> <p>Drone defence deployments around the world with major customers include L3Harris, ST Electronics, Mistral, and Robin Radar Systems.</p> | UK | <a href="https://rinicom.com/drone-detection/skypatriot/">https://rinicom.com/drone-detection/skypatriot/</a>  |

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| <b>Robin Radar Systems</b>  | <b>Elvira</b>                | Detector | Elvira offers 360-degree coverage which combines “smart software with affordable radar” for fast tracking and detection. The system works in low visibility conditions, and in urban environments full of obstacles, moving objects, and wireless radio devices. It can detect swarms of drones. Elvira’s map-based interface is comprised of colour coded tracks which can be toggled on and off, and the track visualisations and colours are all user configurable. Elvira’s tracks and alarms can be integrated as a layer in existing security systems and Command and Control (C2) systems. A simple XML broadcast-based interface is included as standard. Other protocols, e.g. ASTERIX, are available on request. The system is camera ready. It can be equipped with a high-resolution pan-tilt-zoom (PTZ) camera for visual confirmation of the target. Elvira is designed to be ready for integration with other detection systems, existing command centres and new forms of intervention.   | Netherlands | <a href="https://www.robinradar.com/products/all-systems/elvira/">https://www.robinradar.com/products/all-systems/elvira/</a>   |
| <b>Saab</b>                 | <b>Giraffe radars/Falcon</b> | Detector | <p>Saab’s Enhanced Low, Slow and Small (ELSS) system is a capability that enables the company’s Giraffe range of air surveillance and air defence systems to distinguish between UAVs and birds with accuracy. Its Giraffe portfolio now includes the ground based long-range Giraffe 8A, as well as sea and land versions of the Giraffe 4A, the short-range Giraffe 1X and medium-range Giraffe AMB. Giraffe radars are equipped to detect stealth-cloaked aircraft, and that they also feature industry-leading jamming resistance measures.</p> <p>In February 2019, Lockheed Martin, Diehl Defence and Saab announced an agreement to develop the Falcon™ air defense weapon system. According to a Lockheed Martin press release, Falcon integrates Diehl’s 40-kilometer range Infra-Red Imaging System Tail/Thrust Vector-Controlled (IRIS-T) SLM interceptor and vertical launcher, Saab’s 360-degree AESA Giraffe 4A radar through Lockheed Martin’s flexible SkyKeeper command and control battle manager. Falcon’s open architecture allows the system to easily integrate into any air operations centre.</p> | Sweden      | <a href="http://saabgroup.com/Media/news-press/news/2015-09/giraffe-radar-shows-enhanced-anti-uas-skills/">http://saabgroup.com/Media/news-press/news/2015-09/giraffe-radar-shows-enhanced-anti-uas-skills/</a> |
| <b>Securus Technologies</b> | <b>Drone detector</b>        | Detector | Securus Technologies has spent over 18 months evaluating the technology and potential partners dedicated to detecting drones and stopping them from reaching correctional facilities. Drone detection uses a digital antennae structure (DAS) infrastructure similar to that of Securus’ Wireless Containment Solution.   | USA         | <a href="https://www.securustechnologies.com">https://www.securustechnologies.com</a>   |

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| <b>Silent Sentinel</b> | <b>Oculus</b> | Detector | <p>High resolution cameras such as the OCULUS HERITAGE are Silent Sentinel's contribution to the joint development of a counter drone detection capability with Kelvin Hughes. The cameras can detect and identify a PHANTOM-sized drone well beyond 750-1,000m and slave high resolution cameras to the appropriate vector for detailed observation.</p> <p>In October 2021 Silent Sentinel announced the launch of the Rapid Deployment Kit (RDK). Developed to meet the increasing demand for flexible surveillance, the RDK allows for swift set-up of a surveillance position even in remote locations.</p> <p>The RDK consists of a Pelican watertight, dustproof and crushproof carry case containing a tripod, an Oculus or Aeron thermal PTZ camera, and a laptop or GTAC depending on the needs of the customer. The Kit takes no more than twenty minutes for one individual to set up, and has a bank of six 5590-type NATO standard hot-swappable batteries which means that the Aeron camera can provide uninterrupted surveillance for up to 30 hours, or indefinitely when connected to an external power source such as AC 110-220 or DC from a vehicle.</p> <p>The RDK weighs approximately 30kg (depending on the camera model), meaning the contents of the lightweight and durable carry case can be split between two individuals and carried to otherwise inaccessible locations, making it ideally suited to search &amp; rescue operations conducted by law enforcement and disaster relief organisations such as FEMA.</p> <p>Once deployed, the RDK can also be connected with a mesh radio to create an arrayed network of systems capable of providing surveillance and threat detection over a wide area. The RDK's durability and the PTZ's precision means it is well-suited to the most challenging of applications, such as maritime, border security and vehicle-mounted installations, and can be quickly configured accordingly. If required, the RDK can be upgraded to include a complete Over The Horizon (OTH) capability including remote power control and camera streaming.</p> | UK/USA | <a href="http://silentsentinel.com/oculus-heritage.html">http://silentsentinel.com/oculus-heritage.html</a> |
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| <b>Skydroner</b>       | <b>Skydroner 500, 1000</b> | Detector | SkyDroner 500 is designed for urban installation with a detection range of up to 500m. It is ideal in providing total building surveillance in a city environment. SkyDroner 500 can be deployed at the rooftop to provide 24 hours monitoring of surrounding drone activities. SkyDroner 1000 has an effective detection range up to 1000m. It is designed to perform long range surveillance of drone activities in a desert environment. The system is built to meet IP65 standard and operated up to 60 degrees with minimum maintenance. The SkyDroner Central Control Unit has been designed: to alert officer of approaching drone; to indicate progressive distance of the anonymous drone; to provide video footage for easy verification; to identify and indicate type of drone; to record date/time of an event; to generate incident reports  | Singapore | <a href="http://www.skydroner.com/product">http://www.skydroner.com/product</a>   |
| <b>STANLEY/Skyense</b> | <b>Validrone</b>           | Detector | The system maps the position of the drone on a map and provided that the remote pilot is within sight, the pilot can also be located. STANLEY Validrone™ enables precise situational awareness through its long range, which can detect threats early, as well as visually verify through automatically positioned PTZ cameras.  | Sweden    | <a href="https://www.stanleysecurity.com/sv/losningar/stanley-validrone">https://www.stanleysecurity.com/sv/losningar/stanley-validrone</a> |
| <b>Spotter RF</b>      | <b>UAVX</b>                | Detector | <p>UAVX helps commercial facilities and large-scale venues actively monitor and secure their premises, protecting them from unwelcome drones and UAVs. The UAVX precisely detects, tracks and classifies small drones, such as the DJI Phantom, using SpotterRF's compact surveillance radar (CSR), artificial intelligence, and long-range video tracking. UAVX offers comprehensive protection from terrorists, vandals and disruptors.</p> <p>Key features</p> <ul style="list-style-type: none"> <li>• Permanent or temporary installation</li> <li>• Spotter RF radar</li> <li>• Day and thermal cameras</li> <li>• Automatic target classification (Artificial Intelligence)</li> <li>• Optional RF Jammer</li> <li>• 350m quadcopter detection range</li> <li>• Up to 750m optical video tracking range</li> <li>• 1/6 the price of competitive radar counter UAV system</li> </ul> <p>In August 2018 the company launched the first 3D drone detection radar “that creates a full dome drone detection area from 0 to 90 degrees in the vertical and 360 degrees in the horizontal with a single radar that weighs 12 pounds.”</p> | USA       | <a href="https://spotterrf.com/uavx_counter_uav_drone_system/">https://spotterrf.com/uavx_counter_uav_drone_system/</a>                     |

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|  |                              |          | “The 3D-500 radar measures latitude, longitude and altitude of all aerial targets in a 1 km wide hemisphere dome, even directly above the radar with no gaps in coverage. Rapid threat assessment is simple with the automatic detection and 3D tracking of sUAS combined with fully automated camera cueing on the target. Manpower and cost are both reduced with this system while mitigating the threat of undesired aerial presence.”  |        |   |
| <b>Squarehead</b>                                  | <b>Discovair</b>             | Detector | The Discovair system is a fully automated passive, acoustic drone detection system for close proximity air marshalling. The system utilizes acoustic array sensors, allowing for both detection and tracking of drones. The system detects audio anomalies within field of view and runs a discrimination algorithm on the anomaly. Discrimination is immediate, and tracking is provided in real time.   | Norway | <a href="http://www.sqhead.com">http://www.sqhead.com</a>   |
| <b>Sree Sai Aerotech Innovations Pvt Ltd/Zuppa</b> | <b>Zuppa D’Track RFM</b>     | Detector | The Zuppa NPNT Compliant RFM ‘Zuppa D’Track incorporates full “No Permission, No Take-off” (NPNT) functionality, as specified under the Directorate General of Civil Aviation’s (DGCA) CAR3 Drone 1.0 regulations and the Ministry of Civil Aviation’s ‘Drone Ecosystem Road Map Drone 2.0’. The Zuppa D’Track RFM will enable monitoring and keeping a check on drone flights as it is equipped to send alerts in case of violations of route and altitude, tampering and crashing or intrusion of geo-fence no-fly zones by drones.   | India  | <a href="http://www.ptinews.com/pressrelease/33532_press-subZuppa-Eyes-1-85bn-Global-Counter-Drone-Market-With-Launch-of-India-s-First-NPNT-Compliant-Drone-Tracker">http://www.ptinews.com/pressrelease/33532_press-subZuppa-Eyes-1-85bn-Global-Counter-Drone-Market-With-Launch-of-India-s-First-NPNT-Compliant-Drone-Tracker</a> |
| <b>SRI</b>   | <b>Airfield Radar System</b> | Detector | In October 2019 Security Radar Integrators (SRI) selected Echodyne’s EchoGuard solid state 3D radar to support the company’s Airport Radar System (ARS). SRI’s equipment already provides perimeter security at multiple airports in Europe and the US and the selection of EchoGuard aims to expand SRI’s provision of surveillance of UAS for a range of commercial and governmental applications. When integrated into multi-sensor systems such as SRI’s, Echodyne’s electronically scanned array (ESA) radars are designed to cue other sensors for object identification and potential mitigation.<br><br>SRI also partners with Navtech, L3Harris, Furino, FLIR, and DeTect. | USA    | <a href="http://www.sri-radar.com/">http://www.sri-radar.com/</a>   |
| <b>STANLEY/Skyse nse</b>                           | <b>Validrone</b>             | Detector | The system maps the position of the drone on a map and provided that the remote pilot is within sight, the pilot can also be located. STANLEY Validrone™ enables precise situational awareness through its long range, which can detect   | Sweden | <a href="https://www.stanleysecurity.com/sv/losningar/stanley-validrone">https://www.stanleysecurity.com/sv/losningar/stanley-validrone</a>   |



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|            |                  |          | threats early, as well as visually verify through automatically positioned PTZ cameras.   |     |   |
| <b>TCI</b> | <b>Blackbird</b> | Detector | <p>TCI's Drone Detection technology provides field-proven, fully automated detection and geolocation of drones and their radio controllers. It can be deployed interactively by an operator, or automatically for unattended operation (providing low cost of ownership). The system scans the RF spectrum looking for the RF signature of drones and radio controllers. When a drone or controller is detected, the system geolocates the target and provides a notification. Local operators receive notifications by visual and audible alarm. Remote personnel can be notified by other mechanisms, including email and instant text message. Security personnel can then observe the location of both the drone and the controller on the integrated map and track the target's movements. Knowing the location of the drone's controller helps authorities pinpoint the operator for a safe and effective intervention.</p> <p><b><u>Partnerships</u></b></p> <p>TCI International and Enterprise Control Systems (ECS) have partnered to offer a new range of RF drone detection, location and countermeasure capabilities.</p> <ul style="list-style-type: none"> <li>• BlackTALONTM. "The new platform provides RF-only drone detection, location and defeat capabilities, or the addition of radar and electro-optical sensors for more robust detection, tracking and target identification. In addition, any existing Blackbird COMINT system can be upgraded to perform full drone RF detection, location, identification, tracking and defeat."</li> <li>• Independent Claw. This is "a self-contained directional inhibitor system that combines an RF transmitter with a high-gain, multi-band directional antenna system. Claw RF Inhibitor's sensor-agnostic, modular design means it could not be easier for an integrator looking for an RF defeat solution to harmonize seamlessly with third-party, multisensory C2 drone detection and kinetic systems, to provide world-class RF inhibition capability for C-UAS."</li> <li>• BlackSWIFTTM: Next Generation Tactical COMINT Hardware Platform. Designed to operate the Blackbird COMINT and drone detection and geolocation software, the platform provides faster scan rates, broader</li> </ul> | USA | <a href="https://www.tcibr.com/tci-blackbird-integrated-drone-detection-and-geolocation-system-counter-uas-system/">https://www.tcibr.com/tci-blackbird-integrated-drone-detection-and-geolocation-system-counter-uas-system/</a> |

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|                                    |  |          | instantaneous bandwidths, programmable DDCs and man-portable IP67 and rack-mount configurations.  |                       |   |
| <b>Telaforce</b>                   | <b>Drone detection and protection system</b> | Detector | The technology, according to TelaForce, can identify and locate unmanned aircraft flying in restricted or protected airspace, with the added benefit of being able to track back to their operators on the ground. TelaForce also claims it can operate in any weather condition, through continuous, automated monitoring.   | USA                   | <a href="http://telaforce.com/">http://telaforce.com/</a>   |
| <b>Telespazio VEGA Deutschland</b> | SkyPatriot                                   | Detector | SkyPatriot is designed to detect and classify rogue drones visually using camera technologies and artificial intelligence-based software. Telespazio VEGA Deutschland, a subsidiary of Leonardo and Thales, has integrated SkyPatriot Hunter to its command and control software along with multiple other sensor types including radio direction finder and radar. In April 2020, Telespazio VEGA Deutschland selected the UK drone detection company Rinicom as part of a layered drone detection solution. Telespazio is to include Rinicom's SkyPatriot optical sensor for its Distributed Detection, Identification and Tracking (DIDIT) offer.  | Italy/Germany /France | <a href="https://rinicom.com/telespazio-vega-deutschland-choose-skypatriot-optical-drone-detection-solution/">https://rinicom.com/telespazio-vega-deutschland-choose-skypatriot-optical-drone-detection-solution/</a> |
| <b>Terma</b>                       | <b>T.react CIP</b>                           | Detector | <p>The T.react CIP counter drone solution is based on the company's wide area perimeter solution which utilizes intelligent detection sensors, cameras, data fusion and AI technology. This is designed to provide a coherent situational awareness picture assisting the operator in countering the threat.</p> <p>Detect: T.react CIP detects drones by utilising a specially designed radar from the SCANTER product line, offering 360 degrees surveillance capability. Equally, the detection may be complemented by using other radar types and detection technologies. The T.react CIP system analyses input from the sensors and presents this to the operator on the screens in a simplistic and easy to understand way.</p> <p>Track: T.react CIP is designed to automatically track the drone and present its three dimensional position and track history on the operator display. The solution can handle any number of drones simultaneously and depending on the severity level determined by the operator, the system will automatically assign</p> | Denmark               | <a href="http://www.terma.com">www.terma.com</a>  |

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|        |           |          | <p>one or more cameras to an event allowing the operator to get a visual confirmation of the intrusion.</p> <p>Identify: T.react CIP uses machine learning, artificial intelligence and complex pattern recognition to sort the data collected by the radar, thermal sensors, and cameras. T.react CIP is designed to intelligently sort regular activities from abnormal ones to focus only on illegal activities, suspicious behaviour, unauthorized perimeter breaches, and airborne security threats like drones.</p> <p>Defeat: T.react CIP counter drone can interface to different types of counter measures ranges which assist the operator to counter the threat. Soft kill to hard kill and GPS jamming</p>  |        |   |
| Thales | ECOsystem | Detector | <p>At World ATM Congress 2017, Thales announced the launch of ECOsystem UTM, an advanced solution for Unmanned Aerial System Traffic Management (UTM), built with key technology from partner Unify.</p> <p>In April 2022 the Thales/CS consortium was reported to have won the French Defence Ministry PARADE national C-UAS contract.</p> <p><b><u>Partnerships</u></b></p> <p>Thales and UTM company Unify have signed an agreement to incorporate Unify's Validation Engine, a sophisticated software application that conducts real-time validation of drone flight plans, into Thales ECOsystem, a decision support platform for improved aviation operations.</p> <p>In July 2021 Thales and Operational Solutions Limited (OSL) signed a cooperation agreement to further develop and deliver joint opportunities and solutions in the areas of civil C-UAV and unmanned traffic management (UTM). Under the agreement, Thales will incorporate OSL's FACE command and control software platform into its civil C-UAV and UTM solutions.</p> <p>In December 2021 MARSS announced a collaboration with Thales for the delivery of system solutions to provide protection of critical infrastructures against multiple threats.</p> | France | <a href="https://www.thalesgroup.com/en/ecosystem">https://www.thalesgroup.com/en/ecosystem</a> |

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|               |                        |          | Thales and DroneShield have a partnership through the Global Supply Chain (GSC) Program, with Thales having integrated DroneShield sensors into Thales military and aerospace broader systems.  |        |  |
| <b>Thales</b> | <b>SQUIRE</b>          | Detector | SQUIRE is a man-portable medium-range ground surveillance radar that can detect and classify moving targets on, or close to, the ground at ranges up to 48 km. It consists of compact components to be carried in two backpacks. Each weighs less than 23 kg, including batteries, and can therefore be easily carried by two persons.  | France | <a href="http://www.thalesgroup.com">www.thalesgroup.com</a> |
| <b>Thales</b> | <b>Ground Observer</b> | Detector | <p>The Ground Observer 20 Multi-Mission (GO20 MM) is a single mode multi-mission radar for continuous 360° 3D detection, tracking and automatic classification of the full threat spectrum. It is designed for simultaneous ground and low-level air surveillance, providing early UAV detection, in particular of micro-drones.</p> <p>The radar surveys a large volume in 3D, with fast update rates, enabling early detection and automatic classification of long-range drones when they are not yet a threat, providing opportunity for C-UAV measures.</p> <p>Through an HMI Venus interface, operators can recognize and assess if and what counter strategy to adopt. In complex scenarios such as asymmetric conflicts or high-density combat, the ability to classify automatically and quickly to get a fast situation picture provides tactical advantage.</p> <p>Compact and modular, the GO20 MM is designed to be easily transportable and deployable. In 5 minutes, two soldiers can set it up and quickly redeploy for a new mission, whether on a mast or for off-board operations.</p> | France | <a href="http://www.thalesgroup.com">www.thalesgroup.com</a> |

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| <b>ThalesRaytheon Systems</b> | <b>AN/MPQ-64F1 Improved Sentinel</b> | Detector | The AN/MPQ-64F1 Improved Sentinel is a three-dimensional, phased-array system that operates in the X-band frequency range. Its primary mission is to automatically detect, track, identify, and report airborne threats, including helicopters, high speed attack aircraft, cruise missiles and unmanned aerial vehicles (UAVs). The Improved Sentinel is the standard for the alerting and cueing of targets to support a variety of weapons, including Stinger missile based SHORAD weapon systems, VSHORAD missile systems and air defence guns. This advanced tactical radar detects and tracks threat aircraft at several times the range of short-range weapons, providing early warning to ground crews and supporting maximum-range engagement of threats   | France/USA | <a href="http://www.thalesraytheon.com/fileadmin/tmpl/Products/pdf/Improved_Sentinel_Radar_Data_Sheet_-_April_2011.pdf">http://www.thalesraytheon.com/fileadmin/tmpl/Products/pdf/Improved_Sentinel_Radar_Data_Sheet_-_April_2011.pdf</a> |
| <b>ThirdEye Systems</b>       | <b>Meduza, aEye</b>                  | Detector | <p>ThirdEye Systems presented its passive drone detection platform Meduza at Eurostaory 2018. Based on on-the-fly, real-time thermal computer vision algorithms, Meduza can be installed as a stand-alone unit or as a complementary system to long-range detection systems. Unlike radar, it can detect drones low on the horizon, even against a complex background, according to the company. The man-portable platform is already integrated with hard-kill systems, so it can shoot down any drone it detects.</p> <p>“Meduza offers high scanning abilities over vast areas and can detect objects over different types of terrain, including urban areas and more,” says Lior Segal, CEO of ThirdEye Systems. ThirdEye Systems also presented aEye, a fully autonomous, on-the-fly, AI-based, neural-network thermal analytics and classification system, with day and night capabilities. aEye’s on-board analytics enable threat detection while the drone is in flight. The management software of this cost-effective system facilitates enhanced situational awareness, while reducing operators’ cognitive stress levels. aEye can be installed on any third party drone, from DJI M200 to high-duration drone platforms and MIL-STD drones, and is already operational on an advanced long-range VTOL platform.</p> | Israel     | <a href="http://thirdeye-systems.com/about-us/">http://thirdeye-systems.com/about-us/</a>   |

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| <b>TRD Consultancy</b> | <b>Orion-7 MP Drone Slayer/ Orion D/ Orion H Drone Slayer</b> | Detector | <p>Orion produces the Orion -D Manpack portable drone detection system which can detect and identify single or multiple drones at ranges of between 200 to 500m. The drones can then either be sent away or jammed and brought down using the Orion H handheld anti-drone system or the Orion-7 MP ‘Drone Slayer’ with a range of up to 1,500m. The system is capable of jamming a swarm of drones. Orion units provides anti-drone solutions to governments, security firms and private companies.</p> <p>TRD Singapore exhibited the latest addition to its ORION family of anti-drone systems at the Singapore Air Show in early 2020. The ORION-H+ is a light-weight handheld jammer that operates in six frequency bands, three more than the Super Light Weight ORION-H. The Orion-H+ covers the 433MHz, 915MHz, 2.4GHz and 5.8GHz RF bands as well as GNSS frequencies L1 and L2. The bands can be used at the same time or on an individual basis and result in a drone landing automatically or returning to base. TRD says the jammer is designed to operate up to 1 km on a range of drone types and has a battery life of one hour.</p> | Singapore              | <a href="https://gbp.com.sg/drone-jammer-makes-debut-at-dsa-2018/">https://gbp.com.sg/drone-jammer-makes-debut-at-dsa-2018/</a>           |
| <b>Trakka Systems</b>  | <b>TrakkaCam, TrakkaBeam, TrakkaMaps</b>                      | Detector | <p>Trakka Systems reports the Trakka Interceptor Package Solution for Counter Terror (TIPS-C) provides mobile, total mission management</p> <ul style="list-style-type: none"> <li>• TrakkaCam TC-300G<br/>New generation compact high performance multi sensor surveillance system for land missions including law enforcement, search and rescue, civil protection, military ISR and force protection, on a variety of manned and unmanned platforms or installations. The TC series features advanced technology and ergonomic industrial design to set new standards for compact high performance systems in non-ITAR single-LRU configuration.</li> <li>• TrakkaBeam TLXc<br/>The TLXc model combines the searchlight and airborne camera technology together with its dual-sensor thermal imager/high-definition TV camera payloads.</li> <li>• TrakkaMaps - TM-100</li> </ul>  | Sweden, Australia, USA | <a href="https://www.trakkasystems.com/military-surveillance-isr-land/">https://www.trakkasystems.com/military-surveillance-isr-land/</a> |

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|                   |                     |          | <p>TrakkaMaps TM-100 is a full-featured mission mapping and video management system that can run on various computer platforms, including notebooks and ruggedized laptops.</p> <p><b><u>Partnerships</u></b></p> <p>Trakka is partnered with DroneShield</p>   |           |   |
| <b>Trustcomes</b> | <b>DroneBlocker</b> | Detector | N/a   | France    | <a href="https://www.trustcomes.com/en/droneblocker">https://www.trustcomes.com/en/droneblocker</a>     |
| <b>UAV Vision</b> | <b>CM202U</b>       | Detector | <p>The company designs and manufactures high performance, lightweight, gyro stabilized camera payloads for ISR applications. The advanced CM202 gyro-stabilised, multi-sensor camera ISR payload is engineered to offer customisation and the low SWaP gimbal is suitable for integration on a UAV, manned aircraft, fixed land system or mobile land vehicle. The CM202U is a multi-sensor, gyro-stabilised gimbal for counter UAS operations. The entire system is man-portable and robust, and includes object tracking capability, low power consumption, direct drive motors for accurate positioning, Static Target Detection Algorithm, and Moving Target Detector Algorithm.</p>  | Australia | <a href="http://www.uavvision.com/mission/counter-uas">http://www.uavvision.com/mission/counter-uas</a> |
| <b>Unify</b>      | <b>BLIP</b>         | Detector | <p><b><u>Partnerships</u></b></p> <p>In April 2019 Fortem Technologies and Unify announced they would collaborate to develop a joint airspace safety and security solution for drone operations. According to a company press release: “This new end-to-end solution will allow UTM and U-space architectures to be used by public safety officers, military groups and other government agencies to secure airspace around critical infrastructure, airports, stadiums, public venues and more.” Unify’s BLIP (Broadcast Location and Identity Platform) is an e-Identification sensor that detects position, altitude, temperature, pressure, speed and direction, when placed directly on a drone. This information can be accessed in real-time by relevant authorities, such as police officers or government organizations, through secured applications. Fortem SkyDome is an AI data platform that uses distributed Fortem TrueView radar to digitize the airspace above and around</p> | Belgium   | <a href="https://www.unify.aero/">https://www.unify.aero/</a>   |

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|--|-----------------------|----------|--|-----|--|
|  |                       |          | infrastructure, venues, events and cities, for approved drones to fly safely and unapproved drones to be identified quickly. The new joint solution will combine and leverage the capabilities offered by these solutions.   |     |  |
| <b>US Naval Surface Warfare Center</b> | <b>Threat Tracker</b> | Detector | <p>US Naval Surface Warfare Center Panama City Division scientists and engineers have developed a system to autonomously detect, track, and classify UAS from the land or sea. The Threat Tracker is a detection system comprising commercial off the shelf 3D radars and optical sensors according to a report by Naval Sea Systems Command. The equipment will be on display at Sea Air Space Exposition 6-8 April 2020.</p> <p>“What makes the Threat Tracker unique is that it incorporates machine learning algorithms to autonomously process radar detections, analyse thermal images to assist in video based tracking, and classify tracked targets to determine if the object is a UAS,” said Marvin Peardon, NSWC PCD Threat Tracker program manager. “This is important because it can decide on its own if it is a bird or an actual UAS.”</p> <p>Another unique feature is the Threat Tracker’s Gyro-stabilized marine platform. “We developed this system with the ability for it to be mounted on a boat or vehicle,” said Jeremy Johnson, NSWC PCD Threat Tracker systems manager. “The Gyro-stabilized Marine Platform will prevent the imagery from being distorted and possibly misclassified.” Once the imagery is classified, the information is sent to the user’s command and control (C2) system of choice.</p> <p>“We developed this programme to be able to provide the information collected to any C2 system,” said Peardon. “The user at that point can make a determination about the next step.”</p> | USA | <a href="http://www.navsea.navy.mil">www.navsea.navy.mil</a> |



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| <b>Vaereos</b>  | <b>Counter drone methodology</b> |          | Vaeros implements a methodology for counter-drone operations that focuses on four key areas: technology foraging, situational awareness, active detection and response, and training and education.   | USA | <a href="http://vaeros.org/capabilities/uas-counter-uas-testbed/">http://vaeros.org/capabilities/uas-counter-uas-testbed/</a> |
| <b>Vodafone</b> | <b>Internet of Things</b>        | Detector | <p>In February 2018 UK mobile telephone network provider Vodafone has announced the start of drone tracking and safety technology trials. Vodafone's approach uses 4G Internet of Things (IoT) technology to protect aircraft from catastrophic accidents as well as prevent inadvertent or criminal drone incursions at sensitive locations such as airports, prisons and hospitals. The Vodafone IoT drone tracking and safety technology trials support the objectives of the European Aviation Safety Agency (EASA). Vodafone has developed one of the world's first Radio Positioning Systems (RPS) for drones. This uses a 4G modem and SIM embedded within each drone to enable:</p> <ul style="list-style-type: none"> <li>• real-time tracking of each drone (with up to 50 metre accuracy) by drone operators and authorised bodies such as air traffic control;</li> <li>• over-the-horizon/beyond line-of-sight control by the operator, greatly reducing the risk of accidental incursions when operators lose sight of their drones;</li> <li>• protective geofencing, with drones pre-programmed to land automatically or return to the operator when approaching predetermined exclusion zones (such as airports and prisons);</li> <li>• emergency remote control intervention to provide the authorities with the means of overriding a drone operator's control to alter a drone's flight path or force it to land;</li> <li>• SIM-based e-identification and owner registration.</li> </ul> <p>In a preliminary trial in late 2017 Vodafone used its 4G network to control a 1.3 metre wingspan, 2 kilogram X-UAV drone. Throughout the preliminary trial – which took place over a 32-kilometre course around the town of Isla Mayor, near Sevilla in Spain – the drone transmitted a real-time HD video feed and flight data including speed, RPS location and GPS coordinates. Further trials, which will be coordinated with the relevant authorities, are now scheduled in Spain and Germany through 2018 with the intention of making the Vodafone drone tracking and safety technology available for commercial use from 2019.</p> | UK  | <a href="http://www.vodafone.co.uk">www.vodafone.co.uk</a>  |

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| <b>Vorpal</b>            | <b>VigilAir</b> | Detector | <p>VigilAir, Vorpal’s flagship product, is an RF-based drone situational awareness solution. VigilAir detects, geolocates and tracks drones with sensitivity and accuracy to provide high clarity drone situational awareness. VigilAir is comprised of several RF sensors (four as a minimum) deployed in the Area of Interest, and a clouded server acting as a command and control centre. Distances of few kilometers between sensors and unlimited system scalability provide wide coverage, in both urban and rural areas. The solution enables the accurate detection, geolocation and tracking of both drone and operator, providing users with actionable intelligence and zero false alarms. VigilAir is a fully passive system (RF reception only) and can be operated from fixed installations or deployed ad-hoc in its ruggedized version. Founded in 2009, Vorpal Ltd. has accumulated experience in realizing advanced signal processing and analysis solutions, with in-house proprietary knowledge and algorithms. Aided by experience in military-grade Signal Intelligence (SIGINT), Vorpal designs and deploys advanced, highly accurate geolocation solutions.</p> <p>In March 2020 VigilAir was certified by the UK government’s Center for the Protection of Critical Infrastructure (CPNI). CPNI is the UK’s government authority for protective security advice to the UK national infrastructure, working to reduce its vulnerabilities to different threats. VigilAir was evaluated and certified under the CPNI’s Counter Unmanned Aerial Systems Detect, Track and Identify (DTI) testing and evaluation standard.</p> | Israel  | <a href="http://www.vorpal-corp.com">www.vorpal-corp.com</a>   |
| <b>Weibel Scientific</b> | <b>XENTA</b>    | Detector | <p>Weibel’s C-UAV XENTA-C radars have been developed for detection and tracking of all types and sizes of fixed winged or propelled drones. The XENTA-C1 and XENTA-C3 radars meet the requirement for drone detection and surveillance for civilian applications such as Critical Infrastructure Protection, Border Protection, Perimeter Control and UTM. XENTA-C1 (Low Power) and XENTA-C3 (High Power) feature a 30-degree elevation-opening angle and 360-degree azimuth coverage. In early 2022 Thales purchased 12 XENTA short range radar from the company.</p> <p><b><u>Partnerships</u></b><br/>In September 2021 Thales and Weibel Scientific signed a Cooperation Agreement to integrate Weibel’s short- range ground mission radars into the Thales radar portfolio to address C-UAV missions, especially for export markets.</p>  | Denmark | <a href="http://www.weibelradars.com">www.weibelradars.com</a> |

## Directed energy

| Company                 | Product  | Type            | Description  | Country | Website   |
|-------------------------|--|-----------------|--|---------|---|
| Boeing                  | Counter-electronics High Power Microwave Advanced Missile Project (CHAMPS) | Directed energy | In October 2012 Boeing and the U.S. Air Force Research Laboratory (AFRL) Directed Energy Directorate, Kirtland Air Force Base, N.M., successfully tested the Counter-electronics High-powered Microwave Advanced Missile Project (CHAMP) during a flight over the Utah Test and Training Range. CHAMP, which renders electronic targets useless, is a non-kinetic alternative to traditional explosive weapons that use the energy of motion to defeat a target. During the test, the CHAMP missile navigated a pre-programmed flight plan and emitted bursts of high-powered energy, effectively knocking out the target's data and electronic subsystems. CHAMP allows for selective high-frequency radio wave strikes against numerous targets during a single mission.   | USA     | <a href="http://www.boeing.com/features/2012/10/bds-champ-10-22-12.page">http://www.boeing.com/features/2012/10/bds-champ-10-22-12.page</a>   |
| Boeing/General Atomics  | DGHELWS  | Directed energy | In late 2021, General Atomics Electromagnetic Systems (GA-EMS) and Boeing team has been awarded a U.S. Army Rapid Capabilities and Critical Technologies Office (RCCTO) contract to develop a 300kW-class solid state Distributed Gain High Energy Laser Weapon System. Delivery will be a 300 kW-class distributed gain laser with an integrated Boeing beam director. The objective of this contract is a demonstration of the design.<br><br>"The high power, compact laser weapon subsystem prototype that GA-EMS will deliver under this contract will produce a lethal output greater than anything fielded to date," said Scott Forney, president of GA-EMS. "This technology represents a leap-ahead capability for air and missile defense that is necessary to support the Army's modernization efforts and defeat next-generation threats in a multi-domain battlespace." | USA     | <a href="https://www.ga.com/ga-ems-and-boeing-team-to-develop-300kw-class-helws-prototype-for-us-army">https://www.ga.com/ga-ems-and-boeing-team-to-develop-300kw-class-helws-prototype-for-us-army</a>               |
| Boeing/General Dynamics | MEHEL 2.0  | Directed energy | MEHEL is a laser testbed on a Stryker-armored fighting vehicle chassis and serves as a platform for research and development. MEHEL 2.0 is an improved version of the original MEHEL with a laser upgraded from 2kW to 5kW and other added C-UAS capabilities. MEHEL 2.0 also has a number of U.S. Army Aviation and Missile Research, Development, and Engineering Center counter-unmanned aircraft system mobile integrated capability components to increase the robustness of its capabilities.  | USA     | <a href="https://www.army.mil/article/184353/army_demonstrates_integration_of_laser_weapon_on_combat_vehicle">https://www.army.mil/article/184353/army_demonstrates_integration_of_laser_weapon_on_combat_vehicle</a> |

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| <b>CILAS</b>           | <b>HELMA-P</b> | Directed energy | <p>The CILAS HELMA-P laser platform has been undergoing trials on board a French navy vessel. CILAS has been testing the laser system on target drones in France since 2020.</p> <p>The HELMA-P system was designed from a joint relationship between CILAS and Ariane Group, whose development took place from 2017 to 2019. The system consists of a 2-axis turret with a set of optical sensors and the laser weapon itself which has a power of 2 Kilowatts. This turret is operated by a single operator through a man-machine interface. It has a capability to reach targets up to 1 kilometer away.</p>  | France | <a href="http://www.maritime-executive.com">www.maritime-executive.com</a>  |
| <b>General Atomics</b> | <b>DGHELWS</b> | Directed energy | <p><b><u>Partnerships</u></b></p> <p>In late 2021, General Atomics Electromagnetic Systems (GA-EMS) and Boeing team has been awarded a U.S. Army Rapid Capabilities and Critical Technologies Office (RCCTO) contract to develop a 300kW-class solid state Distributed Gain High Energy Laser Weapon System. Delivery will be a 300 kW-class distributed gain laser with an integrated Boeing beam director. The objective of this contract is a demonstration of the design.</p> <p>“The high power, compact laser weapon subsystem prototype that GA-EMS will deliver under this contract will produce a lethal output greater than anything fielded to date,” said Scott Forney, president of GA-EMS. “This technology represents a leap-ahead capability for air and missile defense that is necessary to support the Army’s modernization efforts and defeat next-generation threats in a multi-domain battlespace.”</p> <p>The system will leverage GA-EMS’ scalable Distributed Gain Laser technology with Boeing’s beam director and precision acquisition, tracking and pointing software to provide a complete demonstrator with sophisticated laser and beam control.</p> | USA    | <a href="http://www.ga.com/general-atomics-acoustic-detection-system-successfully-performs-at-us-army-event">http://www.ga.com/general-atomics-acoustic-detection-system-successfully-performs-at-us-army-event</a> |

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| <b>Leidos</b>          | <b>HPM C-UAS</b>   | Directed energy | According to the US Department of Defense contract website Leidos Inc has been awarded a USD26,907,358 cost-plus-fixed-fee contract for the development of a mature prototype based on the first generation technology demonstrator, high-power microwave (HPM) counter unmanned aerial system (cUAS) prototype. Work will be performed in Albuquerque, New Mexico, and is expected to be completed by February 28, 2024   | USA | <a href="https://www.defense.gov/News/Contracts/Contract/Article/2945663/">https://www.defense.gov/News/Contracts/Contract/Article/2945663/</a>   |
| <b>Lockheed Martin</b> | <b>ATHENA</b>  | Directed energy | ATHENA is a transportable, ground-based system that serves as a low-cost test bed for demonstrating technologies required for military use of laser weapon systems. Lockheed Martin funded ATHENA's development with research and development investments. It uses the company's 30-kilowatt Accelerated Laser Demonstration Initiative (ALADIN) that provides great efficiency and lethality in a design that scales to higher power levels. ATHENA is powered by a compact Rolls-Royce turbo generator.  | USA | <a href="http://news.lockheedmartin.com/2017-09-20-Upgraded-Lockheed-Martin-Laser-Outguns-Threat-in-Half-the-Time">http://news.lockheedmartin.com/2017-09-20-Upgraded-Lockheed-Martin-Laser-Outguns-Threat-in-Half-the-Time</a>   |
| <b>Lockheed Martin</b> | <b>HELIOS</b>  | Directed energy | In March 2018 the US Navy awarded Lockheed Martin a USD150 million contract, with options worth up to USD942.8 million, for the development, manufacture and delivery of two high power laser weapon systems, including intelligence, surveillance and reconnaissance (ISR) and counter-Unmanned Aerial System (counter-UAS) capabilities, by fiscal year 2020. The High Energy Laser and Integrated Optical-dazzler with Surveillance (HELIOS) system brings together laser weapon, long-range ISR and counter-UAS capabilities. HELIOS combines three key capabilities, brought together for the first time in one weapon system: <ul style="list-style-type: none"> <li>• A high-energy laser system: The high-energy fiber laser will be designed to counter unmanned aerial systems and small boats.</li> <li>• A long-range ISR capability: HELIOS sensors will be part of an integrated weapon system, designed to provide decision-makers with maximum access to information. HELIOS data will be available on the Lockheed Martin-led Aegis Combat System.</li> <li>• A counter-UAS dazzler capability: The HELIOS dazzler will be designed to obscure adversarial UAS-based ISR capabilities.</li> </ul> | USA | <a href="https://news.lockheedmartin.com/2018-03-01-Lockheed-Martin-Receives-150-Million-Contract-to-Deliver-Integrated-High-Energy-Laser-Weapon-Systems-to-U-S-Navy">https://news.lockheedmartin.com/2018-03-01-Lockheed-Martin-Receives-150-Million-Contract-to-Deliver-Integrated-High-Energy-Laser-Weapon-Systems-to-U-S-Navy</a> |
| <b>Lockheed Martin</b> | <b>High-powered-microwave (HPM) based airborne counter</b> | Directed energy | In August 2018 US Army Contracting Command announced a notice of intent to sole-source its requirement for an Airborne High-Powered Microwave (HPM) Counter Unmanned Aircraft System (CUAS) along with Delivery, Development and Support (Solicitation Number: W911QX-18-R-0073) to Lockheed Martin. "The Government intends to solicit and negotiate with Lockheed Martin (CAGE Code 64059), located at 1701 W Marshall Drive, Grand Prairie, TX 75051-2704 for high-powered-microwave (HPM) based airborne counter unmanned aircraft   | USA | <a href="http://www.lockheedmartin.com">www.lockheedmartin.com</a>  |

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|                         | <b>unmanned aircraft systems</b>       |                 | <p>systems (CUAS), including the necessary development, integration and support required to meet the government’s performance requirements to field UASs with payloads capable of negating adversary UAS in in a timely and efficient manner. Unmanned aircraft system payloads under consideration include explosives, nets, entanglers/streamers, and high-powered-microwave (HPM) sources.”</p> <p>In November 2017 the US Air Force Research Lab (AFRL) awarded Lockheed Martin USD26.3 million for the design, development and production of a high power fibre laser. AFRL plans to test the laser on a tactical fighter jet by 2021. The contract is part of AFRL’s Self-protect High Energy Laser Demonstrator (SHIELD) program, and is a major step forward in the maturation of protective airborne laser systems. “Lockheed Martin continues to rapidly advance laser weapon systems and the technologies that make them possible,” said Dr. Rob Afzal, senior fellow of laser weapon systems at Lockheed Martin. “We have demonstrated our ability to use directed energy to counter threats from the ground, and look forward to future tests from the air as part of the SHIELD system.”</p> |         |   |
| <b>MBDA Deutschland</b> | <b>High-Energy Laser Weapon System</b> | Directed energy | <p>Precise and scalable laser weapon systems designed to protect major events and critical infrastructures. Effective against a range of threats, including mini-UAVs proven in a series demonstrations and tests from target acquisition, engagement and destruction at distances of up to 2km. MBDA is examining laser-armament options for naval and air applications as well as ground-based mobile laser effector concepts with capacities in excess of 100kW, 360-degree coverage and open system architecture for close and intermediate-range protection against micro UAVs and RAM (rocket and mortar) targets. MBDA says it can provide full system solutions complementing conventional weapon systems with laser effectors. The company claims: ultra-high-performance density from one effector; precise fine tracking and multi-stage control; proof of system’s ability to engage highly agile targets and a future-proof principle. Advantages for military application include avoidance of collateral damage caused by fragmenting ammunition and low logistics overhead and minimum costs per firing.</p>   | Germany | <a href="https://www.mbda-systems.com/innovation/preparing-future-products-3/high-energy-laser-weapon-systems/">https://www.mbda-systems.com/innovation/preparing-future-products-3/high-energy-laser-weapon-systems/</a> |

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| <b>MZA Associates</b>                  | <b>HELWS</b>  | Directed energy | <p>In September 2021 the US Office of Naval Research (ONR) awarded a USD18.7 million cost-plus-fixed-fee contract to MZA Associates to develop the C-UAS High Energy Laser Weapon System (HELWS), according to a US DoD contract notice. The Office of Naval Research is supporting development of directed-energy weapons that cause physical damage that degrades, neutralizes, defeats, or destroys enemy capabilities such as UAVs.</p> <p>MZA engineers will design, develop, deliver, integrate, test, and demonstrate a compact, portable, low-cost and reliable C-UAS HELWS using the latest available commercial components. The contract is due completion in August 2023, with further options to continue until August 2025. Initial research funds for USD9.3 million have been released in the current fiscal year.</p> <p>MZA Associates specializes in modeling, analysis, design, development, integration, and testing of high-energy laser and advanced optical systems in support of advanced beam-control systems, atmospheric characterization, and optical systems engineering.</p> | USA    | <a href="https://www.mza.com/">https://www.mza.com/</a>  |
| <b>Rafael Advanced Defense Systems</b> | <b>Drone Dome, I-Dome</b>   | Directed energy | <p>Drone Dome is an interception system that uses a laser beam to locate and destroy hostile drones.</p> <p>At the 2018 Eurostaory event Rafael launched its I-Dome – a mobile all-weather air defence system designed to intercept and destroy short-range rockets, drones and artillery shells. All components are installed on a single truck and the integrated system is reported to be effective in all weather conditions and function as a stand-alone system or as part of a wider network.</p>   | Israel | <a href="http://www.rafael.co.il/4312-en/Marketing.aspx">http://www.rafael.co.il/4312-en/Marketing.aspx</a><br><a href="http://www.globes.co.il/en/article-rafael-unveils-laser-based-drone-interception-system-1001193645">http://www.globes.co.il/en/article-rafael-unveils-laser-based-drone-interception-system-1001193645</a> |
| <b>Raytheon</b>                        | <b>High-Power Microwave weapon/High Energy Laser Weapons System (HELWS)</b> | Directed energy | <p>Demonstrated in 2013. Raytheon is one of several defence contractors chosen by the Office of Naval Research to develop a high-powered laser weapon capable of hitting fast-moving targets at a distance under the Ground Based Air Defense Directed Energy On the Move programme.</p> <p>In August 2019 Raytheon was awarded a USD23,817,657 contract for two prototype High Energy Laser Weapon Systems (HELWS). This award provides for outside continental U.S. (OCONUS) field assessment for purposes of experimentation including, but is not limited to, 12 months of in-field operation</p>  | USA    | <a href="http://www.raytheon.co.uk/news/feature/laser_tech.html">http://www.raytheon.co.uk/news/feature/laser_tech.html</a>  |

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|                 |                    |                 | <p>by Air Force personnel against unmanned aerial systems threats. Work will be performed OCONUS and is expected to be completed by Nov. 1, 2020.</p> <p>In late 2021 the UK Ministry of Defence (MoD) has selected Raytheon UK to supply a demonstrator contract to provide a HELWS. Raytheon UK will deliver the MOD's high-energy laser demonstrator to show the application of directed energy weapons technology to help protect the UK armed forces from UAVs.</p>   |        |   |
| <b>Raytheon</b> | <b>MRZR</b>        | Directed energy | <p>Raytheon has combined a high-energy laser with a variant of its Multi-spectral Targeting System – a sophisticated package of electro-optical and infrared sensors – and installed it on a Polaris MRZR, a small, all-terrain vehicle. This makes the system particularly suited to expeditionary missions, the company says. The system is standalone, with a footprint of roughly 30 square feet. On a single charge from a standard 220v outlet, the HEL system on board the MRZR delivers four hours of intelligence, surveillance and reconnaissance capability and 20 to 30 laser shots. The system can also be coupled with a generator to provide virtually infinite magazine depth. The weaponised MTS sensor package that is the core of the system. In this configuration, the MTS provides its standard setting ISR and tracking capabilities while also serving as a beam director.</p> | USA    | <a href="https://www.raytheon.com/news/feature/laser_dune_buggy">https://www.raytheon.com/news/feature/laser_dune_buggy</a>   |
| <b>Roketsan</b> | <b>Alka</b>        | Directed energy | <p>Roketsan unveiled its first locally-developed directed-energy weapon (DEW) Alka that can destroy or disable hostile drones at the International Defense Industry Fair 2019 (IDF '19). Alka is equipped with both laser and electromagnetic systems to either destroy or disable drones and other similar aircraft. Alka is claimed to be able to disable a swarm of drones up to 4 kilometers (2.4 miles) away and destroy drones with explosives from 500 meters (1,600 feet) away.</p>  | Turkey | <a href="https://www.dailysabah.com/defense/2019/05/08/turkeys-roketsan-unveils-directed-energy-weapon-alka-against-drones">https://www.dailysabah.com/defense/2019/05/08/turkeys-roketsan-unveils-directed-energy-weapon-alka-against-drones</a> |
| <b>SAIC</b>     | <b>RCCTO HEL</b>   | Directed energy | <p>In October 2021 the US Army awarded a USD5.5 million multiple-year contract to SAIC and Liteye Systems to integrate the company's SHIELD counter UAS payload in the US Army (RCCTO) High Energy Laser (HEL) prototype effort.</p>   | USA    | <a href="https://www.saic.com/what-we-do/platforms/weapon-systems">https://www.saic.com/what-we-do/platforms/weapon-systems</a>   |
| <b>UAVOS</b>    | <b>C-UAS laser</b> | Directed energy | <p>UAVOS anti-drone laser system offers precise drone detection and tracking performance and allows laser neutralization of drones. The advanced counter-UAS technology allows it to effectively destroy UAVs at a distance of up to 500</p>   | USA    | <a href="https://www.uavos.com/">https://www.uavos.com/</a>   |



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|  |  |  | <p>m, while optical devices can be disabled at a distance of up to 3 km. When UAVOS' heavy-duty precision pan-tilt platform system identifies a threat, it allocates the target to the laser, locks onto the target, tracks it, and carries out a kill with its unique integrated laser technology. Optionally, it is possible to connect an all-round radar to detect small targets at distances up to 4 km.</p> <p>UAVOS exhibited its anti-drone laser system at the UMEX Unmanned Systems Exhibition in February 2022 with MP3 International, a Grade One Group company.</p> |  | <p><a href="https://www.unmannedsystemstechnology.com/2022/02/uav-os-to-introduce-new-uav-platforms-counter-drone-system/">https://www.unmannedsystemstechnology.com/2022/02/uav-os-to-introduce-new-uav-platforms-counter-drone-system/</a></p> |
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## Electronic Counter Measures (ECM)

| Company          | Product      | Type | Description  | Country | Website   |
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| Aeronautica SDLE | Drone jammer | ECM  | The Spanish Ministry of Defence announced in late 2019 it has awarded Aeronautica SDLE a contract to supply two anti-drone systems which will be used by the Guardia Civil. The devices are portable rifle-shaped systems which act by inhibiting the signal of drones identified as potential threats using directive antennas. The unit interrupts communications between the drone and its control station, jamming command and control transmissions, telemetry, video link and satellite signal. The counter drone system is designed to operate against multiple numbers of drones simultaneously and can be equipped with omnidirectional antennas in order to protect against sudden undetected threats. Available in different versions, it can be integrated into a vehicle or installed in fixed locations. | Spain   | <a href="https://www.aeronauticasdle.com/press-room/">https://www.aeronauticasdle.com/press-room/</a>   |
| Allen-Vanguard   | ANCILE™      | ECM  | The ANCILE™ is an electronic shield for defeating commercial drones. ANCILE™ prevents the intended drone mission by using an RF inhibition technology to disrupt a wide range of command and control protocols. It assures total enforcement of a no-fly zone, says the company, for example to protect convoys, operating bases, sensitive locations and public events. ANCILE™ is effective against multiple, simultaneous drone threats including swarms. It can be used stand-alone or easily integrated into any suite of electronic assets and tailored to any specific circumstance or requirement.   | Canada  | <a href="http://www.allenvanguard.com/">http://www.allenvanguard.com/</a>   |
| CellAntenna      | D3T          | ECM  | D3T™'s key features are: <ul style="list-style-type: none"> <li>• Detects Incoming Drones at standoff distance up to 1 Km</li> <li>• Prevents Entry of restricted airspace of Drone up to 1000 feet above facility covered and up to 300 meters from fence line</li> <li>• DSP (Digital Signal Processing) determines type of Flight Control system being used</li> <li>• Deployment of several electronic counter measures (ECM) based on Threat Level</li> <li>• SDR Technology allows for upgrade of system as new drone flight control platforms enter market</li> <li>• Does not interfere radio frequency communication.</li> <li>• Fiber Based system cannot be jammed.</li> </ul>  | USA     | <a href="https://cellantenna.com/solutions/d3t-drone-detection-and-defeat-technology/">https://cellantenna.com/solutions/d3t-drone-detection-and-defeat-technology/</a> |

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|                         |                                    |     | <ul style="list-style-type: none"> <li>• Scalable to cover large secure building campuses.</li> <li>• Can be combined with Guardian Service™ cellphone control to provide both Drone and Phone (cell phone) protection in any secure facility.</li> </ul>   |        |   |
| <b>Convexum</b>         | <b>Perimeter protection system</b> | ECM | Convexum provides a solution to the rising threat of uncontrolled or malicious use of commercial drones, by actively taking control over them, preventing entry into protected airspace, and landing them in a safe location designated by the customer. Convexum offers the ability to land the drone at predefined locations and deny takeoff, in order to insure maximum precision and to minimize collateral damage and risk from drone crashes in the perimeter and its surroundings.  | Israel | <a href="https://convexum.com/">https://convexum.com/</a>   |
| <b>CTS Technologies</b> | <b>Drone jammer gun</b>            | ECM | <p>Specifications for the 2016 drone jammer gun:</p> <ul style="list-style-type: none"> <li>• Frequency and power: GPS 5W,wifi 2.4G 25W ,5.8G 1.5W</li> <li>• Antenna: yagi antenna for 2.4G and 5.8G,Log antenna for 5.8G(High gain antenna is option)</li> <li>• Each band power can on/off</li> <li>• Built in polymer lithium battery</li> </ul>  | China  | <a href="http://ctstechnologies.com/3-in-1-drone-jammer-gun-2016-2-4g-5-8g-and-gps.html">http://ctstechnologies.com/3-in-1-drone-jammer-gun-2016-2-4g-5-8g-and-gps.html</a> |
| <b>Digitech</b>         | <b>JAM 100, JAM 200, JAM 300</b>   | ECM | Qingdao-based Digitech Info Technology (Digitech) in October 2017 launched its JAM family of C-UAS systems at the Ocean Sciences and Technology Exhibition in China, according to press reports. The range comprises the vehicle-mounted JAM-1000, the man-portable JAM-2000 and static JAM-3000 devices. According to Digitech, the JAM-1000 system is designed to defeat ‘hobby drones’, commercial multicopters, as well as small fixed-wing UAVs by causing a targeted threat to crash or retreat by activating its return-to-base protocol. The system disrupts radio frequency (RF) communications in the 2.4 and 5.8 GHz spectrums as well as satellite navigation signals including BeiDou, GLONASS, and GPS.” The company is quoting an effective range of 300 m with a full 360° coverage in the azimuth and 0-75° in elevation. The manportable JAM-2000 system offers a similar jamming profile against RF and satellite signals, although it has been specifically designed for dismounted operations with a rifle-type handheld transmitter and the jammer unit and battery packaged in a backpack. The | China  |   |

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|  |                          |     | complete system weighs approximately 20 kg, split into 8 kg and 12 kg for the transmitter and backpack respectively  |         |   |
| <b>Flex Force Enterprises</b>                    | <b>Dronebuster</b>       | ECM | <p>At the start of 2022 Flex Force Enterprises reported the delivery of its 1000th Dronebuster hand-held drone countermeasure. Flex Force designed the Dronebuster in 2017 to be an effective, low-cost drone countermeasure. After fielding the 1000th system, Drone Force continues to diversify the Dronebuster product line to now include multiple variants.</p> <p>This year will see production deliveries of the latest Satellite Navigation Attack feature along with other performance and durability upgrades to the Dronebuster family of products.</p>  | USA     | <a href="http://www.flexforce.us">www.flexforce.us</a>  |
| <b>H.P. Marketing &amp; Consulting Wüst GmbH</b> | <b>HP47 and HP 3962H</b> | ECM | <p>The HP47 "Dronegun" offers a fast and mobile solution against incoming UAVs by stopping the drones in the approach and controlled to land, or by GPS back to the starting point and thus to locate the dronepilot. The HP 47 interferes with the familiar remote control as well as satellite-controlled frequencies. A selection of the frequencies to be interfered with is necessary. LEDs provide information about the active channels as well as the battery status. The system has already been successfully deployed several times and has been able to support many critical deployment structures. The HP 3962 H provides flexible solution against commercial UAVs. A kind of disturbance bell around the jammer prevents the UAVs from entering the affected area; Configurations by directional antennas are readily possible. Through the network integration, a stationary, alarm-based safety lattice can be provided for airports, prisons and government facilities.</p> <p><b><u>Partnerships</u></b></p> <p>The SkyWall Patrol Net-Capture and HP47 handheld-jamming systems have been used together by leading specialist law enforcement across Europe since 2016. OpenWorks and HP has combined forces to show a new track-defeat concept at</p> | Germany | <a href="https://www.hp-jammer.de/jamming-products_e.php">https://www.hp-jammer.de/jamming-products_e.php</a> |

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|                                       |                       |     | the NATO Technical Interoperability Exercise, in VreDePeel Airbase in the Netherlands in 2021. The HP47 system is attached to a quick-release mount on the SkyTrack positioner. Operators can position the SkyTrack-HP47 system in a fixed location for a temporary protective scenario, such as a roof top. The system can be operated remotely, with the operator receiving high-quality video of the tracked target and on-command precise jamming. The handheld jammer can be quickly disconnected when required and continue the mission in a handheld operation, while the SkyTrack system continues to provide overwatch.   |       |  |
| <b>Indian Institute of Technology</b> | <b>AI-based C-UAS</b> | ECM | Researchers at the Indian Institute of Technology (IIT) Madras report development of counter drone technology capable of detecting “Rogue drones visually using algorithms powered by Artificial Intelligence (AI): and hacking them to change their flight path or land safely”. The AI powered motion detection algorithms can detect motion even in dark conditions. The research was carried out by a team from IIT’s Department of Aerospace Engineering. The development is targeted for use by law enforcement agencies, security services and armed forces to help secure airspace over critical civilian and military installations. An IIT facebook post said: “A major advantage of this system is that it can be controlled over the internet and can navigate autonomously, by hacking their GPS, follow the target drone and change its flight path or land safely. The programmable nature of the aerial vehicles also opens up the possibility of swarming of drones and hence can intelligently detect and track people, drones, vehicles and other objects.” | India | <a href="http://www.iitm.ac.in">www.iitm.ac.in</a> |

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| <b>Invisible Interdiction</b> | <b>Ghoul Tool</b> | ECM | <p>Invisible Interdiction has launched the second of the Ghoul Tool line of drone countermeasures for military, law enforcement, and counter-terror forces. The GTFS works by breaking the command and control or navigation radio links between the drone pilot and the aircraft. Key differentiators quoted by the company include:</p> <ul style="list-style-type: none"> <li>• Power: One MBITR Li-ion battery provides 2+ hours of continuous operation</li> <li>• Very easy, one-hand operation, can still operate primary weapon with other hand</li> <li>• Optional field programmable bands</li> <li>• HERO, HERP, HERF certified</li> <li>• Size: 20”L x 7.5”H x 5”W</li> <li>• Weight: 5 pounds</li> </ul> <p>In May 2019 the company announced it has been awarded a contract to design, test and qualify a very small, lightweight rail-mounted C-UAS jamming module. According to the company: “This Phase 3 contract is the result of a Special Topic SBIR award originally envisioned by the Air Force’s Las Vegas-based innovation hub called AFWERX. Several barriers to working with the Air Force were removed including a shorter application process, an accelerated contract award and a shorter period of performance. This effort started in the fall of 2018 in response to the Air Force’s pursuit of innovative counter-drone technologies. Invisible Interdiction submitted a concept that was selected and proven feasible late last year. This UAS denial system will be similar in size and weight to existing rail-mounted aiming lasers that are mounted on the Picatinny rail of issued shotguns or M4 rifles.”</p> | USA | <a href="https://invisidiction.com/">https://invisidiction.com/</a> |
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| <b>K9</b>   | <b>Covert, portable DJ500C drone jammer, portable Terminator 3000 jammer, fixed DJ500F jammer</b> | ECM | <p>K9 Electronics provides a range of drone jamming systems. Its covert portable drone jamming system (DJ500C) is fully enclosed and operational from its waterproof, shockproof enclosure. The DJ500C designed for covert use against commercial and domestic UAV drones used to spy on or take illegal images and videos. By simply pointing the DV500C towards the drone, the drone will be immediately disconnected from its users control transmitter forcing it to land. The portable Terminator 3000 drone jammer gun is a high power, full frequency jamming system designed to jam all remote control frequencies used by modern drones and UAV's. The system also has the capability to disrupt satellite navigation frequencies used by drones and UAV's in flight. The fixed site drone jamming system DJ500F can be used to protect areas from commercial spy drones and UAV's snooping, taking pictures and streaming video. The DJ500F can disable the communications link between the drone operators transmitter and receiver thus forcing the drone to land or return to it origin, dependent on how its programmed. Using the GPS option on the DJ500P the drone will become lost and therefore forced to land. The DJ500F can be installed on top of most buildings including factories, warehouses, apartment blocks, and houses. With special fixtures the system can be installed on yachts.</p> | Belarus | <a href="http://www.drone-jammer.co.uk">http://www.drone-jammer.co.uk</a> |
| <b>KEAS</b> | <b>MinKa-750D, MinKam-715</b>   | ECM | <p>KEAS is expanding its offering and launching the digital versions of its flagship products: the MinKa anti-drone system and the BLOCKio mobile communication jammer.</p> <p>The vehicle-mounted digital MinKa-750D and mobile analog MinKam-715 anti-drone jammers are equipped with seven frequency ranges at 50 and 15W per band respectively.</p> <p>“The mobile MinKam-715 (44 lb. cabin case form factor) and the digital on-board MinKa-750D are designed to protect sensitive sites such as prisons, G7-type events, convoys, and military zones,” says a company press release. “Equipped with omnidirectional or directional antennas, they can neutralize all the frequencies used by known civilian drones, while allowing other RF equipment used by frontline staff to work. Three models are available: jamming on detection, detection only or continuous jamming. The units can also be controlled via a tablet or a C2 command and control API. The benefit of using digital technology lies in the improved performance and real-time configurability in the field.</p>  | France  | <a href="https://keas-group.com/">https://keas-group.com/</a>             |

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|                 |                                   |     | <p><b>Partnerships</b></p> <p>In early 2022 CERBAIR and KEAS won a contract for “the acquisition and maintenance of a solution for the detection, characterization and neutralization of drones (DCND) in penitentiary establishments located in metropolitan France metropolitan and overseas”.</p>  |        |   |
| <b>Kirintec</b> | Sky Net Longbow/ Recurve          | ECM | The Sky Net Longbow and Recurve suite of products allow users to respond to and counter specific terror threats. The technology targets the control and video feed from target drones (offering a physically smaller and tactical solution to threats) and counters their use for intelligence gathering, target acquisition and direct target effect. Applications include military operations, national and border security, prisons and airlines. The systems cover the same frequency bands as a vehicle-installed system and can operate with omni-directional as standard, or directional low-, mid- and high-band antenna if required. Sky Net Longbow, Recurve and Recurve Max are also available with CTI (Communications Through Inhibition) technology.  | UK     | <a href="https://www.kirintec.com/sky-net-defeating-uas-uav-drones/">https://www.kirintec.com/sky-net-defeating-uas-uav-drones/</a> |
| <b>KRET</b>     | <b>R-330KMK Zhitel/“Resident”</b> | ECM | The electronic warfare (EW) unit of the Western Military District (ZVO) is now in place around the city of Kursk, equipped with R-330KMK Zhitel or “Resident” automated radio interference systems. These systems are understood to be able to detect and jam radio signals and interfere with UAV mission systems up to a radius of 30km.. According to Defence 24 ( <a href="http://www.defence24.com/639005,electronic-warfare-russian-response-to-the-natos-advantage-analysis">http://www.defence24.com/639005,electronic-warfare-russian-response-to-the-natos-advantage-analysis</a> ): ““Zhitel” (R-330Zh) system consists of two elements: a wheeled platform with an operator station for the reconnaissance system (0.1-2GHz frequency range) and a trailer with emitters and antennas of the active jamming system. According to the official information, the system’s purpose is to detect, track and jam the Inmarsat and Iridium satellite communications and GSM 1900 cellphones, and also to act against GSM navigation system utilizing the NAVSTAR satellites. “Zhitel” may be operated | Russia |   |



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|  |                                |     | autonomously or it may, alternatively, be remotely controlled by the R-330KMK station. Its range has been defined as 15 kilometres in case of the ground-system jamming and 200 kilometres, with regards to the airborne platforms.   |       |   |
| <b>Mitsubishi Electric Corporation</b> | <b>Drone Deterrence System</b> | ECM | Mitsubishi Electric's Drone Deterrence System is reported to have a one-touch instant jamming mode, is lightweight enough to be moved by one person and has a detection and jamming range of about 1 km, although this could change depending on operational circumstances. The control unit can be incorporated into a laptop computer. The company cited frequency detection specifications of 920MHz, 2.4GHz and 5.7GHz. Current users are said to be governmental.  | Japan | <a href="https://www.uasvisio n.com/2017/03/28/ mitsubishis-first-anti-uav-system/">https://www.uasvisio n.com/2017/03/28/ mitsubishis-first-anti-uav-system/</a>   |
| <b>Northrop Grumman</b>                | <b>JCREW</b>                   | ECM | The Joint Counter Radio-Controlled Improvised Explosive Device (RCIED) Electronic Warfare (JCREW) system is a software-programmable jammer that provide protection from device-triggered improvised explosive devices (IEDs), such as those carried by UAS. Northrop Grumman developed mounted, dismounted and fixed-site variants to protect vehicles, warfighters, and permanent structures for the Navy and the U.S. Air Force.  | USA   | <a href="https://news.northropgrumman.com/news/releases/northrop-grumman-awarded-95-million-jcrew-production-contract">https://news.northropgrumman.com/news/releases/northrop-grumman-awarded-95-million-jcrew-production-contract</a> |
| <b>Radio Hill Technologies</b>         | <b>Dronebuster</b>             | ECM | The Dronebuster is an RF jamming device. This means the device is designed to interrupt the control of the drone by overwhelming the control frequency. This causes the drone to stop and hover, or return to the operator, depending upon the model of the drone. The drone operator has no control while the frequency is being overwhelmed with RF energy. The Dronebuster can take this one step further and also overwhelm the GPS signal, which will cause the drone to land or fall out of the sky. The Dronebuster™ is a cost effective tool for security teams and first responders to use during fluid, ambiguous, fast-paced encounters. The | USA   | <a href="http://www.radiohilltech.com/">http://www.radiohilltech.com/</a>   |

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|----------------|--|-----|--|----|---|
|                |  |     | <p>system allows security teams and law enforcement to efficiently deal with a drone approaching a Forward Operating Base, hovering over a large crowd, snooping into secure/private areas, or flying in restricted airspace. With the Dronebuster™, the operator has the tools to intercept the drone command link and command the drone to descend or go home. All the operator must do is aim the Dronebuster™ at the drone and toggle the switch. The LE, or law enforcement model of the Dronebuster allows State and local law enforcement and first responders to clear nuisance drones without forcing them to land. This model will interfere with both communications and video downlinking protocols. It will not however, interfere with GPS navigation signals. In many cases, the drone will simply 'go home.' For all non US Government entities: This device has not been authorized as required by the rules of the Federal Communications Commission. This device is not, and may not be, offered for sale or lease, or sold or leased, until authorization is obtained. The sale of the Dronebuster LE model is awaiting rules changes at the FCC that will allow for its use by State and local law enforcement.</p> |    |   |
| <b>Repulse</b> | <b>Repulse 24/<br/>Repulse 2458E/<br/>Repulse 2458H<br/>Handheld/<br/>Repulse360</b> | ECM | <p>Repulse drone protection systems do not rely on detection, as they are light weight standalone units that can be left switched on 24 hours a day. The systems produce an electronic shield/no fly zone above 1km vertically and horizontally impenetrable by any commercially available drone using 2.4GHz or 5.8GHz for control. Units available are:</p> <p><b>Repulse 24:</b> Can be installed internally to an aircraft to provide protection by beaming in front of the aircraft for 1km. It can also be used as a mobile unit fitted in a security vest as it is very lightweight. The unit only utilises the 2.4GHz frequency as that will give users the greater distance for drone flight which is where the problem seems to be around aircraft and airports or other applications.</p> <p><b>2458E</b> which is ruggedised or enclosed to keep it weatherproof, portable and can be used as permanent mounting; can be supplied with tripod mount and can run off 12v 6800ah battery enclosed in the unit or be plugged into 12v DC mains supply. Weighs 2.5kg including battery.</p>  | UK | <a href="https://www.repulse-drones.com/products.php">https://www.repulse-drones.com/products.php</a> |

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|                     |   |     | <p><b>2458H Handheld</b> – a handheld unit, weighing just 1.5kg, with a tripod mount in the handle. Normally runs off 12v 6800ah battery but can be plugged into 12v DC mains supply;</p> <p><b>Repulse 360/20</b> - ruggedised/enclosed unit which provides a more permanent/weatherproof solution but can at the same time be used as a quick mobile deployment system. Units can protect an area with at least a 2km diameter for a full 360° which is useful for buildings and large areas. The domes have been specifically designed to combat the harsh environmental conditions such as found in the Middle East.</p> |             |   |
| <b>SCG</b>          | <b>DroneRIFLE, DroneRanger, DroneJammer</b> | ECM | SCG's Drone-Defense Jammer is a high performance application specific jammer, automatically controlled and managed by ART HMI software. The company also manufactures a complete range of counter-UAS products.  | Switzerland | <a href="https://scgroup-ltd.com">https://scgroup-ltd.com</a>   |
| <b>SESP</b>         | <b>Drone Defeater</b>                       | ECM | SESP Group's Drone Defeater depowers Unmanned Aerial Vehicles and Secures the perimeter, transforming any field base into a protected fortress. The Drone Defeater severs the connection between drone and pilot. SESP's UAV jamming solution packs intense reservoirs of power to establish the strongest and broadest possible perimeter of security. Seamlessly integrated into any SUV, or as standalone equipment, the Drone Defeater floods the skies with blocking waves, rejecting the penetration of any enemy drone  | UK          | <a href="http://sesp.com/dronedefeater/">http://sesp.com/dronedefeater/</a>   |
| <b>Veth Systems</b> | Drone Hunter                                | ECM | The Drone Hunter System (DHS) is an RF jamming device which can block the communication of public drones or can realise a field protection. It can locate a drone more than 1 km away and send it back to its point of location or can land it. DHS1 AirVault is suitable for large coverage areas such as airports, public buildings and prisons. DHS AirVault Mini, which is mobile, is designed for protection of smaller units such as vehicles, private buildings, boats and events.  | Hungary     | <a href="https://cee-aviation.com/doc/Presentation_Dron%20Hunter.pdf">https://cee-aviation.com/doc/Presentation_Dron%20Hunter.pdf</a> |

## Gun

| Company                   | Product                     | Type | Description   | Country | Website   |
|---------------------------|-----------------------------|------|---|---------|---|
| <b>Avtomatika Concern</b> | <b>Pishal</b>               | Gun  | Avtomatika Concern (a subsidiary of Rostec state corporation) has introduced an anti-UAS gun called “Pishal” for law enforcement and military units. Reportedly, this anti-UAV weapon has been successfully tested in combat. “The representative of Concern Avtomatika said that in July 2018, this weapon was used to successfully prevent more than 20 UAV attacks. Pishal...interrupts the connection between the UAV and control station. It is said to have an effective range of up to 2,000 meters and can work in frequencies from 600 MHz to 6,000 MHz. Pishal weighs three kilograms (about 6 lbs 10 oz) which makes it quite lightweight for use by a single operator. It is also advertised to be harmless for the operator,” say press reports. | Russia  | <a href="https://www.thefirearmblog.com/blog/2018/09/10/russian-pishal-anti-drone-gun-to-be-sold-both-in-military-le-and-civilian-markets">https://www.thefirearmblog.com/blog/2018/09/10/russian-pishal-anti-drone-gun-to-be-sold-both-in-military-le-and-civilian-markets</a> |
| <b>Harp Arge</b>          | <b>ES-60 anti-drone gun</b> | Gun  | Harp Arge, a subsidiary of Ekba Holding, in March 2020 launched a new version of its anti-drone gun, designed to create high-speed electromagnetic interference to disrupt communications between drones and their control units. The ES-60 Electromagnetic Anti Drone Gun weighs only 2.5 kg and is capable of combating rogue drones within a 3 km range. The new model features new antenna technology which enabled the company to significantly reduce the size and weight of the weapon. Harp Arge has supplied anti-drone guns to the Turkish Armed Forces and the General Directorate of Security. It has also exported units to Azerbaijan. Harp Arge was acquired by Ekba Holding in early March 2020.  | Turkey  | <a href="http://www.harparge.com">www.harparge.com</a>  |

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| <b>Jiun An Technology</b> | <b>Raysun MD1</b> | Gun | The Raysun MD1 Multicopter Defender is a shoulder rifle that disrupts a drone's radio frequency within three seconds, giving its operator the impression that it is out of range. The drone is then programmed to return to its owner, make a controlled descent, or fall out of the sky. The device facilitates control of ISM or GPS signals individually, so the user can cut down an ISM signal while keeping the GPS working to track the owner's position and respond. There is a night vision device and thermal scope for night-time operation within 1,100m. The system has been used by the Iraqi military. | Taiwan | <a href="http://www.jiunan.com.tw/en/defense/MulticopterDefender.html">http://www.jiunan.com.tw/en/defense/MulticopterDefender.html</a> |
| <b>Kongsberg</b>          | <b>PROTECTOR</b>  | Gun | <p>The PROTECTOR family of Remote Weapon Systems are suitable for any missions - whether on land or at sea, on mobile or static platforms – for remote operation of payloads ranging from small caliber weapons to medium caliber automatic cannons. The system is modular, however all variants of the PROTECTOR Family share the same baseline technology.</p> <p>In January 2022 Kongsberg reported a new contract from Kraus-Maffei Wegmann (KMW) for the delivery of its PROTECTOR RS4 remote weapon system for the German Joint Fire Support Team schwer (JFSTsw) programme.</p>                                | Norway | <a href="http://www.kongsberg.com">www.kongsberg.com</a>  |

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|----------------|------------------------------|-----|--|--------|--|
| <b>Lokmas</b>  | <b>Stupor anti-drone gun</b> | Gun | Russia's Lokmas Stupor anti drone gun has a range of 500m and electromagnetic and optical-electronic suppression systems interrupts the operation of control channels, data transmission and navigation. In addition, the gun is equipped with a laser emitter of visible range, which allows the user to partially or completely disorganize the process of video filming, which is conducted from the drone. | Russia | <a href="http://antikopter.ru/perenosnoy-kompleks-elektromagnitnogo-i-optiko-elektronnogo-podavleniya-bespilotnykh-letatelnykh-apparatov-grazhdanskogo-naznacheniya-pkp-bpla">http://antikopter.ru/perenosnoy-kompleks-elektromagnitnogo-i-optiko-elektronnogo-podavleniya-bespilotnykh-letatelnykh-apparatov-grazhdanskogo-naznacheniya-pkp-bpla</a> ). |
| <b>MC-CLIC</b> | <b>Anti-UAV Rifle</b>        | Gun | Developed originally to stop drones approaching the Prince's Palace in Monaco, MC-Clic's anti-UAV rifle has three antennas and a maximum range of 1km. Batteries allow for 90 minutes' continuous use. Intercepted drones can be forced to land once the radio signal has been interrupted for long enough.  | Monaco | <a href="http://www.monacolife.net/more-details-emerge-of-made-in-monaco-anti-drone-rifle/">http://www.monacolife.net/more-details-emerge-of-made-in-monaco-anti-drone-rifle/</a>  |

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| <b>Smart Shooter</b>   | <b>SMASH</b>                       | Gun | <p>The SMASH 2000 Plus is reported by the company to add a drone mode to its targeting systems which allows the shooter to lock onto a target and will only allow a round to be discharged when it can be guarantee to hit the target. “The SMASH fire control system puts a precision anti-drone capability at the fingertips of its users, featuring built-in targeting algorithms that can track and hit even very small drones skimming along at high speed, at ranges of up to 120 metres, with the first shot,” says the company. The SMASH 2000 Plus has a built-in storage so video or images can be recorded for training or after-action reviews.</p>   | Israel | <a href="https://www.smart-shooter.com/products/">https://www.smart-shooter.com/products/</a> |
| <b>Zala Aero Group</b> | <b>REX 1 counter UAS gun, Zont</b> | Gun | <p>Zala Aero Group, a Kalashnikov company, has presented its REX 1 counter-UAS gun at the Army 2017 forum in Russia. According to the company: “The weapon is equipped with a block of suppression, which drowns in the radius of five kilometers signals of the US satellite navigation system GPS, Russia’s GLONASS, China’s BeiDou and Europe’s Galileo. Also, the device is capable of blocking GSM, 3G, LTE signals at a kilometer distance and interfering with frequencies of 900 Mhz, 2.4 GHz, 5.2 – 5.8 GHz. The REX 1 disables the drone but does not damage it physically – the aircraft loses its connection with the control panel and smoothly lands...To put the device in combat readiness, just press one button. The weapon is equipped with a fastening system, so that it can additionally be equipped with sights, lights, designators, as well as objective control devices....The weight of REX 1 is 4.2 kg, while the model has a built-in battery that provides continuous operation of the device for three hours.”</p> <p>Russian news agency TASS reported in October that Zala had demonstrated a new device of satellite navigation signal suppression for unmanned aerial vehicles (UAVs) at the Interpolytex-2018 security exhibition. “The compact module is placed under an unmanned aerial vehicle’s wing and suppresses the signal of satellite navigation systems within a radius of up to 5km, and also blocks the operation of all devices that use satellite navigational systems for navigation,” the Kalashnikov press office said.</p> | Russia | <a href="http://zala.aero/rex-1/">http://zala.aero/rex-1/</a>                                 |

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|  |  |  | <p>The satellite navigation signal suppressing system has been developed for Special Operations forces. The system can be used to neutralize an enemy's equipment that may pose a threat to defended facilities. The new system will expand the range of electronic warfare devices developed by Zala. It comprises the REX-1 anti-drone rifle and the ZONT man-portable device. The new satellite navigation signal suppressing system has undergone successful trials and proven its efficiency.</p> |  |  |
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## Integrated systems

| Company | Product                                   | Type                           | Description   | Country      | Website   |
|---------|---|--------------------------------|---|--------------|---|
| AEC     | C-UAS system                              | Detector, ECM, directed energy | In late 2021 Saudi Arabia's AEC reported it was in the final phase of deploying its integrated C-UAS system throughout the Kingdom. According to company officials at the Dubai Air Show, the system detects drones at 10km via a 3d radar, then relays the target to a network of cameras. The image is then scanned by an intelligence officer to identify the nature of threat and the most effective means of mitigation These include kinetic, laser and jamming technologies  | Saudi Arabia | <a href="https://www.unmannedairspace.info/counter-uas-systems-and-policies/saudi-arabias-aec-starts-deployment-of-nationwide-c-uas-network-dubai-air-show-2021/">https://www.unmannedairspace.info/counter-uas-systems-and-policies/saudi-arabias-aec-starts-deployment-of-nationwide-c-uas-network-dubai-air-show-2021/</a> |
| Anduril | AI C-UAS, Sentry Tower, interceptor drone | Detector, intercept drone      | <p>Anduril secured its first contract in 2017 to provide perimeter security to US Customs and Border Protection for the US-Mexico border. The company subsequently expanded its Artificial Intelligence (AI) –based technology to support drone detection and mitigation activity. The company's suite of detection and identification products includes Sentry Tower – a network of optical, microwave and infrared detection systems – and AI-powered Lattice sensor fusion system. Lattice is a software and hardware system which can be used to integrate third party sensors into a single networked platform. It is designed to classify and track any vehicle, person, drone or other threat in a defined area. The counter-drone solution also includes the modular Ghost UAS component, an autonomous single rotor, long-endurance high speed drone. It is operated autonomously from the Lattice web mobile App. Multiple Ghosts can be controlled by one operator to support large-scale operations such as patrolling wide areas.</p> <p>The US Department of Defense (DoD) in January 2022 awarded an indefinite-delivery/indefinite-quantity contract with a maximum ceiling of USD967,599,957 to Anduril Industries to provide counter drone technology and services for Special Operations Command over a 10-year period. Approximately USD1 million is available in 2022. The work will be performed in various locations within and outside the continental US until January 2032.</p> | USA          | <a href="http://www.anduril.com">www.anduril.com</a>  |

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| Ascent Vision | CM202U, X-MADIS | Detector, ECM | <p>The CM202U is a gyro-stabilized, multi-sensor gimbal. It is specifically designed for counter-UAS operations and has simple plug-and-play hook up. The sensor package includes object tracking capability, low power consumption, and direct drive motors for accurate positioning. The entire system is man-portable and includes a Static Target Detection Algorithm and a Moving Target Detector Algorithm to detect people, vehicles, sUAS, UAVs, and general motion.</p> <p>In August 2019 the US Air Force awarded Ascent Vision Technologies a USD23 million contract to supply mobile counter-drone vehicles for the eXpeditionary Mobile Air Defense Integrated System (X-MADIS) programme. The contract award follows 18 months of testing, trials and evaluation across multiple military services and operational spectrums. The mission of the X-MADIS is to detect, locate, track, identify and defeat small unmanned aerial systems (sUAS) by combining the capabilities of radar, optics, radio frequency detection and electronic command and control mitigation of the aircraft. AVT's X-MADIS solution delivers this capability while the vehicle is static or on-the-move.</p> <p>Ascent launched its next-generation multi-mission imaging system for maritime C-UAS in February 2020. According to a company press release: "Combining full HD, 4 sensor configurations and a next generation video processor in a compact, man portable system, the CM262M is the ideal multi-mission optic for maritime ISR and CUAS operations. An IP67 rating ensures reliability in performance in harsh conditions experienced at sea.</p> <p>In April 2020 Ascent Vision released the latest variant of X-MADIS, offering next-generation portable, on-the-move counter sUAS capabilities. According to a company press release the newest version of the X-MADIS incorporates several new hardware components for enhanced ruggedness and on-the-move accuracy in rough terrain. It also offers improved power distribution and simpler setup and deployment. To ensure no threat goes undetected, the X-MADIS combines radar with a radio frequency (RF) detection sensor for reliable detection, classification and locating of commercial sUAS.</p> <p>"Tailored to each mission, customers now have a choice of multiple electronic warfare systems to defeat sUAS and drone swarms. Two gyro-stabilized optics are available for integration, including the pioneering CM262 4-configuration,</p> | USA | <a href="http://www.ascentvision.com/counter-uas.html">http://www.ascentvision.com/counter-uas.html</a> |
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|   |  |                  | 26lb payload and the field-proven CM202U 12lb payload. Both optics are enhanced with smart features, artificial intelligence and machine learning capabilities for improved situational awareness.”  |         |  |
| <b>ASELSAN</b>  | <b>IHTAR,<br/>GERGEDAN,<br/>İHASAVARTM</b> | Detector,<br>ECM | <p>ASELSAN’s IHTAR anti-drone system aims to neutralize mini and micro UAV threats in urban and rural environments. It is available in various configurations (fixed, deployable etc.) and detects and tracks multiple UAVs with high accuracy using portable radar. It applies jamming against at least remote control (RC) Devices, Radios, GPS receivers, Wi-Fi, ISM Bands, GSM900/1800, 3G and 4G. IHTAR uses the GERGEDAN jammer to create protection against all known mini-UAV/model aircraft attacks with its specially designed antenna patterns creating semi-spherical protection umbrella.</p> <p>The GERGEDANTM Anti-Drone and RCIED Jammer System is designed to protect military bases, facilities, high value assets, ceremonies, meetings, demonstration areas and checkpoints against drone/min iUAV attacks by jamming the RC frequencies, GPS/GLONASS frequencies, data link frequencies, image forwarding frequencies and RCIED triggering frequencies (if any) of drones/mini-UAVs simultaneously. GERGEDANTM also provides protection against RCIEDs and it is used to protect convoys, VIP vehicles in motion. GERGEDANTM covers the whole RF band and creates protection against all known drone/mini-UAV attacks with its specially designed antenna patterns creating semi-spherical protection umbrella as well as ground threats such as road-side RCIEDs.</p> <p>İHASAVARTM is a handheld-backpack C-UAS jammer. İHASAVARTM, removes the need for sensor systems to track drones/mini-UAVs and provides a cost-effective solution by giving the ability to security personnel to take down a drone/ mini-UAV at the first sight. The system is powered by rechargeable Li-Ion batteries at least for 1.5 hours of continuous operation</p> | Turkey  | <p><a href="http://www.aselsan.com.tr/en-us/press-room/Brochures/Air-and-Missile-Defense-Systems/IHTAR_ENG.pdf">http://www.aselsan.com.tr/en-us/press-room/Brochures/Air-and-Missile-Defense-Systems/IHTAR_ENG.pdf</a></p> <p><a href="http://www.aselsan.com.tr/en-us/press-room/Brochures/Electronic-Warfare-Systems/GERGEDAN_IHA_ENG.pdf">http://www.aselsan.com.tr/en-us/press-room/Brochures/Electronic-Warfare-Systems/GERGEDAN_IHA_ENG.pdf</a></p> <p><a href="http://www.aselsan.com.tr/en-us/press-room/Brochures/Electronic-Warfare-Systems/IHASAVAR_ENG.pdf">http://www.aselsan.com.tr/en-us/press-room/Brochures/Electronic-Warfare-Systems/IHASAVAR_ENG.pdf</a></p> |
| <b>Belgium<br/>Advanced<br/>Technology<br/>Systems (BATS)</b> | <b>Drone Guard</b>                         | Detector,<br>ECM | Drone Guard is a compact light weight scalable drone detection and disruption System. The detection layer is based on compact radar, capable of detecting and tracking the drones. The radar triggers the other layers of the protection suite. As a result of the radar detection an Electro-Optical (EO) system that is cued to the suspected drones for classification and identification. The second layer provides the countermeasures used to disrupt the target flight. These are activated from the command and control centre based on inputs from  | Belgium | <a href="http://www.bats.be/sites/default/files/Drone%20Guard%20BATS%20Brochure.pdf">http://www.bats.be/sites/default/files/Drone%20Guard%20BATS%20Brochure.pdf</a>  |

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|                   |                                  |               | the radar and EO sensors. Countermeasures include cueing a jammer to the target or a weapon mount to physically destroy the target.  |     |   |
| <b>Black Sage</b> | <b>UASX counter drone system</b> | Detector, ECM | <p>Black Sage's UASX system uses automatic target classification, video tracking and threat prioritization to automate the CUAS detect-identify-defeat process. UASX fits into three ruggedized plastic cases and is lightweight enough to travel as checked luggage. When rapid deployment is necessary, the complete system is unpacked and set up in less than 30 minutes. UASX stations are modular and enable scaled coverage across large geographic areas using existing point-to-point radios, cat5/6 or fiber networks. Radars, cameras and effectors are registered with a central hardware component and positioned according to unique requirements of the site. Multiple range capabilities are available to accommodate the needs of small sites and large campuses. Vamtac and Humvee mounted counter-UAS systems enable extreme long range protection against UAS threats. Cockpit integrated command and control and rapidly deployable carbon-fiber mast and sensor payload make for a timely and rugged solution for forward operating bases and remote VVIP applications.</p> <p>In July 2018 Black Sage announced it was providing stadiums and venues a relatively low-cost solution for specific high-risk events. According to the company, the Black Sage counter drone system provides: early detection to allow law enforcement to take action even before the drone is airborne, AI classification to reduce false alarms, operator location to assist law enforcement in apprehension, and forensic data to ensure prosecution is all provided by the service."</p> <p>In March 2019 Echodyne reported that its security radar, EchoGuard, has been selected by Black Sage Technologies, Inc. as the preferred radar sensor for mid-range C-UAS security solutions.</p> <p>Partnerships</p> <p>In June 2019 Raytheon and Black Sage announced they are partnering through a formal teaming arrangement to provide an integrated drone detection and mitigation system for civil authorities, critical infrastructure and military organizations around the world.</p> | USA | <a href="https://www.blacksagetech.com/counter-uas">https://www.blacksagetech.com/counter-uas</a> |

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|----------|------------|------------------|--|----|---|
| Blighter | AUDS, A800 | Detector,<br>ECM | <p><b>Partnerships</b></p> <p>AUDS is a smart-sensor and effector package capable of remotely detecting small UAVs and then tracking and classifying them before providing the option to disrupt their activity. The system may be used in remote or urban areas to prevent UAVs being used for terrorist attacks, espionage or other malicious activities against sites with critical infrastructure. The AUDS Team brings together three UK companies, each with the unique capabilities required to create an effective counter UAV system. Blighter's A400 series air security radars are able to detect small UAVs in all weather conditions, 24 hours a day flying in urban areas or near to the horizon. The Chess Dynamics Hawkeye Deployable System (DS) and EO Video Tracker, featuring both a long range colour camera and a high sensitivity Thermal Imager (TI), along with state-of-the-art video tracking technology, is able to track the UAV and, combined with radar target information, classify the target. The operator is then able to make a timely and informed decision to use the Enterprise Control Systems ('ECS'), smart RF inhibitor to selectively interfere with the C2 channels on the UAV allowing the system to disrupt the UAV's mission. The smart RF inhibitor uses directional antennas to achieve maximum range of operation with minimum collateral effect.</p> <p>The company launched its A800 3D multi-mode drone detection radar at DSEI 2021; the radar uses multi-mode surveillance capability usually reserved only for large-scale radar systems and packaging it into a smaller, more flexible radar with a maximum range of 20km. According to the company:</p> <p>"The A800 3D multi-mode radar is ideally suited to border and perimeter surveillance, capable of being mounted to fixed towers and masts, as well as to land vehicles and mobile surveillance trailers. This will be the first time that the A800 will be available to view in person. The radar's main function is to detect and locate consumer 'hobby' drones in 3D space. The radar's optimised air security mode provides a unique ability to search for low-slow-small (LSS) threats caused by the misuse of small drones including the commonly used 'DJI Phantom' style quadcopters. An Artificial Intelligence based micro-doppler target filtering feature helps to reduce false alarms and improve the detection of multicopter and winged drones."</p> | UK | <a href="http://www.blighter.com/products/auds-anti-uav-defence-system.html">http://www.blighter.com/products/auds-anti-uav-defence-system.html</a> |
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|                    |                          |               | <p>In March 2019 Blighter partnered with Genetec™, a technology provider of unified security, public safety, operations and business intelligence, to integrate its range of Blighter ground surveillance radars with Genetec™ Security Center, the company's unified IP security platform.</p> <p>In June 2020 Blighter signed a partnering agreement with Australian systems integration company AMS Defence to supply ground-based radar solutions for critical infrastructure protection and complex airborne threats such as drones and unmanned aircraft systems. The partnership will explore a number of opportunities in the fields of force protection, perimeter security and critical Infrastructure protection. As part of the agreement, Blighter will include the Blighter A400 series air security/drone detection radars, Blighter B400 series radars and the coastal security specialised C400 series radars. Additionally, to support ground forces, Blighter and AMS Defence will be providing the Blighter B202 MK 2 man-portable radar system for rapid, mobile deployment and the Blighter Orbiter radar system for vehicle mounted solutions, including drone detection.</p> |             |   |
| <b>BSS Holland</b> | <b>DroneBlocker</b>      | Detector, ECM | DroneBlocker is a full-stack counter-Wifi-UAV solution, from detection to neutralization. For Wi-Fi drones (Parrot Bebop, ArDrone, 3DR Solo) and hybrid Radiofrequency/Wi-Fi drones (some DJI Phantom, Yuneec Typhon, Blade Q350), DroneBlocker offers capabilities from detection, localization, identification to neutralization – connection breaking and in some cases remote control over the drone.  | Netherlands | <a href="http://www.bssholland.com/product/counter-wifi-uav-solution-drone-blocker/">http://www.bssholland.com/product/counter-wifi-uav-solution-drone-blocker/</a> |
| <b>CACI/Six3</b>   | <b>CORIAN/SkyTracker</b> | Detector, ECM | <p>CACI International announced two new technologies to mitigate threats from unmanned aircraft systems during the AUSA Annual Meeting and Exposition in Washington on 11-13 October, 2021.</p> <p>CORIAN 2.0, the next generation fixed-site multi-sensor platform expands on existing CORIAN technologies with improved mechanical design, capability advancements, and integration with other phenomenology. These enhancements extend the range of system effectiveness, provide the ability to guard against multiple, simultaneous threats from standoff distances and easily integrate with other systems, including command and control systems such as forward area air defence command and control (FAAD C2).</p>  | USA         | <a href="https://www.caci.com/west17/pdf/cyber-electronic-warfare-sensor-suite.pdf">https://www.caci.com/west17/pdf/cyber-electronic-warfare-sensor-suite.pdf</a>   |

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|                |                           |               | <p>CORIAN Tactical, the new system offering both fixed and on-the-move protection against sUAS threats, secures airspace and critical infrastructure in environments ranging from dense population areas to remote locations. With a tailorable and scalable configuration, low size, weight, and power (SWaP) and precise capabilities, the ruggedized system offers expanded mission options that can be installed in less than an hour.</p> <p>CACI's SkyTracker Technology Suite is a family of systems that detect, track, classify and defeat Group 1-5 UAS threats. The technology portfolio enhances operational awareness across high-level UAS threat groups and within a layered defence construct across numerous environments.</p>  |        |   |
| <b>Cerbair</b> | <b>Counter UAS system</b> | Detector, ECM | <p>The Cerbair system, fixed or mobile, combines several Radio Frequency and Optical sensors in order to adapt the solution to the level of risk, site configuration and budget. Detection characteristics: Sensor frequencies detected - 2,4GHz / 5 GHz; range up to 3km; detection angle: 90°; Ethernet connection / POE. Video sensor: High resolution: 5MP; Range up to 150m; Detection angle: 90°; Near-infrared at night; Ethernet Connection / POE. Visualizing drone intrusions in real time is possible thanks to powerful algorithms: Detection rate: 90%; Optical real-time tracking of the drone flightpath; Evidence collection (HD picture, video recording of the intrusion); Drone model recognition; Simplified integration on existing system via API. Threat resolution: Alerts configured for a rapid and adapted intervention (visual, sound, text message etc...) - Passive actions: evacuate people to a safe place, interrupt a conversation, search the site, block the drone's line of sight etc; Counter-measures to neutralize the drone by forcing its landing: jamming (flight commands and geolocation) or capturing it with a net thrower.</p> <p>MEDUSA is a smart counter measure that delivers a proportionate response to a drone attack, whether it is an isolated UAV or a swarm, says the company. It can be used in conjunction with Cerbair's HYDRA detection unput that allows the counter measure to reduce its collateral interferences. The jammers are configured in 15W (MEDUSA 100) and 50W (MEDUSA 200) with spectrum extension available by adding low frequency ranges on which several rarer drones can operate.</p> | France | <a href="http://www.cerbair.com/2017/solution.php?lang=en&amp;gclid=Cj0KEQjw7dfKBRCdkKrvmfKtyeoBEiQAch0egWgTCwNVDclUrHSm bHVVh1roN9upQ3Ik1HLj3AS8viMaAlWr8P8HAQ">http://www.cerbair.com/2017/solution.php?lang=en&amp;gclid=Cj0KEQjw7dfKBRCdkKrvmfKtyeoBEiQAch0egWgTCwNVDclUrHSm bHVVh1roN9upQ3Ik1HLj3AS8viMaAlWr8P8HAQ</a> |

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|                       |   |               | <p>MEDUSA 100 and MEDUSA 200 offer an omnidirectional neutralisation solution that triggers the emergency procedure of rogue drones, often leading to their immediate landing. The equipment can be supplied with a wheeled transport case, a tripod and antenna mounting.</p> <p>The range is 2.4 and 5.8GHZ and L1 band; 433, 868, and 915 MHz, and L2 optional.</p> <p>Partnerships</p> <p>Cerbair and C-UAS market intelligence company DroneSec signed a partnership in August 2021 through which CERBAIR will provide its customers with weekly information in French, English, and Arabic on developing threats identified by DroneSec.</p> <p>In early 2022 Cerbair and French electromagnetic interference specialist KEAS won a contract for “the acquisition and maintenance of a solution for the detection, characterization and neutralization of drones (DCND) in penitentiary establishments located in metropolitan France metropolitan and overseas”.</p>                  |    |   |
| <b>Chess Dynamics</b> | <b>Hawkeye Deployable System and EO</b> | Detector, ECM | <p>The Chess Dynamics Hawkeye Deployable System (DS) and EO Video Tracker, featuring both a long range colour camera and a high sensitivity Thermal Imager (TI), along with state-of-the-art video tracking technology, is able to TRACK the UAV and, combined with radar target information, classify the target.</p> <p>In June 2019 Chess Dynamics developed an automated drone protection systems specifically for use at airports. Based on the military Counter-Unmanned Aerial System (C-UAS) AUDES, installed by Chess at London Gatwick Airport following the sustained drone attack in December 2018 which closed the airport, “the new scalable systems have been developed specifically to offer protection within the airport perimeter and flightpath for up to 10km from the runway,” says the company.</p> <p>Based on two elements – AirGuard – protecting the airport perimeter, and AirShield – protecting the flightpath, the systems are configured to the specific</p> | UK | <a href="http://www.chess-dynamics.com/hawkeye-deployable-systems/">http://www.chess-dynamics.com/hawkeye-deployable-systems/</a> |



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|                                |  |               | <p>requirements and desired level of security of each installation. Both systems are aimed at providing fully automated detection and alert to UAV presence to minimise resource required, and significantly reduce the risk of error and security response delay.</p> <p>AirGuard offers a 3D detection and protection ‘bubble’ around the perimeter of the airport. Incorporating multiple sensors including radar, acoustic sensors, radio frequency (RF) direction-finders and electro-optical (EO) video tracking technology, the system automatically detects and tracks airborne objects and flags an alert to the operator. Using real-time analysis of the camera output, the operator can classify the threat and use a simple system to respond to an emerging situation, escalating or downgrading the security threat as required. It also allows the operators to provide necessary security agencies with accurate information, including recorded video evidence for future prosecution purposes, while minimising potential disruption from false alarms.</p> <p>AirShield offers Air Traffic Control (ATC) operations an automated UAV detection and alert solution to maximise protection of the flightpath up to 10km from the runway, enabling rapid decisions to be made, including ordering aircraft to divert their course, should a threat be identified.</p> <p>Partnerships</p> <p>In early 2020 Liteye Systems (USA) signed a strategic alliance agreement with Chess Dynamics to market a portfolio of Chess products and services in the US. Products include an array of layered technologies designed to address force protection and surveillance.</p> |     |   |
| <b>Citadel Defense Company</b> | <b>Drone Defense System, Hunter algorithm, Titan</b> | Detector, ECM | <p>The company was acquired by BlueHalo in November 2021.</p> <p>Citadel Defense provides a comprehensive, automated system to detect and prevent s-UAS from entering a protected space. The system passively and simultaneously monitors multiple relevant frequency bands within the RF spectrum in search of emissions that correspond to the characteristics of drone control, video and telemetry signals. When a detected signal is determined to be valid, the system will utilize multiple escalating tactics to prevent the drone/UAS from entering the protected area. Notification of detections,</p>  | USA | <a href="https://www.citadelthreatmanagement.com">https://www.citadelthreatmanagement.com</a> |

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|  |  | <p>engagements, and system status is displayed via a dedicated tablet computer, providing the operator automatic or manual control of mitigation strategy. The system is rugged, compact, rapidly deployable (less than five minutes to set up), and can be seamlessly transferred between man-portable, vehicle mount, and static configurations. Citadel’s system has been fielded overseas, undergone combat evaluations and has third party validation.</p> <p>Citadel’s technology is derived from expertise spanning several disciplines, beginning with detailed knowledge of the Radio Frequency (RF) control transmission standards used across all commercial (and most military) drones and UAVs. This includes the protocol variants utilized for Radio Control (RC), first-person video (FPV), and Wi-Fi-based control emitted by drones, controllers, and downlink transmitters. A single Citadel system can analyze and transmit signals spanning the RF range from DC to 6 GHz, including the 100 channels at 2.4 GHz and 150 at 5.8 GHz, the most commonly used bands for commercially available drones. The system is able to isolate and identify these signals from in-band RF spectral noise, discriminating a target signal from miles away. Once a potential detection is discovered it enters the machine learning-based signal path and is refined for detailed analysis and identification.</p> <p>Proprietary algorithms then identify the control signal parameters, intelligently predict the rest of the pattern if necessary, and produce a transmitted mitigation solution. It does so via three approaches – Predictive, Targeted, and Smart Jam transmissions - based on control protocol and operator / mission preference. Citadel’s algorithm has demonstrated an ability to detect and engage military and commercial drones not seen previously in multiple live demonstrations, and key to the Hunter Algorithm’s performance is the use of multiple classifiers. This fuses the capabilities of separate discrete machine learning algorithms to provide significant performance improvements and superior false positive rejection. The Citadel system will then either output a mitigation signal for the target drone system or issue a smart jamming signal localized to the control frequency/s identified.</p> <p>Citadel’s technology is designed to comply with 18 USC 2511 (Electronic Communications Privacy Act) in relation to sampling radio frequency spectrum data and does not use packet headers to identify drone signals or any other</p> |  |  |
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|  |  | <p>identifier that could uniquely identify a specific drone or controller. Citadel assists with enforcing Temporary Flight Restrictions (TFRs), used by the FAA to restrict flights in certain areas. Some have become more permanent, like those around Disneyland, or are event based, such as when the President visits a location. The FAA publishes TFRs as necessary, but there are also unpublished TFRs for sporting events, wildfires and emergency situations outside of FAA publishing.</p> <p>In March 2019 the company launched its Titan C-UAS system. “Designed and developed alongside U.S. warfighters and security experts, the Titan provides the user real-time information, identifying and classifying an approaching unmanned aerial vehicle or swarm, and selectively applying precise countermeasures to induce the UAV to land or return to its home base. Citadel Defense uses machine learning, artificial intelligence, and software defined hardware technology to rapidly address new threats – making sure the effectiveness of protecting people and assets is always ahead of the ever-evolving threat.”</p> <p>In May 2020 Citadel released new software incorporating ‘deepfake neural networks’ to protect against adversarial attacks on protected airspace. The technology is designed to help US and allied forces combat growing enemy tactics that attempt to confuse existing security intelligence equipment as electronic warfare escalates. The company has incorporated ‘Generative Adversarial Networks’ into its Titan C-UAS solution.</p> <p>In October 2021 The company has launched new solutions including Titan Drone Finder (DF), Titan Tactical Assault Kit (TAK), and Titan Multi-Sensor (MS) to address emerging requirements.</p> <p><b><u>Partnerships</u></b></p> <p>In March 2020 Liteye Systems announced a partnership with Citadel Defense to enhance their counter drone solutions.</p> <p>In March 2021 Citadel Defense teamed with Syzygy Integration to develop a custom counter drone application for the Department of Defense (DoD) and</p> |  |  |
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|                |   |                  | federal government agencies. The application accelerates situational awareness and co-ordinated responses to uncooperative drone activity around critical infrastructure, National Special Security Events (NSSE), military bases, and the border   |        |   |
| <b>CS</b>      | <b>Boreades</b>   | Detector,<br>ECM | <p>Boreades meets a requirement from the SGDSN in the framework of the project funded by the ANR (French National Research Agency):</p> <ul style="list-style-type: none"> <li>• Detecting drones, identifying and tracking drones</li> <li>• Neutralizing and recovering drones by jamming and spoofing the remote control and navigation systems</li> <li>• Locating remote pilots</li> </ul> <p>The system can jam and decoy the drone's navigation system, making it possible to take control, to select the recovery point, and above all to estimate the location of the remote pilot. It is a high-performance scalable multi-sensor and multi-effector system, mainly based on civilian technologies with a very low Total Cost of Ownership. The hardened real-time supervision system is based on an unique command &amp; control system and a crisis management module developed by CS Group.</p> <p>In April 2022 the Thales/CS consortium was reported to have won the French Defence Ministry PARADE national C-UAS contract.</p> | France | <a href="https://uk.c-s.fr/BOREADES-an-operational-French-system-to-detect-neutralize-malicious-drones-flights_a584.html">https://uk.c-s.fr/BOREADES-an-operational-French-system-to-detect-neutralize-malicious-drones-flights_a584.html</a> |
| <b>Dedrone</b> | <b>Drone Tracker RF100, RF 160, RF-300, 3.5, Cloud, DroneDefender</b> | Detector,<br>ECM | <p>Dedrone provides an automatic, integrated, and self-contained platform that delivers drone classification and countermeasures to secure against drone threats and their operators 24/7. The company says DroneTracker is the only modular system on the market that can be customized to address site-specific threats, adapted for easy integration to an existing security program, and accommodates building structures, landscapes, and other exterior conditions." Dedrone's DroneTracker platform provides a complete airspace monitoring and management solution through a convenient browser-based interface. DroneTracker allows users to readily configure multiple sensors, active and passive countermeasures, and alerts for automatic, 24/7 operation. The software continuously displays real-time airspace information and classifies drones using Dedrone's DroneDNA advanced analysis and pattern recognition capabilities. Defensive measures against hostile drones can be activated</p>                                 | USA    | <a href="https://www.dedrone.com/en/dronetracker/drone-protection-software">https://www.dedrone.com/en/dronetracker/drone-protection-software</a>   |

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|  |  |  | <p>automatically, with security service providers notified as appropriate. Dedrone automatically classifies, issues alerts, and records evidence to identify and assess potential threats, and can automatically trigger offensive or defensive countermeasures if needed.</p> <p>Combined with the broad coverage and early warning capabilities of Dedrone’s RF-100, the new RF-300 adds situational awareness so organizations can determine the nature and severity of threats from unauthorized drones. Dedrone’s RF-100 and RF-300 are both supported by Dedrone Cloud.</p> <p>In March 2018 Dedrone launched a new sensor, the RF-300, which automatically locates drones and their pilots. According to the company “When combined with the broad coverage and early warning capabilities of Dedrone’s RF-100, the new RF-300 adds situational awareness for organizations to determine the nature and severity of threats from unauthorized drones.”</p> <p>Key features of the RF-300 include:</p> <ul style="list-style-type: none"> <li>• Automatically tracks a drone’s flightpath, providing advance opportunity to protect sensitive infrastructure and deploy security measures</li> <li>• Pinpoints the location of a drone pilot, enabling security personnel to either alert law enforcement of an illegal intrusion or confront the pilot at their launch site</li> <li>• Connects to DroneTracker, Dedrone’s software platform, which combines multiple sensors and countermeasures, including RF, cameras, and microphones, for complete airspace security.</li> </ul> <p>In July 2018 Dedrone announced the release of Dedrone Cloud which “streamlines and accelerates drone detection technology installations, without requiring on-site IT infrastructure or maintenance.” According to a company press release additional highlights of Dedrone Cloud include:</p> <ul style="list-style-type: none"> <li>• Accelerates technology deployment: Dedrone Cloud enables easier deployment of the Dedrone system and thus makes it quicker for customers perform a threat analysis of their airspace</li> </ul> |  |  |
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|  |  |  | <ul style="list-style-type: none"> <li>• Removes the need for on-site infrastructure: Dedrone Cloud does not require additional IT infrastructure, helping security teams avoid additional costs for hardware, and time spent for installation</li> <li>• Eliminates manual updates and maintenance: Communication between DroneTracker Software and RF sensor is configured automatically, and all new feature updates are automatically integrated into a customer’s DroneTracker software</li> <li>• Ensures data is reliable, accessible and secure: With a 99.9% uptime rate, Dedrone Cloud enables security providers to have the latest information on their airspace activity</li> </ul> <p>In September 2018 Dedrone released DroneTracker 3.5, a drone detection system aimed at defeating drone swarms.</p> <p>In April 2019 the company announced the launch of its Drone Tracker 4 C-UAS.</p> <p>In January 2019 Dedrone launched the Dedrone RF-160, an upgraded version of the company’s existing foundational RF sensor, the RF-100. The newest radio frequency sensor includes new features such as increased detection range, streamlined installation process, and integrated Long-Term Evolution (LTE) wireless communication. The RF-160 quantifies how many drones are in the user’s airspace, providing early detection of drones, before they even take off. Dedrone also manufactures a separate sensor, the RF-300, which provides localization and tracking of sUAS. The RF-160 is available for order today and will begin delivery in March 2020.</p> <p>New features of the RF-160 include:</p> <ul style="list-style-type: none"> <li>• Integrates LTE for fast startup and access to data for drone risk analysis: Only needing power supply and a pole, it automatically connects to the Dedrone Cloud via LTE and immediately starts to detect drones. An on-premise server is not required. Users can assess their drone risk and use these insights to act upon drone threats.</li> <li>• Provides detection range of up to 5 km: The RF-160 provides early warning and classification of sUAS. A single RF-160 has an average detection range of 1.6 km, and under ideal conditions, up to 5 km for</li> </ul> |  |  |
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|  |  |  | <p>certain drones. This range extends when one or more RF-160s are working together, and more information on drone activity can be generated when layering with other detection technologies, including the RF-300, radar, and PTZ-cameras.</p> <ul style="list-style-type: none"> <li>• Incorporates an advanced design for urban environments: Urban areas have more radio frequency activity from radio communication, televisions, cell phones, GPS, and other technologies. The RF-160 meets the needs of organizations in such environments with higher potential of RF interference.</li> <li>• Includes expanded RF band detection range for the detection of commercial, consumer, and home-built sUAS: Radio frequency spectrum operates on a wide range depending on the types of communication technology used. Commercial, off the shelf drones typically operate on the 2.4 and/or 5.8 ghz sub-band. The RF-160 comes with an advanced antenna configuration to ensure that drones that may operate outside the typical spectrum are identified.</li> <li>• Increased computing power and data processing: The RF-160 features a high-performance processor, enabling rapid data processing and analytics and allows timely responses to sUAS incursions.</li> </ul> <p>In October 2019 the company announced the purchase of Batelle’s DroneDefender range. These systems are non-kinetic cUAS solutions developed to instantaneously defend airspace against commercial drones without compromising safety or risking collateral damage. The systems quickly disrupt an adversary’s control of a drone, neutralizing it so that no remote action, including detonation, can occur, minimizing drone damage and risk to public safety. The system comprises a:</p> <ul style="list-style-type: none"> <li>• Handheld Unit – The DroneDefender handheld units are portable, intuitive and man-in-the-loop. The system employs two different defences to disrupt unwanted UAS—remote control disruption and GPS disruption. Learn more about the handheld version.</li> <li>• Ground-based Unit – The DroneDefender ground-based system leverages the technology developed for the handheld system for a more capable cUAS solution. The remote control defeat capability can be paired with a detection and tracking system and integrated with almost any 360° positioner.</li> </ul> |  |  |
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|  |  |  | <p>By mounting the disruption capability on a mechanical positioner, the ground-based DroneDefender system utilizes significantly amplified power, increased antenna gains, and the precision aim-point of the positioner to neutralize UAS threats at much greater distances than the handheld version.</p> <p><b><u>Partnerships</u></b></p> <p>In September 2018 AT&amp;T and DEDrone announced they were teaming up on a drone detection solution that helps protect military bases, venues, cities, and businesses, from malicious drones. The software-centric platform identifies approaching drones by means of radio frequency, visual, radar, and other sensor data. Analysis of sensor data then reliably classifies approaching drones and finds their locations. It then triggers alarms to alert security staff. It can also be integrated with other counter measures to help protect the public, such as building management and alarm systems.</p> <p>In June 2020 DEDrone announced it had partnered with communications company BlackBerry to deliver advanced counter drone technology. As part of this embedded technology partnership DEDrone is integrating BlackBerry AtHoc software into its products to enable real-time secure alerts when a malicious or unauthorized drone is detected in an airspace.</p> <p>In July 2021 General Dynamics Mission Systems teamed DEDrone to provide drone detection and drone neutralising capability to US government customers. The partners aim to detect and defeat the growing unmanned aerial system threat. In September 2021 General Dynamics reported it had developed a new counter-Unmanned Aerial Systems Expeditionary Kit, providing highly mobile C-UAS coverage for remote security requirements, in partnership with DEDrone. “This ruggedized solution allows users to rapidly deploy and setup C-UAS detection to assess UAS threats within a mission Area of Responsibility (AOR) in less than an hour with no tools required,” according to a company statement. The Counter-Unmanned Aerial System Expeditionary Kit allows users to rapidly deploy and setup Counter-UAS detection to assess threats in less than an hour with no tools required. The full kit consists of an Operational Node, Hub Node, and Remote Nodes.</p> |  |  |
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|                      |                               |                  | <p>Dedrone and IT solutions provider Carahsoft Technology announced a strategic partnership in early 2022 to market commercial anti-drone security solutions.</p> <p>In December 2021 Dedrone announced a partnership with Swiss telecoms provider Swisscom to protect people, property and information from the threat of unauthorised drones. Together, Dedrone and Swisscom Broadcast plan to protect critical infrastructure facilities, airports, and events, as well as companies in the pharmaceutical and watchmaking industries. Additionally, the solution will enable law enforcement agencies to ensure public safety in their regions.</p>   |     |   |
| <b>Department 13</b> | <b>MESMER® ,<br/>Scout 13</b> | Detector,<br>ECM | <p>D13's MESMER® Counter Drone System is a patented, low power, non-jamming, non-line of sight, non-kinetic drone mitigation solution. MESMER® provides a safe and effective method of protecting personnel and infrastructure from dangerous drones. The key differentiator for MESMER® is its ability to manipulate weaknesses in all digital radio protocols. This allows MESMER® to put into effect sophisticated automated detection and mitigation strategies to stop, redirect, land or take control of drones across a range of national security and defence scenarios. The patented technology is built on open source software architecture, which ensures that MESMER® can be seamlessly integrated into existing security and surveillance systems. The MESMER® v1.0 system has three key components:</p> <ul style="list-style-type: none"> <li>• General purpose computer server running Linux OS. Multiple Ethernet ports are utilized for intra-system communication.</li> <li>• Software Defined Radios (SDR). MESMER® utilizes commercially available SDRs for RF signal reception and generation. SDRs can generate arbitrary waveforms which are used for drone detection, identification, and mitigation.</li> <li>• RF Front End. Provides signal conditioning on both receive and transmit channels, and allows MESMER® to perform optimally in a real-world environment.</li> </ul> <p>The system can be operated using a graphical user interface: a tablet with a touch screen, or a standard desktop monitor with a keyboard and mouse. The system can also be operated in auto-mitigation mode that does not require operator intervention to initiate a drone mitigation.</p> | USA | <a href="https://department13.com/mesmer/">https://department13.com/mesmer/</a> |

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|                      |         |                   | <p>Scout13 is an intelligent drone sensor system providing situational awareness for commercial, government and military applications, including drone detection, identification, attribution and location.</p> <p>Atlas13 is the new software user interface (UI) that Scout13 and Mesmer will talk to, constantly feeding detection data into the system to enable the most efficient drone detections and best practice airspace management and compliance.</p> <p><b><u>Partnerships</u></b></p> <p>Blackbird-C is the latest sUAV from Nightingale Security. It is a smaller transportable version of the Blackbird drone, which is improving the opportunity for faster response mobile surveillance operations.</p> <p>At the start of 2021 Department 13 partnered with Australian aviation software provider AVCRM (Advanced Compliance Risk Management) to bring clients a new operational safety, asset management and complete situational awareness service</p> |         |   |
| Deutsche Telecom/DFS | Magenta | Detector, capture | <p><b><u>Partnerships</u></b></p> <p>Together with partners from industry, Deutsche Telecom has developed the Magenta cyber-shield – a detection and alert system for drones. It uses technology developed by the leading partner Dedrone based in Kassel as well as frequency scanners from Rhode &amp; Schwarz, microphone arrays from Squarehead and radar devices from Robin Radar Systems. In February 2019, DFS and Rheinmetall, Germany’s largest supplier for defence technology, tested an integration together with the Bundeswehr, Germany’s armed forces. Air traffic data were exchanged with advanced radar systems, with acoustic and infrared sensors, and with optical equipment to detect a potentially threatening drone. A catch-and-carry drone threw a net over the disruptive drone and took it to the ground.</p>  | Germany | <a href="https://www.telekom.com/en/media/media-information/archive/magenta-drone-defense-shield-445192">https://www.telekom.com/en/media/media-information/archive/magenta-drone-defense-shield-445192</a> |

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| <p><b>D-Fend Solutions</b></p> | <p><b>Autonomous counter-drone perimeter security system,</b></p> | <p>Detector, ECM</p> | <p>D-Fend Solutions provides an autonomous counter-drone perimeter security system that automatically detects, identifies, and intercepts intruding commercial drones. D-Fend provides comprehensive, safe, portable, and scalable solutions for securing a stationary perimeter. The system is based on autonomous cyber software-defined radio technology that combines cyber and wireless signal processing techniques to take control over drones' communication links without causing spectral interference.</p> <p>In February 2020 the US Department of Defense's (DoD's) Defense Innovation Unit selected D-Fend's EnforceAir C-UAS system as the sole Radio Frequency system for integration into a counter drone system. According to D-Fend EnforceAir was selected as a best-in-its-class RF system for follow-on integration and operational assessment from a field of 16 companies in 2019. A D-Fend press report says DIU evaluated EnforceAir's ability to integrate into a system of systems at a government test facility during a counter drone event in November 2019, with lessons learned informing the Department's approach to integration of capability. This led to its selection in 2020.</p> <p>EnforceAir c-UAS is an advanced autonomous system that automatically and passively detects, locates and identifies rogue drones as well as mitigates risk by taking control over (takeover) them and landing them safely at a predefined safe zone, applying a non-jamming &amp; non-kinetic technology which does not require line-of-sight, and is suited to all complex environments, whether urban or rural.</p> <p>In April 2021 D-Fend launched a Multi-Sensor Command &amp; Control (MSC2) system designed to control multiple sensors used by EnforceAir. By controlling multiple EnforceAir sensors remotely from a single server, MSC2 facilitates expanded and uninterrupted coverage for rogue drone detection and mitigation, without increasing the number of personnel needed to operate the multiple EnforceAir systems, says the D-Fend press release</p> <p>In October 2021 D-Fend Solutions released a new software version of its EnforceAir, as part of the company's quarterly software enhancement programme. The new version includes improvements to the MSC2 system, detailed map information to make communication with law enforcement more effective and additional protection plan options.</p> | <p>USA</p> | <p><a href="http://www.d-fendsolutions.com">www.d-fendsolutions.com</a></p> |
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| <b>Diehl Defence</b>          | <b>Guardion/IRIS-T</b> | Detector,<br>ECM | <p>The GUARDION drone defence system combines the scalable solutions customized to very specific customer requirements to reliably detect and defend against threats posed by the unauthorized use of drones. GUARDION is offered as an integrated product. GUARDION focuses on integrating electronic detection, verification and countermeasures and connecting them to a position mapping and command and control tool. The HPEM counterUAS effectors from Diehl Defence, R&amp;S® ARDRONIS from Rohde &amp; Schwarz work with the TARANIS® command and control and position mapping system developed by ESG</p> <p>In February 2019, Lockheed Martin, Diehl Defence and Saab announced an agreement to develop the Falcon™ air defence weapon system. According to a Lockheed Martin press release, Falcon integrates Diehl's 40-kilometer range Infra-Red Imaging System Tail/Thrust Vector-Controlled (IRIS-T) SLM interceptor and vertical launcher, Saab's 360-degree AESA Giraffe 4A radar through Lockheed Martin's flexible SkyKeeper command and control battle manager. Falcon's open architecture allows the system to easily integrate into any air operations centre.</p> <p>In early 2022 Diehl Defense announced it was adding passive radar capabilities from Hensoldt to its ground-based air defense (GBAD) IRIS-T SLM unit to increase the surveillance capability of the overall system. The IRIS-T SLM is currently equipped with Hensoldt's multifunction radar TRML-4D, and adding Hensoldt's Twinvis passive radar will provide operators of the IRIS-T SLM system with additional functions, such as emission-free early detection of flying objects and the transmission of aerial photographs to the operators without putting the main sensor into operation, says the press release.</p> | Germany | <a href="http://www.diehl.com/en/nc/diehl-defence/press/reliable-protection-against-drones-esg-diehl-defence-and-rohde-schwarz-cooperate.html">http://www.diehl.com/en/nc/diehl-defence/press/reliable-protection-against-drones-esg-diehl-defence-and-rohde-schwarz-cooperate.html</a> |
| <b>Digital Global Systems</b> | <b>CLEARSKY™</b>       | Detector,<br>ECM | <p>CLEARSKY™ combines automated RF spectrum analysis and drone threat management to provide stadiums with interference-free communications and a barrier against unauthorized drones. CLEARSKY™ uses patented technology to automatically capture, interpret, locate, and alert on rogue wireless signals, ensuring that stadium and field communications are available. The signal classification engine uses Artificial Intelligence to detect known and unknown</p>   | USA     | <a href="https://www.digitalglobalsystems.com/clearsky-stadiums/">https://www.digitalglobalsystems.com/clearsky-stadiums/</a>   |

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|  |  |  | <p>drones in record times, and the drone defence mechanism keeps unauthorized drones out of restricted airspace while also disabling the drone’s video feed.</p> <p><b>Stadium RF Operations</b></p> <ul style="list-style-type: none"> <li>• Identifies and locates interference and performance issues for wireless camera systems, on-field radio, in-house audio-visual, TV broadcast, and staff radio.</li> <li>• Assists with frequency coordination.</li> <li>• Constantly learns the environment, identifying emerging issues and enhancements.</li> <li>• Provides optimum performance models for different events – concerts, sports, etc., while fine tuning during the event.</li> <li>• Mobile surveys/monitoring available for areas not covered by fixed nodes</li> </ul> <p><b>Drone Threat Management Zone</b></p> <ul style="list-style-type: none"> <li>• Push a button to engage drone detection and defence. No operator training required.</li> <li>• Protection against single or multiple drones.</li> <li>• Provides line of bearing to both drone and controller.*</li> <li>• Stops unauthorized drone incursion without affecting other wireless communications.</li> <li>• Disables video feed of unauthorized drone.</li> <li>• Mobile and/or fixed-node deployments.</li> <li>• Passively monitors wideband radio frequencies.</li> <li>• AI learning engine can detect previously-unseen drone protocols and publish this new pattern to other DGS nodes in near-real time.</li> </ul> |  |  |
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| <b>DroneShield</b> | <b>DroneGun,<br/>DroneSentry<br/>(X), Drone<br/>Sentinel,<br/>DroneCannon,<br/>Radar Zero,<br/>DroneNode,<br/>RFPatrol, Rf<br/>Zero,<br/>DroneOptID</b> | Detector,<br>ECM,gun | <p>DroneSentinel provides the fully integrated sensor suite of DroneSentry without the DroneCannon RF countermeasure capability. With integrated data from all available sensors, users can rapidly detect and assess potential threats. An intuitive user interface provides live and historical data from all sensors, and broadcasts configurable alerts based on user-defined criteria. DroneSentry integrates DroneShield’s suite of sensors and countermeasures in a unified platform deployable in permanent or temporary installations. Incorporating RadarOne radar, WideAlert acoustic sensors, RFOne RF detectors, and DroneHeat and DroneOpt cameras (with integrated DroneBeam), Sentry correlates available data for users and provides maximum situational awareness and the quickest response to airborne threats. DroneSentry also includes the DroneCannon RF countermeasure, providing an end-to-end detection and response capability.</p> <p>In February 2018 DroneShield announced the launch of RadarZero, a compact drone detection radar product. According to the company: “At roughly the size of a paperback book, the product can detect drones up to 750m away and sells for a fraction of the cost of the larger longer-range more conventional radars. Because of its small formfactor, RadarZero is portable and mobile. RadarZero complements DroneShield’s existing longer-range (larger formfactor) RadarOne product and is offered both as a standalone product and as part of the company’s DroneSentinel drone detection and DroneSentry drone detection and mitigation platforms. RadarZero does not replace DroneShield’s existing RadarOne module / product. Rather, it is offered as an alternative for relevant users and environments.”</p> <p>In July 2018 DroneShield announced the next version of Rapid Scout® HQ, a vehicle with an integrated counter drone detect and defeat solution. The prior version of Rapid Scout® HQ incorporated a vehicle with an advanced surveillance capability, through a combination of a sophisticated mast-mounted CCTV platform on a vehicle. Going forward, Rapid Scout® will incorporate a counter drone module containing DroneShield’s RadarZeroTM (portable drone detection radar), RFOneTM (drone detection via an RF direction finder) and/or DroneCannonTM (counterdrone jammer) modules into the Rapid Scout® platform. The resulting product is believed to be a first of its kind, a non-military vehicle with a suite of counter drone multi-sensor detect and defeat solutions.</p> | Australia | <a href="https://www.dronesield.com/">https://www.dronesield.com/</a> |
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|  |  |  | <p>In October 2018 DroneShield released DroneShield Complete™ v2.0, a software update for the DroneSentry &amp; DroneSentinel products – drone detection and mitigation interfaces with enhancements to tracking, navigation, functionality and usability. DroneShield Complete™ includes a graphic user interface (GUI) that compiles and analyses environmental data to display to the user seamlessly and effectively. This dramatically reduces reaction and response times.</p> <p>The DroneShield Complete™ GUI harnesses the advantages of each detection technology, providing the user with an early warning system and growing detection threat level as more data is gathered and processed. Remote access to DroneShield products allows the customer to check status, configure system settings, monitor threat levels and respond in real-time. The browser-based monitoring application lets the customer view and control DroneShield detection and response activity from anywhere.</p> <p>In October 2018 DroneShield announced the launch of DroneNode™, a portable, compact and inconspicuous counterdrone jamming device which can be utilised at large outdoor events by law enforcement “without raising public concern”, according to the company. DroneNode™ is an evolution of the company’s existing DroneCannon™ product. The DroneNode™ product is contained in a portable case sized at approximately 50x50cm: Oleg Vornik, DroneShield’s CEO commented: “DroneShield’s recent credentials in the area include the 2018 Olympics, the 2018 Commonwealth Games, 2018 ASEAN-Australia Special Summit, the 2017 Hawaii IRONMAN World Championship, and the 2015 – 2017 Boston Marathons.”</p> <p>In May 2019 DroneShield announced the launch of its body-worn drone detection product, RfPatrol™. According to a company statement: “Weighing under 1kg, the product is expected to be of significant interest to a range of DroneShield’s customer base globally, across military, law enforcement, security and VIP markets. Importantly, as RfPatrol™ is a completely passive (non-emitting) product, it substantially broadens the range of customers to whom the product is lawfully available. The product was developed in response to substantial customer interest. The MkII version of RfPatrol was launched in April 2020. According to DroneShield, the device is completely passive (non-emitting),</p> |  |  |
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|  |  | <p>increasing the range of customers to whom the product is lawfully available, and also appealing to use cases where the device cannot be detectable to the enemy forces due to having no emissions. The next generation of the product is approximately 40% smaller in size, with a reduced weight of 800g (including battery), further ruggedization, as well as a range of further enhancements requested by the end users following last 12 months of in-field deployments. The device can be combined with DroneShield’s Directional Antenna Unit (DAU) to determine the direction of the incoming threat.</p> <p>In July 2019 DroneShield announced the launch of its DroneGun MKIIITM, a portable pistol-shape drone jammer, weighting under 2kg. DroneGun MKIIITM is designed to be an alternate rather than a replacing product for its DroneGun TacticalTM unit, having a shorter effective range of 500m versus 1-2km for DroneGun TacticalTM. In the same month Dronesield and Bosch Security announced a partnership to offer an integrated system for drone detection and mitigation. The solution combines Dronesield’s product suite of multi-sensor detection systems and products with Bosch Security’s video surveillance products to provide one system. The partnership expands market opportunities for Dronesield, in particular with Bosch’s large installed base in Asia-Pacific and globally.</p> <p>In August 2019 DroneShield introduced a cost-effective version of its RfOne radiofrequency direction finder. The RfZero is an omnidirectional drone detection device with a 1km range (RfOne operates over 5km range) and can be integrated with the rest of the fixed site DroneShield product suite, such as DroneCannon, for either automated or manual drone defeat, once RfZero detects the drone. RfZero is a non-emitting device and is unlikely to be subject to regulatory constraints. Target customers include corporate users, prisons and commercial sites, while the company’s RfOne device is popular with airport and military customers.</p> <p>In November 2019 DroneShield announced it had developed a vehicle-mounted drone detection and defeat product called DroneSentry-X. Weighing only 10kg, the compact unit is mountable on most vehicles across military, law enforcement, security and VIP markets. The product is suitable for both vehicle/convoy and fixed site installations and was developed in response to</p> |  |  |
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|  |  |  | <p>substantial customer interest. The system provides an affordable detect-and-defeat solution for price-sensitive customers as an alternative to DroneShield’s full-functionality DroneSentry product DroneSentry-X is a cross-vehicle compatible, automated 360° detect and defeat device. It is suitable for mobile operations with roof mounted sensors that can be automatically or manually activated to disrupt drone activity. According to DroneShield, DroneSentry-X offers the user real-time situational awareness while moving, with the ability to automatically counter drone threats detected by the system. The device can alternatively be deployed at a fixed site or as a temporary pop-up solution, with on site or remote operator access. The equipment provides detection of drones and protection in all directions, with the included digital control panel and display mounted for operator access.</p> <p>In May 2020 DroneShield launched a new software product designed to support camera-based drone detection, identification and tracking. The DroneOptID software has an Artificial Intelligence/Machine Learning (AI/ML) engine and uses computer vision technology to detect, verify and track drones in real time. It works seamlessly with DroneShield’s range drone detection and countermeasure devices. According to a DroneShield press release, the software is camera-agnostic and can work with a wide range of cameras. The initial integration includes Bosch MIC 7000 and 9000 cameras, with all current customers of those cameras globally now able to utilise this software. In addition to compatibility with DroneShield’s DroneShieldComplete native GUI, DroneOptID can be used in third party Command and Control (C2) systems.</p> <p>In March 2021 DroneShield Ltd launched the DroneCannon MKIITM fixed site UAS/drone disruption device. According to the company the DroneCannon MKIITM is substantially lighter and more portable than the original DroneCannon, with increased durability and versatility made possible through advances in DroneShield’s proprietary waveform technologies, mechanical design and customised electronics.</p> <p>In June 2021 DroneShield released a second generation version of its optical Artificial Intelligence/Machine Learning based software DroneOptID 2.0.</p> |  |  |
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|   |  |                    | <p><b><u>Partnerships</u></b></p> <p>In April 2019 DroneShield and the Saudi Telecom Company's STC Specialized signed a Memorandum of Understanding for a strategic relationship for both parties, and that they will co-operate on sales opportunities in Saudi Arabia and the broader Middle East.</p> <p>Thales and DroneShield have a partnership through the Global Supply Chain (GSC) Program, with Thales having integrated DroneShield sensors into Thales military and aerospace broader systems.</p> <p>In May 2021 DroneShield announced a partnership with Zenith AeroTech, a developer of customised tethered aerial vehicles (TAVs). As part of the distribution agreement with DroneShield, Zenith AeroTech will incorporate DroneShield's DroneSentry-C2TM command-and-control ecosystem into its own family of TAVs, along with an Echodyne EchoFlight radar, to counter drone or drone swarm attacks.</p> <p>In March 2022, DroneShield and Teledyne FLIR announced a partnership.</p> <p>In April 2022 DroneShield announced an enhanced version of its Drone Sentry C2 Command-and-Control software, in partnership with location intelligence firm Nearmap.</p> <p>DroneShield has a partnership arrangement with Trakka Systems.</p> |     |   |
| <b>Dynamite Global Strategies (DGS)</b> | <b>AIRDEFENSE, DroneMaster DSR-3X, RF108, Drone Blaster, UrbanDynamite V6000T,</b> | Detector, ECM, gun | A new version of Dynamite Global Strategies (DGS) AIRDEFENSE C-UAS was released in September 2019 and features increased detection range and speed, and an expanded data base according to the company. AIRDEFENSE 6.0 is a modular system which provides a drone shield made up of a number of devices. This enables AIRDEFENSE to attack individual UAS, irrespective of the frequency band used by them during a counter-drone countermeasure. The system is calibrated and tested in the deployment environment, and is available for protection of fixed sites or mobile convoys.   | USA | <a href="https://usdgs.com/">https://usdgs.com/</a> |

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|  |  | <p>DroneMaster CUAS technology protects critical infrastructure, borders, correctional facilities, stadiums, ports, parades, concerts, government buildings, public spaces, sensitive sites and other permanent or temporary sites from any threats posed by drones. The DSR-3X (Drone Surveillance Radar) is the third generation of DGS high-resolution X-Band Drone Detection Radar, used for detection of low altitude moving targets over land or sea. This high-performance 3D radar sensor is specifically developed to address the requirements of the Homeland Security &amp; Defense markets and Air Traffic Regulation institutions in two key applications: counter small unmanned aerial vehicle (C-UAS) and unmanned aircraft traffic management (UTM).</p> <p>DroneMaster™ RF Drone Detection Sensor – RF108 is based on directional real-time measurement of the RF emissions of the drone and its remote control. It warns the operator when drones are in the vicinity. The detection range of RF108 system has no limitation, but it is usually comparable to (or better than) the maximum distance between the drone and its remote operator, depending on the transmitter power of the drone and/or its remote operator. The RF108 detects the RF emissions as soon as the emitting device is turned on, allowing to detect the drone even before it has taken off</p> <p>The DroneBlaster™ Anti-Drone Gun is activated, it transmits multi-bands RF and GNSS jamming signals to disrupt commercial drones’ control functions and causes no damage to drone hardware or surrounding environment.</p> <p>The UrbanDynamite® C-UAS leverages advanced C4ISR capability and lineage of multi-function electronic warfare (EW) architectural design to provide an efficient and effective CUAS solution for defeating current and emerging UAS controller technology. This, combined with its inherent life-saving effectiveness at countering radio controlled improvised explosive device (RCIEDs), provides operators and warfighters with a single-box solution that reduces the size, weight and power burden to a dismounted team, or tactical or non-tactical vehicle platform.</p> <p>The V6000T system adopts advanced multi-function electronic warfare (EW) capability providing the warfighters and VIP convoys with a single-box solution</p> |  |  |
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|                                    |  |                                    | <p>to counter the threats posed by drones and remote-controlled improvised explosive devices (RCIEDs).</p> <p>Drone swarms are a concern in the military domain. With its 360° gapless full dome jamming coverage, the V6000T system can defeat countless drones from up to 2km away simultaneously. A series of RF jamming waveforms in different combinations are used in the V6000T System for the maximum jamming efficiency against all known RCIED and drone threats when operating in a conventional or complex asymmetric threat environment.</p>  |     |   |
| <b>Dynetics – a Leidos company</b> | <b>GroundAware® GA9000/high energy laser/Enduring Shield</b> | Detector, missile, directed energy | <p>GroundAware® is a radar-based ground-based perimeter surveillance system. The GA 9000 series offers 3D radar capabilities for detecting, tracking, classifying, and responding to security threats posed by class 1 and 2 drones and other aircraft in low-altitude airspace, along with humans, animals, and vehicles on the ground. The GroundAware family of surveillance sensors can be integrated with a range of security systems, offers a layered security approach for deterrence and response, and monitors critical areas 24/7, in real-time, and in all-weather. It builds on the technology of the GA1360 and GA4120 models.</p> <p>In May 2019 Dynetics, along with its partners, was awarded a USD130 million contract to build and test the U.S. Army Space and Missile Defense Command/Army Forces Strategic Command’s (USASMDC/ARSTRAT) High Energy Laser Tactical Vehicle Demonstrator (HEL TVD) program, a 100-kilowatt class laser weapon system. Team members are Lockheed Martin, Rolls-Royce and MZA Associates. As the prime contractor, Dynetics will be responsible for final assembly and integration and testing of the system... Lockheed Martin (as the laser weapon system integrator, will provide the laser weapon subsystem, optimizing the performance of the laser module, power and cooling systems, and operator interfaces. Rolls-Royce Liberty Works will design the integrated power and thermal management system.</p> <p>Enduring Shield is a mobile ground-based weapon system designed to acquire, track, engage and defeat unmanned aircraft systems, cruise missiles, and rockets, artillery and mortars.</p> | USA | <a href="https://www.dynetics.com/">https://www.dynetics.com/</a> |

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|                  |                                     |                                | <p>Derived from Dynetics technology and modified around previous Army science and technology programs, the Enduring Shield solution has been bid to meet the Army's Indirect Fire Protection Capability Increment 2 program needs. In creating Enduring Shield, Dynetics redesigned the launcher, created cost efficiencies, reduced complexity and refined capabilities.</p> <p>Enduring Shield is capable of firing a range of missiles while, providing current and future growth capabilities. The system offers a 360-degree envelope with the ability to engage multiple targets simultaneously. It can be fully integrated with the Army's Integrated Air and Missile Defense Battle Command System, and offers both cyber resiliency and electronic warfare protections.</p>   |                      |   |
| <b>ECA Group</b> | <b>IT180 drone detection system</b> | Detector, intercept drone      | ECA Group and Groupe Gorgé subsidiary have developed a drone able to locate, identify and track offending operators and aircraft. It is based on the use of ECA Group's IT180 drone, including several transponders. After detecting the offending drone through land-based resources, the strategy consists of activating the IT180 drone: first, it will locate the operator using its on-board technology; second, it will approach and identify the operator using its cameras.  | France               | <a href="https://www.ecagroup.com/en/event/neutralization-malicious-drones-eca-group-innovating-and-validates-unique-technology-locate">https://www.ecagroup.com/en/event/neutralization-malicious-drones-eca-group-innovating-and-validates-unique-technology-locate</a> |
| <b>EDGE</b>      | <b>C-UAS system</b>                 | Detector, ECM, directed energy | <p><b>Partnerships</b></p> <p>In March 2021 UAE EDGE agreed a memorandum of understanding (MoU) with Israel Aerospace Industries (IAI) to develop an advanced C-UAS tailored to the UAE market, with wider ranging benefits for the MENA region and beyond. EDGE subsidiary, SIGN4L, a provider of electronic warfare services and solutions for national security, is collaborating with the Israeli defence manufacturer. According to a joint press release, the fully autonomous C-UAS comprises advanced 3D radar, communications intelligence (COMINT), and electro-optic technologies integrated into a unified command and control system. A series of countermeasures, ranging from soft-kill solutions such as spoofing and jamming, to hard-kill capabilities such as lasers and electromagnetic pulses, are offered based on the level of threat and targeted operating environment.</p> | United Arab Emirates | <a href="https://edgegroup.ae/">https://edgegroup.ae/</a>   |

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| <p><b>ELTA</b></p> <p>(See also IAI/ELTA)</p>      | <p><b>Drone Guard</b></p> | <p>Detector, ECM</p> | <p>ELTA Systems, a division and subsidiary of Israel Aerospace Industries (IAI), in November 2018 unveiled a new and enhanced configuration of its Drone Guard system which detects, identifies and disrupts the operation of UAS and small drones. The new modular configuration has added a Communication Intelligence (COMINT) system for more precise detection, classification and identification based on broadcast frequency and unique communication protocol analysis and verification for neutralizing threats, says the company. Furthermore, the Drone Guard’s 3D Radars, Electro-Optical (EO), and Jammer systems have all been upgraded with bolstered capabilities. The enhanced COMINT system “can effectively jam or disrupt the drone’s control channel and navigation, by supporting an array of communication protocols that can ‘fend off’ a single drone or even a swarm of drones from the guarded premises,” says ELTA.</p>  | <p>Israel</p> | <p><a href="http://www.iai.co.il/17887-en/Groups_ELTA.aspx">http://www.iai.co.il/17887-en/Groups_ELTA.aspx</a></p> |
| <p><b>Embry-Riddle Aeronautical University</b></p> | <p><b>Drone Net</b></p>   | <p>Detector, ECM</p> | <p>Embry-Riddle Aeronautical University is developing a drone detection network of passive rooftop sensors that capture electro-optical and infrared data (EO/IR) called “drone net”, which will be a cost effective alternative to radar, says the university. The system is aimed at small airports, university and corporate campuses, farms or other operations. “In the future, if the Drone Net’s all-sky camera and connected acoustic network detect a small unmanned aerial system (sUAS) without a flight plan, or off its flight plan, the technology will kick into gear,” says Embry-Riddle. “Specifically, the all-sky camera will cue an EO/IR camera to slew and track the sUAS with high-resolution visible and infrared imaging until the non-compliant sUAS leaves the area monitored by Drone Net – encompassing about 1 square kilometer.”</p> <p>Meanwhile in May 2019 the university announced a new C-UAS system that detects and commandeers unauthorized drones, guiding them to land safely, will be commercialized under a licensing agreement between Embry-Riddle Aeronautical University and Drone Defense Systems LLC of Daytona Beach, Fla.</p> <p>According to the university: “The technology, developed by Embry-Riddle faculty member Dr. Houbing Song, suggests a safe, affordable way to neutralize rogue drones – without having to shoot them down or force them to crash-land – even in civilian settings such as large outdoor entertainment arenas and airports. Under the newly inked licensing agreement, Drone Defense Systems LLC received exclusive rights to commercialize the technology, said Dr. Stephanie A. Miller, executive director of technology transfer for Embry-Riddle’s Research</p> | <p>USA</p>    | <p><a href="https://erau.edu/">https://erau.edu/</a></p>   |

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|                      |                |               | Park. In addition, company Founder and CEO Sotirios George Kaminis will work with Song and Embry-Riddle to further refine the concept, build a prototype, and pursue related products, Miller reported.   |        |   |
| <b>Elbit Systems</b> | <b>ReDrone</b> | Detector, ECM | <p>ReDrone is an advanced anti-drone protection system designed to detect, identify, track and neutralize different types of drones at a designated airspace. The system is capable of pinpointing both the drone and its operator's directions. The advanced detection system provides 360-degree perimeter protection and complete, up-to-the-minute situational awareness. It can also deal with several drones simultaneously. After detecting a target, the ReDrone system disrupts the drone's communication with its operator, blocks its radio and video signals and GPS positioning data, and sends it off track, preventing it from carrying out an attack.</p> <p>In September 2019 Elbit introduced a vehicular configuration of ReDrone. ReDrone Vehicular Tactical System detects, identifies and neutralizes all types of drones (at any radio frequency) within a radius of several kilometers, providing any vehicle with a 360 degrees protection shield against hostile drones. Suitable for on-the-move or stationary operations, in day and night and in all weather conditions, ReDrone Vehicular Tactical System is offered for all types of military and para-military vehicles.</p> <p>Rapidly deployable, ReDrone Vehicular Tactical System works automatically or manually, with no setup or operator control required for the entire process. Its open architecture enables a full data flow to the vehicular control system and an effective interface with command and control centers. With the detection of a hostile drone, the ReDrone Vehicular Tactical System neutralizes all communications between the drone and its operator, including radio, video and GPS signals. The system is also capable of separating a drone's signals from its operator's remote control signals in order to locate and track each of them separately.</p> | Israel | <a href="http://elbitsystems.com/pr-new/elbit-systems-reveals-redrone-advanced-anti-drone-protection-neutralization-system/">http://elbitsystems.com/pr-new/elbit-systems-reveals-redrone-advanced-anti-drone-protection-neutralization-system/</a> |
| <b>ELT Roma</b>      | <b>ADRIAN</b>  | Detector, ECM | <p>ADRIAN (Anti-Drone Interception Acquisition Neutralization) is a C-UAS solution designed to Intercept and Neutralize LSS (Low-Small-Slow) UAV in multiple scenarios and environments, including urban and dense-urban environment. ADRIAN is based on multispectral sensors (Radar, EO/IR, acoustic and radio link interceptor) performing data fusion for detection and identification. ADRIAN</p>  | Italy  | <a href="http://www.elt-roma.com/product/adrian">http://www.elt-roma.com/product/adrian</a>   |

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|   |   |               | architecture is modular and can be tailored depending on operational, environmental and cost/effectiveness requirements. ADRIAN reactive and smart jammer is capable to deny the remote control link of the platform and the navigation aids signals used to follow the programmed route through proper waypoints. Jamming techniques enhancing the effectiveness of soft kill disruption of hostile platforms maintaining full operational services of active friendly platforms.  |        |   |
| <b>ELTA Systems</b>                     | <b>Drone Guard</b>                                    | Detector, ECM | See IAI/Elta  | Israel | <a href="https://www.iai.co.il/p/eli-4030-drone-guard">https://www.iai.co.il/p/eli-4030-drone-guard</a>                           |
| <b>EMERCOM (Emergencies Ministry)</b>   | <b>Portable UAS suppression system</b>                | Detector, ECM | Russia's Emergencies Ministry in June 2019 demonstrated a portable C-UAS system during an international disaster response expo near Moscow. According to an 8 June 2019 report from the TASS news agency (translated from Russian): "The EMERCOM of Russia demonstrated the work of the portable UAS suppression complex at the manoeuvres at the Noginsk rescue center training ground, which prevents unauthorized use of drones in the emergency area."  | Russia | <a href="https://www.rt.com/russia/461389-new-antiuav-tech-russia/">https://www.rt.com/russia/461389-new-antiuav-tech-russia/</a> |
| <b>Enterprise Control Systems (ECS)</b> | <b>AUDS, BlackTalon, Independent Claw, BlackSwift</b> | Detector, ECM | <p><b>Partnerships</b></p> <p>ECS produces as range of jammers and is part of the all UK AUDS team - Blighter Surveillance Systems and Chess Dynamics</p> <p>TCI International and Enterprise Control Systems (ECS) have partnered to offer a new range of RF drone detection, location and countermeasure capabilities.</p> <ul style="list-style-type: none"> <li>BlackTALONTM. "The new platform provides RF-only drone detection, location and defeat capabilities, or the addition of radar and electro-optical sensors for more robust detection, tracking and target identification. In addition, any existing Blackbird COMINT system can be upgraded to perform full drone RF detection, location, identification, tracking and defeat."</li> <li>Independent Claw. This is "a self-contained directional inhibitor system that combines an RF transmitter with a high-gain, multi-band directional</li> </ul> | UK     | <a href="https://www.enterprisecontrol.co.uk/">https://www.enterprisecontrol.co.uk/</a>   |



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|               |                  |                         | <p>antenna system. Claw RF Inhibitor’s sensor-agnostic, modular design means it could not be easier for an integrator looking for an RF defeat solution to harmonize seamlessly with third-party, multisensory C2 drone detection and kinetic systems, to provide world-class RF inhibition capability for C-UAS.”</p> <ul style="list-style-type: none"> <li>BlackSWIFFTM: Next Generation Tactical COMINT Hardware Platform. Designed to operate the Blackbird COMINT and drone detection and geolocation software, the platform provides faster scan rates, broader instantaneous bandwidths, programmable DDCs and man-portable IP67 and rack-mount configurations.</li> </ul>  |           |   |
| <b>EOS</b>    | <b>Mopoke</b>    | Detector, ECM, guidance | <p>Using robust battle proven technology from sensor and defeat system providers, the Mopoke C-UAS capability can counter single drones within 8 seconds of detection out to a range of up to 10 km (6 miles). The Mopoke system is designed to not only defeat single drone threats but also swarm drone tactics recently observed in operational theatres across the Middle East. The Mopoke system detects the drone using state-of-the-art software defined, multi-mission, 4D AESA pulse Doppler radar. It tracks the threat using high precision infrared and daylight cameras and advanced video tracking software, before using a non-kinetic radio frequency (RF) inhibitor to defeat the drone. Should the RF inhibitor not be effective, Mopoke switches to hard kill to destroy the drone. Mopoke has been built upon field proven sub-systems to detect all types of drones including fixed wing and quadcopters up to 600kg or less (Group 3).</p>  | Australia | <a href="https://www.eos-aus.com/wp-content/uploads/2020/09/Mopoke-CUAS-Brochure.pdf">https://www.eos-aus.com/wp-content/uploads/2020/09/Mopoke-CUAS-Brochure.pdf</a> |
| <b>Epirus</b> | <b>EMP C-UAS</b> | ECM, directed energy    | <p>Epirus develops software-defined electromagnetic pulse (EMP) technology designed to take down dangerous drones. In September 2019 it won a new type of Small Business Innovation Research (SBIR) contract from the US Air Force’s Space and Missile Systems Center (SMC) as part of its AFWERX technology accelerator programme. According to a company press release: “Epirus was awarded the contract for its novel architecture that makes multi-beam phased array systems extremely affordable and scalable while greatly accelerating their development timeline and reducing development costs. That enables Air Force Special Operators and other satellite communication and phased array customers to be more lethal and survivable in any operational environment.</p> <p>Epirus developed a novel architecture for using commercial off-the-shelf field programmable gate arrays (FPGA), semiconductor devices commonly used in electronic circuits, as ultra-wideband radio frequency (RF) transceivers. It is, says the company, a significantly more resource-efficient approach than other FPGAs,</p> | USA       | <a href="https://www.epirusystems.com/pr-air-force-smc-contract">https://www.epirusystems.com/pr-air-force-smc-contract</a>   |

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|               |  |                   | <p>while being much cheaper and faster than ASIC-based transceivers. Using this new architecture, it becomes much faster and more affordable to develop RF systems for digital beamforming and channelizing, which has multiple uses in communications, electronic warfare and even radar.</p> <p><b>Partnerships</b></p> <p>General Dynamics Land Systems and Epirus have signed a strategic teaming agreement to collaborate to integrate the Epirus Leonidas directed energy system and broader high-power microwave technology into the U.S. Army's Stryker and other manned and autonomous ground combat vehicles for enhanced mobile Short Range Air Defense (SHORAD) capabilities.</p>   |       |  |
| <b>Ericco</b> | <p><b>Low slow moving targets defence system, low altitude and slow speed small targets defence system - fixed, low altitude and slow speed small targets defence system - vehicular, ER-1000 hand-held unmanned aerial vehicles to drive traps, anti-UAV electromagneti</b></p> | Detector, ECM,gun | <p>China's Ericco makes numerous counter-UAS systems. The ER-Low Slow Small Targets Defence System AUAV - Portable is a small hand held jammer, supporting multiple frequency interferences and covering the mainstream unmanned aerial vehicle spectrum. It is powered by lithium batteries. Transmitted power is adjustable with interference range between 800 ~ 1200 meters. The ER-Low-altitude And Slow-speed Small Targets Defence System AUAV-Fixed deals with security threats and unexpected small UAV incursions. The product can be deployed fixed site, unattended with auto-detection, auto-tracing, and auto-attack features. It detects sUAS by radio or radar automatic detection, with tracking and locking, then jamming the data-link or GPS positioning signal. The Interference distance is between 1000 ~ 1200 meters. The ER-Low Altitude Slow Small Target Defense System AUAV—Vehicular is a vehicle mounted version of the ER-Low-altitude And Slow-speed Small Targets Defence System AUAV-Fixed unit. The ER-1000 hand-held unmanned aerial vehicles to drive traps device consists of a hand-held host and a battery pack. The hand-held host for the three-band transmitter antenna comprises an integrated design and can simultaneously generate 2.4GHz / 5.8GHz band UAV flight control interference and satellite positioning interference signals. The ER-Anti-UAV Electromagnetic Interference Gun is a rifle equipped with UAV interference capabilities for GPS satellite positioning signals, remote control signals, image data link. It has a range of 1,500 metres</p> | China | <p><a href="http://www.ericcointernational.com/anti-uav-defence-system/low-altitude-slow-small-target-defense-system.html">http://www.ericcointernational.com/anti-uav-defence-system/low-altitude-slow-small-target-defense-system.html</a></p> |

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|                   | <b>c interference gun</b> |          |  |         |   |
| <b>FN Herstal</b> | deFNder®                  | Gun, ECM | <p>FN Herstal has announced that its deFNder® Family of Remote Weapon Stations was recently tested for countering UAS during the NATO Non-Lethal Technology Exercise (NNTEX-C) which took place between 4 to 24 March 2022 at the PISQ in Sardinia, Italy. FN Herstal developed a container-based perimeter defence solution incorporating a range of sensors (RF sensors and radars) with a combination of both soft and hard effectors. The overall system is operated by two operators protected inside the container.</p> <p>The setup includes:</p> <ul style="list-style-type: none"> <li>• Soft effector: As an escalation of force feature, the setup also includes a smart and scalable signal jammer that can be used as a first response against the UAV to disable the link between the drone and its operator before resorting to live-firing.</li> <li>• Hard effector: One deFNder® Light Remote Weapon Station, which can be fitted with the FN MINIMI® 5.56 or 7.62 or FN MAG® 7.62mm calibre; one deFNder® Medium, which can be fitted with the FN MAG® 7.62mm, .50 calibre weapons such as the FN® M2HB-QCB or FN® M3R, or a 40mm Automatic Grenade Launcher with airburst capacity.</li> </ul> <p>Once a target is detected, the operators have the capacity to select the threat to initiate the neutralization process. The overall system provides advanced functionalities to assist the operator in threat detection and engagement, including:</p> <ul style="list-style-type: none"> <li>• Target tracking based on multiple sensor feedback</li> <li>• Collateral damage mitigation with ready-to-fire indicators</li> <li>• Automatic detection through video stream (Day and InfraRed)</li> <li>• Improved fire control for air targeting</li> </ul> | Belgium | <a href="https://fnherstal.com/en/news/nato-ntex-c-uas-032022/">https://fnherstal.com/en/news/nato-ntex-c-uas-032022/</a> |

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| Fortem | Drone Hunter, SkyDome, F700 Patriot | Detector, Intercept drone | <p>Fortem DroneHunter™ is an unmanned counter-UAS aircraft engineered to autonomously fly toward unwanted drones in the sky—without a human pilot on the ground—and detect, track, classify, monitor via video stream, inspect, and safely capture the intruder drone. Fortem’s DroneHunter™ is claimed to be the world’s first counter-drone system that operates beyond line of sight (BLOS) using radar to protect a perimeter day and night from unwanted air threats.</p> <p>According to the company “Some of the technology was developed and hardened over several years on US Department of Defense applications and is now available for commercial use. Core technologies include TrueView Radar, machine learning, specialized guidance, secure data collection and services, robotics and aerospace design, and open command and control platforms for customers to detect, track, classify and mitigate unwanted drones. The open, secure ground station offers operational flexibility of multiple DroneHunters™.”</p> <p>In September 2018 Fortem Technologies announced the launch of Fortem Portable SkyDome, a counter-UAS technology that establishes a 360-degree view of a designated airspace and enables Fortem’s autonomous DroneHunter, to investigate specific areas and provide ground and airspace security with the ability to mitigate drone intrusions safely. “Portable SkyDome acts as a powerful force multiplier for keeping a designated perimeter and airspace secure,” said a company press release. “,</p> <p>Key benefits of Portable SkyDome are:</p> <ul style="list-style-type: none"> <li>• The system can be set up and torn down quickly at an event or venue and requires no radar or sensor expertise</li> <li>• Boundaries and zones can be created to send automated alerts, texts and emails when intruders enter a zone</li> <li>• Rules can be applied to automatically launch a DroneHunter for additional observation, surveillance, pursuit and capture</li> <li>• When a careless or clueless drone is identified by Portable SkyDome then DroneHunter can be activated to pursue and capture it and tow it away from populated and sensitive areas for safe disposal, regardless of their navigation capabilities</li> <li>• The stand-alone system can be installed and taken down in a few minutes.</li> </ul> | USA | <a href="http://www.fortemtech.com/dronehunter.html">http://www.fortemtech.com/dronehunter.html</a> |
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|  |  |  | <p>In June 2019 Fortem Technologies announced the launch of two new UAS products: SkyDome v. 2.4, an AI-enabled, API friendly platform that allows approved drones to fly safely and rogue drones to be mitigated; and the latest development to it C-UAS drone hunter range – the F700 Patriot.</p> <p>SkyDome System 3.7 adds longer range target validation and implementation of additional unique urban clutter suppression algorithms. This update enables the defeat of low flying targets at longer ranges in urban and other highly-cluttered environments.</p> <p>ThreatAware™ is Fortem’s AI analysis engine that assesses data from multiple sensors and sources in real-time, providing continuous threat levels for multiple objects in the environment. This tool identifies site-specific patterns-of-life and empowers security personnel to have total situational awareness, threat alerts, and to make informed integrated response decisions.</p> <p>The F700 features include:</p> <ul style="list-style-type: none"> <li>• Integrated, no-tangle, repackable parachute system for immediate and beyond-visual-line-of-sight (BVLOS) safe flight</li> <li>• Flip-up built-in hood for quick access to internal electronic components, aiding rapid development and maintenance</li> <li>• Quick-swap battery pack that reduces time between flights and simplifies battery maintenance</li> <li>• Configurable battery box placement for optimal balance with multiple payload configurations</li> <li>• Advanced body shell seal for optimal protection in all kinds of weather</li> <li>• Easy-lock rotor arms and retractable landing gear for simplified shipping and storage</li> <li>• Fast out-of-the-box assembly and set up</li> <li>• Lightweight construction, optimal rotor and motors, and multi-battery pack choices make long, aggressive flight times possible</li> </ul> <p><b><u>Partnerships</u></b></p> |  |  |
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|               |                          |                           | <p>In April 2019 Fortem Technologies and Unifly announced they will collaborate to develop a joint airspace safety and security solution for drone operations. According to a company press release: “This new end-to-end solution will allow UTM and U-space architectures to be used by public safety officers, military groups and other government agencies to secure airspace around critical infrastructure, airports, stadiums, public venues and more.”</p> <p>In August 2019 Fortem Technologies and Hewlett Packard Enterprise (HPE) signed an agreement designed to deliver an airspace management solution for public infrastructure, venues and cities requiring advanced security and data processing to protect against ground and airborne threats. The agreement includes customised drone solutions tailored to any drone platform to provide real-time awareness, security and data for analysis. The solutions combine Fortem’s SkyDome software and TrueView radar to detect, track, categorize and assess threats, with the HPE ProLiant DL20 Gen10 secure servers. The solution works in private secured networks or in protected cloud settings.</p> <p>In March 2021 Toshiba Infrastructure Systems &amp; Solutions invested USD15 million in Fortem Technologies to form a strategic business alliance. The two companies plan to integrate their complementary systems and expand sales around the world, says a joint press release.</p> |             |  |
| <b>Hanwha</b> | <b>C-UAS/Quantum Eye</b> | Detector, directed energy | <p>In March 2019 it was reported researchers were conducting integration tests on a prototype C-UAS radar which consists of a two-panelled radar system, each panel measuring 52 cm x 60 cm (20.5 in x 23.6 in) and designed to detect an apple-sized object at 3 kilometres (1.6 N mi) under a coverage radius of 200 degrees. The radar is designed to be interoperable with the company’s Quantum Eye electro-optic system. “Lee Yong-Wook, head of the Research and Development Department at Hanwha Systems, is quoted as saying that the product being developed is designed to be lightweight, transportable by two people, and less power-consumptive than a military system. Chosun Biz states that KRW12 billion (\$10.7 million) will be invested in the program by 2021, under the supervision of the Korean government’s Electronics and Telecommunications Research Institute (ETRI). The amount is not large, but if Hanwha Systems can be one of the first in the Pacific region to market a C-UAV system as a commercial</p>  | South Korea | <p><a href="https://dsm.forecastinternational.com">https://dsm.forecastinternational.com</a></p> <p>www.hanwha.com</p> |

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|   |  |                           | <p>product, the company may be able to recoup its own most likely significant development costs.”</p> <p>Korea’s Agency for Defense Development awarded a 24.3 billion won (USD21.8 million) contract to Hanwha Group in June 2021 to develop laser beam counter drone weapons. In addition to the hardware development by Hanwha Group, the Korea Atomic Energy Research Institute (KAERI) is also developing related software. KAERI is forming a consortium with 22 partners to co-develop the integrated anti-drone system.</p> <p>The 42 billion-won project will see the development of a total anti-drone system that can detect, identify, analyse, neutralize and investigate illegal drones by 2025.</p> <p>The program includes five public institutions including KAERI and the Korea Aerospace Research Institute and 18 private anti-drone companies including LIG Nex1.</p> |        |   |
| <b>Havelsan/Transvaro</b>                   | <b>Interceptor drone</b>   | Detector, intercept drone | <p><b>Partnerships</b></p> <p>Havelsan and Transvaro are looking to develop a system that can protect large campuses, critical facilities or infrastructures, organizations with scattered forces, like the gendarmerie, as well as critical locations like Ankara. According to a newspaper report, a Havelsan spokesperson said they are creating an entire system by adding different algorithms to the Havelsan systems and integrating different components like radar, electro-optical suites, mixing devices and RF (Radio Frequency) detectors.</p>  | Turkey | <a href="http://www.dailysabah.com">www.dailysabah.com</a>  |
| <b>Henan Zhaonan Information Technology</b> | <b>UAV radio detection system, jamming gun, early warning and control system</b> | Detector, ECM             | <p>The radio detection system rapidly scans and searches UAV remote control signals and undertakes parameter measurement and decoding analysis for these target signals. It can achieve real-time detection and early warning of UAVs and after detecting the invasive UAV, it can send out alarm signals to guide the UAV interference equipment and achieve the interference or interception of the invasive UAV, forcing the UAV to land or return.</p>   | China  | <a href="http://www.szrayopt.com/UAV-defense--system">http://www.szrayopt.com/UAV-defense--system</a> |

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| <b>Hensoldt</b> | <b>Xpeller, TRML-4D, Quadrome</b> | Detector, ECM | <p>Xpeller is able to protect sensitive areas against illicit intrusions of small drones, ranging from individual buildings through big events to airports and military camps. Xpeller uses radars, optical, RF and other sensors to detect and identify the drone and assess its threat potential at ranges from a few hundred meters up to several kilometers. Once the threat has been identified, a jammer interrupts the link between drone and pilot and/or its navigation. The modular system concept relies on the selection of individual devices from the Xpeller tool kit depending on customer requirements and local conditions, thus offering best value for money.</p> <p>At Eurosatory 2018 the company showed its newly developed TRML-4D radar system for ground-based air defence. The 3D multifunctional radar ensures rapid response detection and tracking of approximately 1,500 targets in a radius of up to 250 km and at an altitude of up to 30 km. TRML-4D uses AESA radar technology (AESA = Active Electronically Scanned Array), which enables the acquisition of targets after just one rotation of the antenna, thus improving the response time and hit probability even in a complex environment with a high target density and involving highly agile and asymmetric threats. Thanks to the precise coordination of all the antenna elements in the C band (NATO G band) and special signal processing modes, the radar can provide extremely exact information on the targets. An integrated secondary radar system for identifying friend or foe (IFF) prevents friendly fire. The high performance of the radar is largely due to the great number of transmit / receive (T/R) modules in the antenna, which are made from special RF-capable materials.</p> <p>In late 2021 Hensoldt announced it was developing new AI-based decision-making processes for military operations as part of the “GhostPlay” project. This is intended to support military action at the tactical level at the highest operational speed using a synthetic simulation environment.</p> | Germany | <a href="https://www.hensoldt.net/solutions/air/electronic-warfare/xpeller-counter-uav-system/">https://www.hensoldt.net/solutions/air/electronic-warfare/xpeller-counter-uav-system/</a> |



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|             |             |               | <p>The subject of the research will be, among other things, the extent to which military operations and decisions can be accelerated by AI and what opportunities and risks arise from this. This will include an examination of how AI-based decision support can support the sensor-effector network of a swarm of unmanned systems in complex missions to suppress enemy air defences (SEAD) and how the interaction of the individual components of a defence system can be optimised. At the same time, the ethical aspects that need to be taken into account will be investigated.</p> <p>The innovative technology project, conducted in cooperation with Helmut Schmidt University, Hamburg, will run until the end of 2024 and is funded by the Centre for Digitisation and Technology Research of the Bundeswehr (DTEC.Bw).</p> <p>In September 2021 HENSOLDT introduced its 'Quadome' radar system for naval surveillance and target acquisition at the show. The dual-mode, multi-mission surveillance radar features fast detection and tracking of small, slow and fast targets offers a reliable and stable air picture, with fast track initiation to support longer effector keep-out range. The new-generation radar features the latest gallium nitride (GaN)-based active electronically steered antenna (AESA) technology and is software-defined.</p> <p>Quadome features two main operational modes to simplify operator interaction and to reduce operator workload. Surveillance mode is used for general surface and air surveillance while the self-defence mode is employed for high-threat situations and target engagement, with helicopter support continuously available in either mode.</p> |        |   |
| <b>Herz</b> | <b>Hawk</b> | Detector, ECM | <p>Hawk is an advanced security system designed to protect sensitive infrastructure areas and people. It combines detection, alerting, monitoring and neutralization of unmanned aerial vehicles (UAVs). The system ensures undisputed security. The system comprises a number of elements – fixed and mobile radars, cameras, control station and “drone” neutraliser.</p>   | Poland | <a href="http://thehawkssystem.com/">http://thehawkssystem.com/</a> |

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| IAI/ELTA | <b>Drone Guard, Scorpion</b> | Detector, ECM, intercept drone | <p>To detect low signature, low-level and low-speed airborne targets, ELTA has adapted to this specific mission its 3D radars, which include the ELM-2026D, ELM-2026B and ELM-2026BF for short (10km), medium (15km) and long (20 km) ranges, respectively, with special drone detection and tracking algorithms, as well as adapting them with EO sensors for visual identification of the target. In order to disrupt the hostile UAV, ELTA has developed advanced adaptive jamming systems which can be used in concert with its detection and identification sensors, or as a continuously operated stand-alone system. The jamming disrupts the drone's flight and can either cause it to return to its point-of-origin ('Return Home' function) or to shut down and make a crash landing. Drone Guard systems have been extensively and successfully tested against a variety of different drones and scenarios, including simultaneous multiple drone penetrations or attacks.</p> <p>In July 2020 IAI and Iron Drone entered into a collaboration agreement for the integration of interception capabilities into IAI's Drone Guard anti-drone system. The intercepting drone can be launched during day or night from a docking station that hosts several ready-to-use drones. Several intercepting drones can be launched simultaneously to address several targets or swarms.</p> <p>According to the IAI press release, the radar integrated with Drone Guard is capable of detecting drones as they enter the airspace. The intercepting drone is launched and steered to the target with the help of the radar. It uses sensors and computer vision to home and lock on the target up to the physical hit of the attacker and its neutralization. The entire process is autonomous, requiring no human intervention. The solution can be used in areas where other defense systems cannot because of environmental factors like airports, populated areas, power plants, sensitive facilities, and other infrastructures.</p> <p>In November 2021 IAI unveiled an electronic warfare (EW) system capable of simultaneously targeting multiple threats, across frequencies and in different directions, according to a company press release.</p> <p>The Scorpion family of Electronic Warfare (EW) systems is based on Active Electronically Scanned Array (AESA) technology. With AESA's multi-beam capability, Scorpion can simultaneously scan the entire surrounding region for</p> | Israel | <a href="http://www.iai.co.il/2013/32981-46509-en/MediaRoom.aspx">http://www.iai.co.il/2013/32981-46509-en/MediaRoom.aspx</a> |
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|     |           |               | <p>targets, and deploy narrowly focused beams to interfere with multiple threats across the electromagnetic spectrum. The system is able to target a range of threats, including: UAVs, ships, missiles, communication links, low probability of interception (LPOI) radars, and more. Scorpius effectively disrupts the operation of their electromagnetic systems, including radar and electronic sensors, navigation, and data communications.</p> <p>Scorpius' receiver sensitivity and transmission power (ERP) can detect multiple threats, of different kinds, simultaneously, from increased distances compared with legacy EW systems, and address each threat with a customized response. Scorpius is available across multiple domains.</p> <p>The Scorpius G is a ground-based EW system designed to detect and disrupt ground- and airborne threats. Scorpius-G is a mobile system, and can be quickly deployed by vehicle. Scorpius G creates an electronic dome of protection above a wide geographic sector to neutralize a broad range of modern threats. Scorpius SJ is a standoff jammer designed to disrupt enemy aerial and ground-based electromagnetic operations.</p> <p><b><u>Partnerships</u></b></p> <p>In March 2021 UAE's EDGE agreed a memorandum of understanding (MoU) with Israel Aerospace Industries (IAI) to develop an advanced C-UAS tailored to the UAE market</p> |        |   |
| IMI | Red Sky 2 | Detector, ECM | <p>The system is designed to detect, disrupt and neutralize UAVs engaged in potentially malicious activity or hostile airborne surveillance missions, stopping them from infiltrating sensitive location such as stadiums, airports, secured compounds, military bases and etc., or in order to protect a V.I.P against armful attack carried out by those systems. It combines aerial radar detection, electro optical thermal acquisition and a high powered directional RF neutralization abilities with supreme range of 3-5km of detection and neutralization. The system can be supplied either as an active system or reactive system that operates only after triggering an alarm when unfamiliar object reaches to the aerial security zone</p>  | Israel | <a href="http://www.imisystems.com/whatwedocant/firepower-precision/land-firepower-precision/air-defense/#main-form">http://www.imisystems.com/whatwedocant/firepower-precision/land-firepower-precision/air-defense/#main-form</a> |

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| <b>Indra Sistemas</b> | <b>ARMS (Anti RPAS Multisensor System) family</b> | Detector, ECM        | The ARMS family from Indra is a field proven solution for the protection of any kind of infrastructures from the threats posed by drones. The system has been designed to cope with the smallest targets (<0,01 sqm RCS) and is able to detect single intruders or swarm strategies. Its multi-sensor technology (radar, EOS, RF analysis, RDF, Jamming/Spoofing) combined with an easy-to-use, rule-engine based C4ISR core, provides a modular, scalable solution that can be tailored to the particular needs of any infrastructure. ARMS entry level is “an affordable, self-packaged solution suitable for small areas or single buildings. The family grows up to multi-site deployments where multi-sensor data fusion provides a unique situational awareness picture that can be integrated into existing C4I systems. Drone neutralization is done through time, frequency, space, and power selective Jamming/Spoofing, to defeat the threat with minimum interference in the surrounding RF systems. | Spain | <a href="https://www.indracompany.com/en/security">https://www.indracompany.com/en/security</a>   |
| <b>IXI Technology</b> | <b>Drone Killer</b>                               | ECM, directed energy | According to IXI: “Current counter-UAS system technology includes radio frequency (RF) command and control (C2) disruption systems...and directed energy weapons. These systems protect forward operating bases, airports, and other strategic high-asset facilities. These systems are large and stationary; they cannot be used by a mobile user. In addition, UAS threats are more prevalent at the front lines, at small checkpoints and outposts, and remote areas where convoys, dismounted warfighters, and security personnel on missions away from well-established air control assets....The Drone Killer adds counter-UAS capabilities to mobile forces that cannot use large systems that add weight and require added power sources. The Drone Killer is compact and light-weight, able to be deployed from inside light vehicles or by dismounted warfighters in mobile units, strike teams, checkpoints.”   | USA   | <a href="http://ixitech.com/products/drone-killer/">http://ixitech.com/products/drone-killer/</a> |

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| <b>JCPX</b>            | <b>UWAS</b>                      | Detector, ECM | <p>UWAS is a complete solution designed to detect, identify, track, and neutralize drones. Developed in collaboration with DSNA Services, the system comprises a radar, night and day cameras and a counters measures. The system provides a solution for defence of strategic targets covering a radius of up to 5 km. The UWAS System is an end-to-end system designed to provide effective airspace defence against hostile drones (Micro and Nano UAVs) used by terrorists to perform aerial attacks, collect intelligence, and other intimidating activities. First, the threat is detected and identified. The data is combined and correlated and alerts the operator of the hostile UAV. When the threat reaches the neutralization area, the hostile drone is neutralized by activation of several counter measures. The system is coming with an easy user friendly interface, no specific training required, no specialised operators needed. UWAS has 360° circular coverage and is designed to detect, track, and neutralize drones classified as threats flying in No-Fly zones. UWAS has a very fast response time, it causes minimal collateral interruptions to the surrounding urban environment, with maximum safety to friendly aircraft. The UWAS System is operational under all weather conditions, 24 hours a day.</p>                              | Monaco  | <a href="http://jcp-development.com/">http://jcp-development.com/</a>   |
| <b>KB Radar Design</b> | <b>Groza-R/ Groza-S/ Groza-Z</b> | ECM, detector | <p>The Groza range of radio communications jammers for military use are designed for search, detection and jamming of VHF/UHF fixed-frequency, adaptive and programmable frequency-hopping radio communication links. Groza-R is a counter multicopter electronic gun designed for prevention of small-sized UAVs within visibility range trespassing the territory of protected facilities. It jams UAV control channels and on-board hardware of GPS, GLONASS, Galileo and BeiDou satellite systems. The gun is equipped with a collimator sight. Groza-S is a counter-UAV electronic warfare station mounted to an all-terrain Ford Transit vehicle comprising two masts for SIGINT and jamming hardware, life support system and autonomous power supply. Designed for detection, direction-finding of UAV and UAV ground control post; downlink and uplink jamming of GPS, GLONASS, GALILEO, BeiDou on-board satellite navigation system equipment; and spoofing GPS on-board satellite navigation system equipment.</p> <p>Groza—Z: This complex offers facility protection against mass-production civilian multicopters of DJI Phantom 2, 3, 4; Inspire; Mavic; Matrice; Walkera Voyager 3, etc. type. KB Radar says it ensures detection zone with radius not less than 500-1000 m from the centre of the protected facility, multicopter flight blocking zone</p> | Belarus | <a href="http://www.kbradar.by/en/products/radiolokatsiya/">http://www.kbradar.by/en/products/radiolokatsiya/</a> |

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|               |                            |               | with radius not less than 300-500 m; detection and direction-finding of radiated Ground Control Post (operator's location).   |     |   |
| <b>Liteye</b> | <b>AUDS/T-AUDS, SHIELD</b> | Detector, ECM | <p>The AUDS Technology Team brings together three UK companies each with the unique capabilities required to create AUDS. The Blighter Surveillance Systems Blighter A400 series Air Security radar is able to detect small UAVs in all weather conditions 24 hours a day. The Chess Dynamics EO/IR camera system, with state-of-the-art video tracking technology, is able to track the UAV and, combined with radar target information, classify the target. The operator is then able to make a timely and informed decision to use the Enterprise Control Systems Ltd, ECS, smart RF inhibitor to selectively interfere with the C2 channels on the UAV allowing the system to disrupt the UAV's mission. AUDS is a second-generation system that detects, tracks, identifies, and defeats UAS threats. The AUDS system utilizes state-of-the-art radar, precision thermal and daylight cameras, advanced video tracking, and non-kinetic defeat capabilities. AUDS is a TRL-9 level system, and is in full production.</p> <p>The US version of the AUDS system first deployed with the US Army in late 2016. Liteye is now deploying and supporting their AUDS, M-AUDS, M-AUDS-KE, and C-AUDS variants of their C-UAS system.</p> <p>In March 2021 Liteye launched a multi-mission, multi-domain C-UAS system called Liteye SHIELD.</p> <p>According to a press release, Liteye SHIELD incorporates Artificial Intelligence (AI) and Machine Learning techniques with a newly designed SPYGLASS 3D radar, EO and IR tracking to increase the speed and confidence of the system. The SHIELD Command and Control further ensures the full Detect, Track, ID Kill Chain is automated and conducted at machine speed. .</p> <p>The system is designed to detect, track, identification and classification allowing an operator to monitor the environment, manage multiple systems. Key components include: Spyglass 3D Radar for Detect &amp; Track, AI based RF Detect, AI Target Prioritization, and Automated Video Track.</p> | USA | <a href="http://liteye.com/counter-uas.html">http://liteye.com/counter-uas.html</a> |

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|  |  | <p>SHIELD utilizes a Man-ON-the-Loop local C2, and is networked, requiring low manpower to operate any system from any console with a distributed common operation picture. The local C2 provides multi-sensor resource management &amp; Sensor Fusion to an intuitive operating system with Machine Learning principles and 3D targeting for cueing networked effectors. It is designed to operate across air, ground, surface, and Radio Frequency (RF) spectrum.</p> <p><b><u>Partnerships</u></b></p> <p>In October 2018 OpenWorks Engineering Ltd and Liteye Systems Inc announced they formed an exclusive partnership to support military, law enforcement and security authorities with their counter-UAS missions; The two companies are joining forces to offer an integrated low-collateral-damage C-UAS defeat layer to Liteye’s counter unmanned systems offerings.</p> <p>Liteye and Numerica are cooperating on C-UAS radar systems</p> <p>In early 2020 Liteye Systems signed a strategic alliance agreement with UK manufacturer Chess Dynamics to market a portfolio of Chess products and services in the US. Products include an array of layered technologies designed to address force protection and surveillance.</p> <p>In March 2020 Liteye Systems announced a partnership with Citadel Defense to enhance their counter drone solutions.</p> <p>In August 2020 Liteye announced the launch of a Trailer Anti-UAS Defense System (T-AUDS) which the manufacturer describes as an on-the-move and fixed-site C-UAS solution. According to the Liteye press release, T-AUDS is a multi-domain awareness and protection package, capable of detecting and defeating RF controlled and silent flight drones while mobile, then transiting from on-the-move to static in less than two minutes, with full capabilities being brought to bear in defense of a location. Liteye has integrated AUDS and Citadel’s Titan 3 radio frequency detection into the T-AUDS for enhanced detection, identification, and defeat methods across the full C-UAS mission. T-AUDS provides an on-the-move and static C-UAS capability that includes physical</p> |  |  |
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|                        |                      |                                  | <p>stand-off when necessary and minimizes vulnerabilities during strategic mission sets.</p> <p>In September 2021 the US Air Force awarded Liteye, together with Huntington Ingles Industries, a multiple-year contract worth USD7 million to support C-UAS deployed in Europe and Africa.</p> <p>In October 2021 the US Army awarded a USD5.5 million multiple-year contract to SAIC and Liteye Systems to integrate the company's SHIELD C-UAS payload in the US Army (RCCTO) High Energy Laser (HEL) prototype effort.</p> <p>In early 2022 Liteye Systems announced a collaboration with Pratt &amp; Miller to develop C-UAS capability on the EMAV unmanned ground vehicle.</p>  |     |   |
| <b>Lockheed Martin</b> | <b>Icarus/Falcon</b> | Detector, ECM                    | <p>Built from internal investments, the ICARUS™ system can identify and intercept commercially available drones. Its multi-spectral sensor system detects and characterizes incoming drones within seconds, before using cyber electromagnetic activity to disable it or allowing the operator to take control of the drone and move it to a safe area.</p> <p>In February 2019, Lockheed Martin, Diehl Defence and Saab announced an agreement to develop the Falcon™ air defense weapon system. According to a Lockheed Martin press release, Falcon integrates Diehl's 40-kilometer range Infra-Red Imaging System Tail/Thrust Vector-Controlled (IRIS-T) SLM interceptor and vertical launcher, Saab's 360-degree AESA Giraffe 4A radar through Lockheed Martin's flexible SkyKeeper command and control battle manager. Falcon's open architecture allows the system to easily integrate into any air operations centre.</p> | USA | <a href="http://lockheedmartin.com/us/innovations/061416-webt-laser-swarms-drones.html">http://lockheedmartin.com/us/innovations/061416-webt-laser-swarms-drones.html</a> |
| <b>Lockheed Martin</b> | <b>MORFIUS</b>       | Intercept drone, directed energy | <p>Lockheed Martin presented its MORFIUS armed drone at the at AUSA Global Force Next Conference, 16-18 March 2021. MORFIUS uses a High-Powered Microwave (HPM) designed to counter drone swarms in a future-proof response to an evolving threat. It a reusable drone that can fit inside a six-inch diameter launch tube and weighs less than 30 pounds, light and versatile enough to attach to ground stations, ground vehicles, or aircraft. Working as part of a layered approach to counter-drone defense, MORFIUS units will be launched at hostile</p>   | USA | <a href="http://www.lockheedmartin.com">www.lockheedmartin.com</a>  |



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|               |  |                  | drones, or drone swarms, and then disable them in close proximity, with potentially a gigawatt of microwave power.  |               |  |
| <b>Marduk</b> | <b>Shark</b>                                   | Detector,<br>ECM | <p>Shark is currently understood to encompass a network of systems providing a wide-area defensive capability, with an electro-optical system cued to a target following the initial detection by another sensor, following which it is tracked by Shark and ultimately engaged by laser effectors – initially up to 10 kW – to temporarily or permanently ‘blind’ the optronics payload of a UAV.</p> <p><b>Partnerships</b></p> <p>Milrem Robotics and Marduk Technologies have jointly launched a mobile autonomous C-UAS platform designed to offer protection against loitering munition and surveillance drones, according to a press release.</p> <p>The jointly developed system features the electro-optical C-UAS platform Marduk Shark and the THeMIS unmanned ground vehicle (UGV). This mobile solution provides frontline forces with an independent ability to accurately detect, classify and target loitering munition and other flying objects. It uses advanced Artificial Intelligence and Machine Learning models.</p> | Estonia       | <a href="http://marduk.ee/">http://marduk.ee/</a>              |
| <b>Martek</b> | <b>M.A.D.S.<br/>(Marine Anti-Drone System)</b> | Detector,<br>ECM | <p>Martek CUAS has developed the M.A.D.S™ Martek Anti-Drone System. M.A.D.S™ detects and identifies commercial drones within a 5+km range, providing GPS positioning of both drone and pilot together with the drone’s speed and heading. Configurable and escalating stage alarms in real time allow the threat level to be assessed in good time to decide on appropriate defence actions. Once a real drone threat has been established, the system enables a 500m+ electronic ‘exclusion zone’ to be created. Should the drone approach this exclusion zone, its control/video signal will be blocked, initiating its fail-safe mode forcing it to land or return to its operator.</p>  | UK            | <a href="https://martekcuas.com/">https://martekcuas.com/</a>  |
| <b>MBDA</b>   | <b>Licorne</b>                                 | Detector,<br>ECM | <p>At Eurosatory 2018 MBDA demonstrated its Licorne C2 lightweight and mobile air defence command and control system now with integrated anti-drone capabilities. In the concept system on display, MBDA had reportedly integrated HGH’s Infrared tracking camera; a Sagem electro-optical camera and a Konsortium Engineering Activities System’s (KEAS’s) UAS jammer.</p>   | International | <a href="http://www.mbda-systems.com">www.mbda-systems.com</a> |

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| <b>MC-TECH</b>          | <b>MC-Horizon D360BP</b>               | Detector, ECM | The MC-HORIZON D360BP is described as a reactive system that can identify drones, acquire the targets, and neutralize them automatically from far distances. The system is designed to protect soldiers, including forces on the move, by preventing enemy UAVs from gathering intelligence or bombarding them. The system is reactive, fully automatic, and capable of detecting, acquiring, and neutralizing single targets or drone swarms within a 2km radius, according to MCTECH.  | Israel      | <a href="http://www.mctech-jammers.com">www.mctech-jammers.com</a>                        |
| <b>Meritis</b>          | <b>Integrated drone defence system</b> | Detector, ECM | Meritis Integrated Drone Defence systems are designed to cover the tactical approach drone detection, identification and disruption sector. All products are designed to be modularly integrated depending on customer requirements. Detection and identification systems are based on the SR-9000S drone detection radar, the ADS-2000 acoustic drone detection system and the SC-1000T/SC-1500T camera systems. The jammer units are the RTX-300P2/P6 portable units, the RTX-2000 M6 mobile units and the RTX-3000X stationary units. Integration products include the SWC2U command and control dashboard, the MC3 mobile command and control Cube unit and the SkyCleaner drone gun   | Switzerland | <a href="http://www.meritis.ch/DroneDefEN.html">http://www.meritis.ch/DroneDefEN.html</a> |
| <b>Meteksan Defence</b> | <b>KAPAN, SEYMEN</b>                   | Detector, ECM | <p>Meteksan Defence's KAPAN Anti-Drone system offers precise drone detection and tracking performance with a combination of radar, electro-optic systems and an RF jammer. The full KAPAN system comprises:</p> <ul style="list-style-type: none"> <li>• Retinar FAR-AD Radar</li> <li>• Electro-Optic System</li> <li>• RF Jammer</li> <li>• Command and Control System</li> </ul> <p>The Retinar FAR Anti Drone Radar System (Retinar FAR-AD<sup>®</sup>) is a perimeter surveillance radar, developed to detect mini/micro UAV threats. Retinar FAR-AD<sup>®</sup> provides effective protection against low and high-altitude mini/micro UAVs, with its 40o elevation angle. This radar can detect drones up to 9km according to RCS of Drones.</p> <p>The Electro-Optic System of KAPAN uses MWIR or LWIR thermal cameras and HD day/night cameras on a pan tilt together. These camera systems can be cued on detected targets' coordinate values, which are provided by Retinar FAR-AD<sup>®</sup>.</p> <p>The RF Jammer of KAPAN is a directional jammer providing protection for military bases, residential areas and airports. As the sector of jamming is limited to threat area, other zones of protected area are not affected by jamming. The</p> | Turkey      | <a href="http://www.meteksan.com">www.meteksan.com</a>                                    |

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|            |                                      |               | <p>current RF Jammer of the KAPAN system can jam frequencies between 433 to 5900MHz.</p> <p>In late 2021 the Turkish Presidency of Defence Industries signed an agreement with Meteksan Defense to develop a new electronic warfare (EW) system that can detect and combat rogue drone threats as well as manned aircraft, helicopters and missiles. The system will be able to apply methods of electronic attack to the GPS and command and control (C2) systems used in many land, air and sea platforms.</p> <p>Meteksan's SEYMEN system will be used to jam or deceive a variety of threats, keeping friendly forces safe from harm. It will be composed of radar, electro-optic and electronic warfare elements integrated together on a military tactical vehicle.</p> <p>SEYMEN will be able to jam and deceive navigational systems, including targets in multiple directions simultaneously and targets that use different types of GPS. It will also be able to record and analyse GPS signals, and link multiple systems together to perform co-ordinated tasks.</p> |  |  |
| <b>MSI</b> | <b>Seahawk, electro-optic system</b> | Detector, gun | <p>The MSI-DS SEAHAWK DS A2 gun system couples the MSI-DS SEAHAWK gun mounting to a state-of-the-art electro optical gunfire control system.</p> <p>An off mount Electro Optical Director maximises accuracy whilst providing enhanced 360° situational awareness. The advanced gun fire control system features both video auto tracker and a continuous lead angle predictor.</p>  |  |  |

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| <b>My Defence</b> | <b>Watchdog,<br/>Wolfpack,<br/>Wingman,<br/>Pitbull, KNOX</b> | Detector,<br>ECM | <p>MyDefence products detect and counter commercially available drones (LSS – Low, Slow, Small), by integrating sensors and deterrents. The information is passed through the meshed network and display alerts in any command and control (C2) system (i.e. ATAK) MyDefence “Watchdog” networked sensor offers long range detection for i.e. perimeter protection and the “Wolfpack” is a 360 degree directional detection sensor for point defence and rapid deployment protection. The WINGMAN is a small handheld (wearable) drone detector. The WINGMAN works as a stand-alone product, and can optionally interface with other radios for information relay. The WINGMAN is claimed to be the smallest UAS detector on the market. The PITBULL is the intelligent response to the LSS (Low, Slow, Small) drone as it is an automated response to the threat. Through the intelligent server solution IRIS, the company has developed a system which detect and counter commercially available drones, by integrating sensors and deterrents from MyDefence and others. It display alerts on the graphical user interface and is able to integrate in to any system architecture. The KNOX alarm sounds when an unknown drone is detected in the area of interest. Additionally, KNOX is able to detect and identify drones and protect the area by disturbing the device communication at the precise wireless frequency of the drone without interfering with other mobile signals.</p> <p>In late 2018 MyDefence announced the launch of its drone swarm jamming capability, demonstrated at Electric Storm. During the event, five drone operators attempted to execute a coordinated drone attack. The coordinated attack was effectively neutralized using the MyDefence PITBULL Counter UAS jammer, and all drone operators lost control of their drones, says the company. The device is wearable and weighs only 775 grams. Used in conjunction with the WINGMAN drone detector, the PITBULL can automatically jam drone signals, when a drone is detected, says MyDefence. This reduces the cognitive load of the operator, allowing the soldier to focus on the mission, without worrying about enemy drones.</p> <p>Product features</p> <ul style="list-style-type: none"> <li>• Wearable Counter UAS jammer</li> <li>• Ultra-light form factor with a weight of only 775 grams (w/o battery)</li> <li>• Up to 20 hours standby battery time and 2 hours of continuous jamming</li> <li>• Both automated and manual jamming modes</li> </ul> | Denmark | <a href="http://www.counter-uav.org/counter-uav-solutions.html">http://www.counter-uav.org/counter-uav-solutions.html</a> |
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|            |                           |               | <ul style="list-style-type: none"> <li>• Jamming range of 1,000 meters<sup>1</sup></li> <li>• Average power output is 2W</li> <li>• Software is programmable</li> </ul> <p>In February 2019 MyDefence announced a new version of its KNOX C-UAS system, aimed at protecting large scale civil and military areas against the threat of drones.</p> <p>According to the company: “It is a customizable end-to-end anti-drone solution with purpose-built RF sensors, drone radars, and integrated EO/IR for visual tracking. KNOX is now available for commercial use at airports, prisons, critical infrastructure as well as for military use for base security. The KNOX anti-drone solution fortifies an area against unauthorized drone flights, providing both passive detection and active defeat solutions to neutralize any small drones in the secured airspace. The anti-drone system includes RF sensors to detect and ultimately defeat drone threats. For military customers, we supply reactive smart jamming effectors – a next generation jamming technology with the least possible impact on other radio communication. Other sensor technology includes purpose-built drone radars that track the location of drones as well as integrated EO/IR for visual tracking in real-time. The combination of sensor technologies complements each other to provide the best possible protection against unauthorized drones.”</p> |        |   |
| <b>NSO</b> | <b>Eclipse/NSO Shield</b> | Detector, ECM | <p>Eclipse is a cyber counter-drone platform designed to automatically detect, take over and safely land unauthorized commercial drones in a designated zone. Eclipse deploys an autonomous end-to-end cyber solution to detect activity within a designated perimeter, identify the presence of drones, take over control of drones which present a threat, and land them safely.</p> <p>Eclipse is part of the NSO Shield suite of products. The system offers a threat mitigation capability for dense urban environments, stadiums, critical infrastructure, airports, landmarks, and private enterprises, with smooth integration connecting to existing infrastructure. Eclipse operates automatically according to pre-defined parameters, removing the requirement for real-time decision making. Furthermore, Eclipse is designed not to jam existing communications platforms, with no impact on wireless communications and GPS</p>  | Israel | <a href="https://www.nsoagro.com/News/nso-group-launches-drone-defense-system-eclipse/">https://www.nsoagro.com/News/nso-group-launches-drone-defense-system-eclipse/</a> |

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|                              |  |                   | signals. According to the company it is the only drone defence system that is FCC, CE and CB compliant.  |    |   |
| <b>OpenWorks Engineering</b> | <b>Skywall 100, Skywall 300, SkyAI</b> | Capture, detector | <p>SkyWall offers those exposed to the drone threat the ability to physically capture an aircraft and control its descent to the ground. The SkyWall system is a combination of a compressed gas powered smart launcher and an intelligent programmable projectile. The first system being released is SkyWall100; a man-portable handheld launcher that is highly mobile and a cost effective way of dealing with the drone threat. In September 2017 OpenWorks launched SkyWall300, an updated version of the SkyWall100 hand-held drone capturing system. SkyWall300 is an automatic version with an air powered system that launches the same range of net capture projectiles used with the SkyWall100 handheld system. It integrates with external drone detection and command and control systems to allow for maximum ease of use. It automatically tracks any drone prior to giving the remote operator the ability to command the system to capture the target.</p> <p>In May 2021 Openworks has added a low-cost camera to its SkyAI optical classification and tracking technology. SkyAI “takes a standard Axis camera and adds Artificial Intelligence detection, tracking and motion control to provide robust performance that has been proven on small drones at over 1km with an Axis Q6215. SkyAI can also be trained to detect and track other targets over land, sea or air.”</p> <p><b><u>Partnerships</u></b></p> <p>The SkyWall Patrol Net-Capture and HP47 handheld-jamming systems have been used together by leading specialist law enforcement across Europe since 2016. OpenWorks and HP has combined forces to show a new track-defeat concept at the NATO Technical Interoperability Exercise, in VreDePeel Airbase in the Netherlands in 2021. The HP47 system is attached to a quick-release mount on the SkyTrack positioner. Operators can position the SkyTrack-HP47 system in a fixed location for a temporary protective scenario, such as a roof top. The system can be operated remotely, with the operator receiving high-quality video of the tracked target and on-command precise jamming. The handheld jammer</p> | UK | <a href="https://openworksengineering.com/skywall">https://openworksengineering.com/skywall</a> |

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|  |  |  | <p>can be quickly disconnected when required and continue the mission in a handheld operation, while the SkyTrack system continues to provide overwatch.</p> <p>In October 2018 OpenWorks Engineering Ltd and Liteye Systems Inc announced they formed an exclusive partnership to support military, law enforcement and security authorities with their counter-UAS missions; The two companies are joining forces to offer an integrated low-collateral-damage C-UAS defeat layer to Liteye's counter unmanned systems offerings.</p> <p>In September 2019 OpenWorks Engineering and SteelRock Technologies launched an integrated vehicle mounted counter-drone system, combining radio-frequency (RF) disruption with a physical net to provide a layered defence against unmanned aerial vehicles. Similar to a typical commercial vehicle, the drone defeat system is hidden under rapidly deployable covers to remain discreet when not in use. When a drone threat has been detected, the vehicle can be manoeuvred to defeat the target drone using either SteelRock's NightFighter RF-based effector technology or the SkyWall net capture system. OpenWorks launched the handheld capture system SkyWall100 in 2016 and has since delivered systems to law enforcement and military customers around the world. The NightFighter C-UAV system from SteelRock was introduced at DSEI 2017, and is currently deployed in military, law enforcement and civil protection roles in multiple jurisdictions.</p> <p>OpenWorks partners with ESG Elektroniksystem und Logistik GmbH, lead integrator of the GUARDION C-UAS system. OpenWorks engineers have turned the Axis Q6215-LE into an autonomous system that is easy to integrate and can provide many of the high-cost military capabilities at low-cost.</p> <p>In late 2021 Rohde &amp; Schwarz and OpenWorks collaborated to prove a new high performance and autonomous 3D detection and tracking system for use in C-UAS missions. Integrated through the new SAPIENT standard protocol and tested at the NATO Technical Interoperability Exercise (TIE) event in De Peel Airbase in the Netherlands, the solution combines the R&amp;S ARDRONIS drone detection solution with the recently released SkyAI Autonomous Optical technology.</p> |  |  |
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| <b>Orbital ATK</b>                         | <b>T-REX</b>   | Detector,<br>gun     | <p>Orbital ATK exhibited its Tactical-Robotic Exterminator (T-REX) at DSEI 2017 in London, an integrated version of the Liteye/AUDS UAS detection and identification system mounted on board a Stryker vehicle combined with 30mm cannon.</p> <p>The full suite of systems includes a Blighter A400 Series Air Security Radar; Hawkeye DS and Electro-Optical Video Tracker; Directional RF Inhibitor, giving the T-REX, operator the choice of non-lethal, or lethal UAS disruption capabilities. T-REX also features the Orbital ATK's XM914 Chain Gun with advanced ammunition to defeat Class 1 and 2 UAS.</p>  | USA     | <a href="https://www.orbitalatk.com/">https://www.orbitalatk.com/</a>   |
| <b>Orelia</b>                              | <b>Drone Detector</b>  | Detector,<br>ECM     | <p>The Drone Detector from the Orelia/Squarehead Technologies consortium uses acoustic detection to detect electrical drones, including those without radio frequency links (when on auto-pilot) and that are invisible to radar. It can create a sensing barrier via a network of sensors to protect perimeters from unwanted drones. All monitors are plug-and-play and are centrally controlled on a single management platform. Detected unwanted drones can then be stopped by firing a jammer, as each sensor can be used as a jammer/spoof controller. Applications include cyber intrusions, personal property and infrastructure such as prisons.</p>  | France  | <a href="http://www.drone-detector.com/en/protect-your-business-against-drone-cyber-intrusion/">http://www.drone-detector.com/en/protect-your-business-against-drone-cyber-intrusion/</a> |
| <b>Prime Consulting &amp; Technologies</b> | <b>GROK Jammer/ GROK Mobile Gun/ Mini-range Counter UAV System/ Small-range Counter-UAV System</b> | ECM,gun<br>,detector | <p>Prime Technologies' counter-UAV products can be used separately or as part of complex integrated anti-UAV defence systems. The Grok Mobile Gun is an easily transportable anti-drone rifle that is easy to set up and it helps to neutralise threats within seconds. Drones can be tracked at up to several kilometres' distances. When the UAV is located, the rifle and its mounted directional antennas with horizontal and vertical polarisation are pointed towards the approaching drone and immediately block it. The gun provides autonomous operation for up to 1 hour of continuous jamming. It jams all standard drone remote control frequencies and GSNS signals applied by UAVs. Applications include infrastructure security as well as military security and homeland protection.</p> <p>For continuous jamming at long distances, the company offers the GROK Drone Jammer (GROK J). UAVs including micro-drones can be detected and defeated at distances from 100m to several kilometres. The system blocks remote control radio frequencies and frequency bands of GSNS. Radio frequency jamming can</p> | Denmark | <a href="https://dronemajor.net/about-us">https://dronemajor.net/about-us</a>   |



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|                 |                   |               | <p>be activated automatically upon UAV detection or manually. Frequency band coverage and output power can be adapted on customer request. Additional Pan-Tilt platform with antennas (interfaced with the camera or radar) available. Applications include government installations, industrial plants, airports, military bases, prisons, and protection against espionage attack.</p> <p>The company also offers mini- and small-range counter UAV solutions. Mini-range systems provide drone detection at distances of up to 200 m and are used for security of small installations or when drones have to be detected at relatively short distances. System components: Infrared and Video Surveillance Systems, Grok Visual Command Center.</p> <p>Small-range systems give protection from 200 m to 1 kilometre and are used for protection of private and business facilities. Small-range components: Perimeter Surveillance Radars, Infrared and Video Surveillance Systems, Acoustic Sensors, Grok Mobile Gun. Optional: GROK Drone Detection Radar, RF Detectors, Video Acquisition and Distribution.</p> |         |   |
| <b>PROXIMUS</b> | <b>Bukovel AD</b> | Detector, ECM | <p>Bukovel AD is a system aimed at early detection of approaching enemy's UAVs and full blocking of data and GPS/GLONASS control channels. The key element of this solution is a ground station comprised of Detection and Control modules. In addition to GPS and GLONASS control channels jamming the system also generates a series of false management signals significantly increasing overall performance. Bukovel AD effective range reaches 10-15 kilometres</p>   | Ukraine | <a href="https://proximus.com.ua/">https://proximus.com.ua/</a>   |
| <b>Raytheon</b> | <b>Phalanx</b>    | Detector, ECM | <p>A self-contained package, the Phalanx weapon system automatically carries out functions usually performed by multiple systems: search, detection, threat evaluation, tracking, engagement and kill assessment. The Block 1B version of the system adds control stations that allow operators to visually track and identify targets before engagement. The 1B variant's configuration augments the Phalanx system's proven anti-air warfare capability by adding a forward looking infrared sensor. It allows the system to be used against helicopters and high-speed surface craft at sea while the land-based version helps identify and confirm incoming dangers.</p>   | USA     | <a href="http://www.raytheon.co.uk/capabilities/products/phalanx/">http://www.raytheon.co.uk/capabilities/products/phalanx/</a> |

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|                                |   |                                     | In June 2019 Raytheon and Black Sage announced they are partnering through a formal teaming arrangement to provide an integrated drone detection and mitigation system for civil authorities, critical infrastructure and military organizations around the world.   |         |   |
| <b>Raytheon</b>                | <b>Coyote, KRFS radars</b>  | Detector, intercept drone           | <p>The U.S. Army will use Raytheon Company’s Coyote® unmanned aircraft system and the KRFS radar (Ku band radio frequency system) to counter the escalating threat of enemy unmanned aerial vehicles in the skies above the battlefield. Equipped with an advanced seeker and warhead, the Coyote-enabled system can successfully identify and eliminate threat UAVs when paired with an advanced electronically scanned array KRFS radar, which acquires and accurately tracks all sizes of UAS threats. Coyote is small, expendable and tube-launched. It can be deployed from the ground, air or a ship. Coyotes can be flown individually or netted together in swarms, and they are adaptable for a variety of missions including surveillance, electronic warfare and strike.</p> <p>“Enemy unmanned aircraft are among the biggest threats facing our ground troops today,” said Dr. Thomas Bussing, Raytheon Advanced Missile Systems vice president. “Our small, expendable Coyote provides the Army with an affordable and highly effective solution for countering the growing UAS threat.” In addition to Department of Defense missions, Coyote is also used by the National Oceanic and Atmospheric Administration for hurricane tracking and modelling.</p> | USA     | <a href="http://www.raytheon.com">www.raytheon.com</a>  |
| <b>Rheinmetall Air Defence</b> | <b>Radshield, FIRST, MSP600, UMIT, MEES, Skymaster, C2 software, remote tower, RF-Jammer, HPEM, HEL, Skyranger, Boxer</b> | Detector, ECM, directed energy, gun | <p>Rheinmetall Air Defence offers a modular toolbox which contains a possible solution for all budget sizes to counter this rising threat. In the “sense” domain the company offers:</p> <ul style="list-style-type: none"> <li>• The Oerlikon Radshield® Drone Detection System for multi sensor air space control. The system is optimized to reliably detect low, slow and small objects (multicopters, RC aircraft, balls, balloons, model air ships) and to discriminate them from false targets such as birds. Even a person attempting to trespass a fence can be detected by the system. Objects that are thrown over the fence of a protected asset are also detected, the flight path calculated and shown in the command and control center by triggering an alarm.</li> <li>• The FIRST, an infra-red search and track sensor which ensures permanent reconnaissance of the surrounding area.</li> <li>• The MSP600, a stabilized platform with thermal- and TV cameras, laser range finder and video tracking.</li> </ul>   | Germany | <a href="https://www.rheinmetall-defence.com/en/rheinmetall_defence/systems_and_products/air_defence_systems/drohnenabwehr_toolbox/index.php">https://www.rheinmetall-defence.com/en/rheinmetall_defence/systems_and_products/air_defence_systems/drohnenabwehr_toolbox/index.php</a> |

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|  |  |  | <ul style="list-style-type: none"> <li>• The Universal Multispectral Information and Tracking (UMIT), a mission approved system for air space surveillance. It utilizes different sensors and can detect small drones.</li> <li>• The Mobile Eagle Eye System (MEES), a mission approved air space and ground surveillance system. It combines the two operational components FIRST and MSP 600 and features its own mobile command post.</li> <li>• In the “decide” domain the company offers:</li> <li>• The Oerlikon Skymaster® Command &amp; Control System</li> <li>• Rheinmetall C2 Software which enhances the decision making process by filtering, correlating and processing data from all sensors, providing the operator with one comprehensive and common operating picture. Features such as automatic threat detection, sensor slewing and target tracking have also proven to be key enablers for quick reactions and optimum decision making to counter the threat.</li> <li>• The Remote Tower, an air traffic control centre for airfields in remote locations.</li> </ul> <p>In the “act” domain the company offers:</p> <ul style="list-style-type: none"> <li>• The RF-Jammer, a multichannel, programmable high frequency emitter. The frequencies, antennas and performance can be adjusted to the specific threat environment in order to suppress all common communication frequencies used by drones or even mobile communications. The signal strength of the emitter allows interoperability with existing transmission systems and is therefore ideal for public and governmental frequency regulation.</li> <li>• The High Power Electromagnetics (HPEM) is based on a highly repetitive, semiconductor based impulse generator with a transmitting power in the GW-band. The extremely short pulse durations are emitted through a broad band antenna. This impulse causes drones to abruptly lose control and crash.</li> <li>• The High Energy Laser (HEL) is able to focus the power output of one or several laser modules on one spot on the target, burning its way through the electronic parts and other components and causes the drone to lose control and crash.</li> </ul> |  |  |
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|  |  |  | <p>At 2018 Eurosatory Rheinmetall presented its new Oerlikon Skyranger Boxer air defence system. “It can shoot down incoming rockets as well as mortar rounds – but also unmanned aerial systems, including the low, slow and small kind, e.g. quadrocopter drones; it is also highly effective against low-flying aircraft,” according to the company. “The heart of the new Oerlikon Skyranger Boxer is the air defence module, equipped with an Oerlikon Revolver Gun Mk3 turret. The system features an integrated sensor unit with X-band tracking radar and electro-optical sensors as well as electronic warfare components. This enables swift, autonomous engagement of externally assigned targets. The Skyranger can receive and process target data from both 2D and 3D search radars. Furthermore, the integrated search sensor technology and Oerlikon Skymaster battle management system give the Skyranger an autonomous sector-monitoring and target engagement capability.”</p> <p>In February 2019 DFS and Rheinmetall tested an integration together with the Bundeswehr, Germany’s armed forces. Air traffic data were exchanged with advanced radar systems, with acoustic and infrared sensors, and with optical equipment to detect a potentially threatening drone. A catch-and-carry drone threw a net over the disruptive drone and took it to the ground.</p> <p>In March 2021 Rheinmetall Defence upgraded its mobile ground-based air defence system, the Skyranger 30, according to European Defence Review. The company introduced a concept demonstrator which follows the path of the Skyranger 35 and is built around the company’s 35 mm Oerlikon Revolver Gun. The new unit is a lighter solution, 2-2.5 tonnes versus 4-4.5 tonnes, with a new remotely controlled turret that can be fitted onto bigger armoured vehicles as well as on tracked vehicles considerably extending the number of potential platforms. The idea is to provide army units with a mobile system capable to engage fixed wing, rotary wing, Group I and II unmanned air systems, and cruise missiles, exploiting the combination of a medium calibre gun system using airburst munitions and SHORAD missiles.</p> <p>In early 2022 Rheinmetall has announced more details of its Skyranger 30 HEL a hybrid solution designed to thwart the full range of future airborne threats.</p> |  |  |
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|                            |                           |               | <p>“Here, the interplay of a 30mm automatic cannon, guided missiles, and a high-energy laser (HEL) results in a mix of effectors unique in this combination,” said a company press release. “Teamed with a matching sensor mix, the Skyranger 30 HEL can monitor airspace autonomously, while simultaneously selecting the optimum effector in response to emerging threats. The Skyranger 30 HEL can protect mobile units on the march or critical stationary infrastructure and facilities from aerial threats.”</p>  |         |   |
| <b>Rohde &amp; Schwarz</b> | <b>Guardion, ARDRONIS</b> | Detector, ECM | <p>The GUARDION drone defence system combines the scalable solutions customized to very specific customer requirements to reliably detect and defend against threats posed by the unauthorized use of drones. GUARDION is offered as an integrated product. GUARDION focuses on integrating electronic detection, verification and countermeasures and connecting them to a position mapping and command and control tool.</p> <p>The ARDRONIS C-UAS provides drone control uplink signal detection and disrupting capabilities, even under challenging signal scenarios. Modular and scalable, R&amp;S ARDRONIS can be deployed on a variety of platforms and readily integrated to suit specific threat profiles, with numerous systems operational with government users. According to the company: “R&amp;S ARDRONIS effectively detects and disrupts a UAS control uplink signal at a very early point. It monitors remote control uplink and drone downlink signals (in all relevant frequency bands) and can detect and locate those at an approx. range of up to 5-7 km under optimal conditions.”</p> <p><b><u>Partnerships</u></b></p> <p>In late 2021 Rohde &amp; Schwarz and OpenWorks collaborated to prove a new high performance and autonomous 3D detection and tracking system for use in C-UAS missions. Integrated through the new SAPIENT standard protocol and tested at the NATO Technical Interoperability Exercise (TIE) event in De Peel Airbase in the Netherlands, the solution combines the R&amp;S ARDRONIS drone detection solution with the recently released SkyAI Autonomous Optical technology.</p> | Germany | <a href="https://www.rohde-schwarz.com/uk/home_48230.html">https://www.rohde-schwarz.com/uk/home_48230.html</a> |

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|   |                     |               | <p>With its partners ESG and Diehl Defence, Rohde &amp; Schwarz offers a modular multisensor UAS detection and defence system called GUARDION that includes the R&amp;S ARDRONIS sensors and countermeasures.</p> <p>The HPEM C-UAS networked system from Diehl Defence, R&amp;S® ARDRONIS from Rohde &amp; Schwarz and the TARANIS® command and control and position mapping system developed by ESG have proven their capabilities in operational use.</p>  |        |  |
| <p><b>Rostec</b><br/><b>Avtomatika/Rostec</b><br/><b>Ruselectronic</b></p> <p><b>(see also below)</b></p> | <b>Sapsan-Bekas</b> | Detector, ECM | <p>In July 2019 Avtomatika Concern (part of Rostec) presented the Sapsan-Bekas mobile system for detecting and disabling UAVs at the International Military-Technical Forum ARMY-2019, according to the company. The system can detect a UAV at a distance of 10 km, track its movement and disable it at a distance of over 6 km by suppressing communications and control of the UAV. Sapsan-Bekas is capable of countering UAVs both in manual and automatic modes in a wide frequency range – from 400 MHz to 6 GHz. The system is highly maneuverable since it is installed on an automobile chassis – this is a key requirement for various security agencies. According to a news report the UAV radio suppression subsystem used in Sapsan-Bekas is called Luch (Russian: ray, beam), which was also presented for the first time at ARMY-2019. It affects the drone’s channels of navigation, control and transmission of information, simultaneously blocking eleven frequency bands. The system works on the “friend or foe” principle and does not affect UAVs whose information is entered into the system’s database in advance. The subsystem can also work autonomously outside the system configuration due to a separate control panel.</p> <p>In October 2019 Rostec subsidiary Ruselectronic launched a new radar capable of detecting small UAS. Operating in Ka bandwidth, the multi-channel radar is designed to detect small-sized drones at a distance up to 7.5 km. It comprises a small unit, equal to 325 x 240 x 230 mm mounted on a rotary device to provide visibility in all directions. The company is field-testing the first production units and is marketing the equipment to civilian and military customers.</p> | Russia | <p><a href="https://defenceweb.co.za/office/rostec/PressRelease.php?StoryID=92163">https://defenceweb.co.za/office/rostec/PressRelease.php?StoryID=92163</a></p> |

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| <b>Rosoboronexport</b> | <b>Integrated C-UAS capability</b> | Detect, ECM, missiles, gun | Rosoboronexport in February 2021 announced the development of an all-Russian integrated C-UAS capability. The Repellent-Patrol EW system developed and manufactured by JSC Defense Systems provides zone coverage of the territories. The Repellent-Patrol is a long-range system capable of jamming drones at a range of up to 20 km. The Kupol and Rubezh-Avtomatika systems developed by Avtomatika Concern, part of Rostec State Corporation, carry out continuous radio surveillance and create a protective dome over the installation. This is an impenetrable barrier capable of repelling attacks not only by single drones, but also their massive use from different directions and altitudes within a radius of at least 3 km. The Pishchal electromagnetic gun is one of the lightest handheld jammers on the market, weighing a mere about 3.5 kg. It can jam UAV control/navigation channels at a range of 2 km. These systems are capable of effectively engaging a variety of air attack weapons, including UAVs. The Pantsir-S1M SPAAGM has missile and gun armament and destroys air targets at up to 30 km in range and up to 18 km in altitude. The Tor-M2E's engagement envelope against air targets is 15 km in range and 10 km in altitude. The 'last-ditch' air defense will be best provided by the Verba or Igla-S MANPADS, as well as the Gibka-S MANPADS squad combat vehicles, capable of firing Verba or Igla-S MANPADS. These MANPADS can destroy targets at a maximum range of 6 km and at a maximum altitude of 3.5 km. | Russia | <a href="http://roe.ru/eng/">http://roe.ru/eng/</a>           |
| <b>SafeSky</b>         | <b>Counter UAV system</b>          | Detector, ECM              | The company develops and builds field-deployed mobile counter-drone systems aimed at detecting, identifying, tracking and intercepting commercial drones outfitted to attack military personnel. In July 2017 the US Navy Special Warfare Command signed a USD1.5 million deal for a CUAV from the company.   | USA    | <a href="https://www.skysafe.io/">https://www.skysafe.io/</a> |

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| <b>Sensofusion</b>               | <b>AIRFENCE</b> | Detector,<br>ECM | <p>AIRFENCE has been designed with over three years of military testing with real world tactical scenarios. At its core, it can automatically detect, locate, track and take over UAV controls all on full auto. In addition, AIRFENCE can locate the operator with pin point accuracy in real time.</p> <p>How it works:</p> <ul style="list-style-type: none"> <li>• RF Detection - Software defined radios that can detect UAVs</li> <li>• High Range of Detection - 6 mile (10km) range with a single AIRFENCE unit</li> <li>• Alarm System - Custom configuration to enable early warning and critical warning notifications in real time</li> <li>• Easy to Scale - Scale horizontally by simply adding more units</li> <li>• Triangulation - AIRFENCE uses triangulation as an additional method to detect UAVs</li> <li>• Manual or Automated Response - AIRFENCE can be preprogrammed to run on full auto, or can be configured to “take action” manually</li> <li>• Mobile Notifications - Configure AIRFENCE to send mobile push notifications when UAVs are detected</li> <li>• Over-the-Air Updates - Real time software updates allow the system to continuously adapt to evolving threats</li> <li>• MAPS-AIRFENCE is capable of showing the real time location of the detected UAV’s on a map. Sensofusion maps can be configured for offline access.</li> </ul> <p>In September 2018 Sensofusion launched AIRFENCE 6.0, which can now target individual UAS’, regardless of what frequency band they hop to when counter-attacking.</p> | Finland | <a href="https://www.sensofusion.com/">https://www.sensofusion.com/</a>   |
| <b>Sierra Nevada Corporation</b> | <b>SkyCAP</b>   | Detector,<br>ECM | <p>SkyCap counter UAS is described as a viable and effective solution for lightweight dismounted on-the-move tactical vehicle platforms and fixed-site infrastructure protection. SkyCap is a multifunction variant of SNC’s operationally deployed Modular Advanced Electric Warfare system (AEWS-M). SkyCap is said to provide superior UAS identification and radio frequency defeat performance.</p> <p>“Performance of the SkyCAP dismounted system has demonstrated its immediate readiness and relevance to the Joint Force for dismounted and expeditionary CUAS protection,” the company says. Integrated with “industry-leading” tactical radar detection and electro-optical infrared (EO/IR) sensors.</p>  | USA     | <a href="https://www.sncorp.com/press-releases/snc-counter-uas-showcased/">https://www.sncorp.com/press-releases/snc-counter-uas-showcased/</a> |



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| <b>Skycope</b> | <b>Anti-Drone system</b> | Detector, ECM | <p>Skycope technology can safely and effectively detect, identify, locate and neutralize rogue drones to prevent them from posing security threats in unauthorized areas. Applying the state-of-the-art artificial-intelligence (AI), RF spectrum sensing and signal processing technologies, Skycope provides an advanced anti-drone solution to protect people and property against threats posed by drones or UAVs.</p> <p>Based on high performance omni-directional/directional antennas and high efficiency RF chain, this module performs wide-band RF spectrum sensing and processing. Using cutting-edge signal processing techniques, the library module efficiently extracts the useful information from the wide-band signals received by the RF module. It applies multi-level signal processing and filtration to detect any narrow band, point-to-point communication and frequency hopping drones and decodes their underlying protocols comprehensively. Based on embedded deep learning algorithms, the RF AI module is capable of self-learning and identifying private UAV communication protocols. By careful analysis, advanced level processing and transformation of the received information, the AI module assists in detecting any drone not covered by the library module. This post-processing module makes smart decisions that allows full automation and unattended operation, zero false alarms and zero interference, etc and can differentiate between known-authorized and unauthorized drones, and force the unauthorized drones to hover outside the service area or just return to the owner safely - by cutting off the signal chains and triggering a fail-safe mechanism. Integrates detection, identification, direction finding and defense into one unit, Skycope C-UAV system operators can perform selective drone jamming or initiate wide spectrum jamming.</p> <p>The Anti-Drone system solution to is offered in a Stationary, Vehicle Mounter or Portable System to protect people and property.</p> | Canada | <a href="https://www.skycope.com/">https://www.skycope.com/</a> |
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| <b>Skylock</b> | <b>Anti-drone active and passive systems, DroneLock</b> | Detector, ECM, intercept drone | <p>SKYLOCK provides early detection, long range protection of up to 20km of large objects or 3.5km and neutralization of unauthorized drones up to 2.5km. The company's integrated systems provide the option of passive, selective and active solutions for multiple applications and have already been deployed in several countries. The suite of systems comprises:</p> <ul style="list-style-type: none"> <li>• A radar system. The outer layer of protection is provided by a rotating radar that detects all drones flying in proximity to the defined no-flight zone. The lightweight, portable radar system defines the range, azimuth, elevation and velocity measurements for up to 200 targets simultaneously, including miniature UAV's characterized by a small signature with a low speed and altitude.</li> <li>• EO/IR tracker. The electromechanical modular electro-optical system provides day and night observation, detection, recognition and identification of the drone up to 2.5km depending on the weather conditions and target. The system's EO/IR trackers thermal imaging and daytime camera provides the control room with a precise location and clear images of the drone.</li> <li>• The RF jammer. This comprises of several jamming antennas- a standard configuration of 3-5 antennas and 2-4 antennas are used to jam the frequency range of the RC and video links which are mounted on the EO system gimbal and aligned with the EO sensors line of sight. The operator is able to neutralize the drone, forcing it away, or grounding the drone at its current location. It is especially useful for urban surroundings, where radar line of sight may be blocked by obstacles. The RF jammer has "on the move" mode. <ul style="list-style-type: none"> <li>• The D360 reactive detection system This is triggered by the RF's continuous aerial scanning of most common civilian drone's remote controls. Effective coverage of detection up to 2km, 360°</li> <li>• Laser burner. The operator has the ability to destroy the drone using the systems high powered, accurate laser beam that activates a burner system, effectively destroying the drone within a matter of seconds at range of up to 800m.</li> <li>• Optical tracking. The drone tracker system is based on high end image processing algorithm, the tracker is combined with long range camera systems. The tracker is also used as video encoder with embedded video stabilization capabilities.</li> <li>• Drone gun. A heavy jammer gun for security teams and first responders to use during fluid, ambiguous, fast- paced encounters. The system allows security teams and law enforcement to</li> </ul> </li> </ul> | Israel | <a href="https://www.skylock1.com/">https://www.skylock1.com/</a> |
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|  |  |  | <p>efficiently deal with a drone approaching a Forward Operating Base, hovering over a large crowd, snooping into secure/private areas, or flying in restricted airspace. With the Drone Gun the operator has the tools to intercept the drone command link and command the drone to descend or go home.</p> <p>At the 2018 Eurosatory event Skylock launched its three-in-one anti-drone system that can neutralize a drone from 800m. The first layer is a radar which has a reported detection range of up to 20km for large objects, 10km for medium-sized drones and 5.3 km for small UASs. The second layer includes a thermal camera and tracker. The third layer is a suite of anti-drone systems including a radio frequency jamming system or, for close-in operations, a laser with a 800m range.</p> <p>In early 2021 SkyLock reported it had developed a hard kill system against swarms of drones. According to Asaf Lebovitz, VP of sales, the DroneLock system can work with or without radar. If a radar is used to detect incoming drones the coordinates are transferred to a network of small killer drones that are launched in preprogrammed numbers – between one and 20. Each SkyLock killer drone weighs 960 grams and can operate at a maximum range of 4km and an altitude of 4km.</p> <p>The cruise speed of the killer drone is 150-200km/h. Each unit is equipped with an optical 4K sensor that can work in day and low light conditions. According to the company, the sensor can detect a drone from a range of up to 400 meters.</p> <p>In early 2022 the company launched Sky-Inteceptor, based on five patent pending technologies that enable detection, tracking and kinetic mitigation of small UAVs using a high persistence countermeasure cloud, according to the manufacturer. Sky-Interceptor is designed to improve the ability to defeat small, incoming UAV threats, under all conditions, by disabling their propulsion system. Skylock says the system is safe to operate in urban environments, enables greater range and has no collateral damage. It is effective against evasive manoeuvres and swarms, provides simplified logistics, and is lower cost than conventional kinetic or electronic warfare approaches.</p> |  |  |
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|                |                |                  | <p><b><u>Partnerships</u></b></p> <p>Skylock Anti-Drone Systems has formed a strategic partnership with Mexican security technology company GBSolution to offer ant-drone solutions to government agencies as well as private initiatives in Mexico. The two companies will collaborate to provide counter drone solutions for civil and military applications throughout the country.</p>  |     |   |
| <b>SkySafe</b> | <b>Skysafe</b> | Detector,<br>ECM | <p>The company develops and builds field-deployed mobile counter-drone systems aimed at detecting, identifying, tracking and intercepting commercial drones outfitted to attack military personnel. SkySafe provides military, public safety, and commercial customers with comprehensive airspace awareness and control. Offering fixed, mobile, and temporary drone defence solutions, the company provides the tools to safely and effectively operate authorised drones while protecting against threats. Rogue drones are disabled using radio frequency technology. In some cases, it can force the drone to automatically return to its take-off point, by reverse- engineering the communications and telemetry links that are unique to each model of drone, according to <i>CNN Business</i>.</p> | USA | <a href="https://www.skysafe.io/">https://www.skysafe.io/</a> |

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| <b>SRC</b>                   | <b>Silent Archer</b>  | Detector, ECM | <p>SRC's Silent Archer C-UAS technology is comprised of TRL 8/9 radar and electronic warfare (EW) systems, camera and a 3-D user display to defeat hostile drones, whether a lone target or a UAS swarm. Combined, these systems provide spatial, frequency and optical surveillance capabilities to detect, track, classify and identify the airborne threat. Once the UAS threat is identified, various low-cost, low-risk electronic methods are utilized to disrupt the UAS, such as jamming the communications links between the operator and the aircraft. The Silent Archer technologies work together to provide a complete, end-to-end counter-UAS solution for applications such as:</p> <ul style="list-style-type: none"> <li>• Force protection in contested environments</li> <li>• Critical infrastructure protection</li> <li>• Security for VIPs and high profile events</li> <li>• Urban environment surveillance</li> </ul> <p>SRC has successfully demonstrated the ability for Silent Archer anti-drone technology to detect, track, identify and defeat UAS at U.S. government-sponsored counter-UAS test events like JIAMD's Black Dart, the Army Warfighting Assessment (AWA), Network Integration Evaluation (NIE), and Maneuvers and Fires Integrated Exercise (MFIEX).</p> <p>An open architecture and sensor-agnostic design of Silent Archer technologies support a variety of optional systems and functionality, such as:</p> <ul style="list-style-type: none"> <li>• Direction finding unit (Provides line-of-bearing information to the UAS and their operators)</li> <li>• Wireless networking (For communicating between systems and command and control (C2) centres)</li> </ul> | USA | <a href="https://www.srcinc.com/what-we-do/counter-uas/">https://www.srcinc.com/what-we-do/counter-uas/</a>                                 |
| <b>Synergia</b>              | <b>dronesafeguard</b> | Detector, ECM | <p>dronesafeguard is a mix of layered C-UAV solutions that seek to interdict intruder drones as far out as possible from the caility, asset or person being protected. This is "protection in depth" and it relies on progressively interleaved C-UAV systems and sub systems to: detect, track, respond and then defeat the drone risk threat before physical, asset. syber or reputational damage is inflicted. Developed with Chenega International.</p>   | UK  | <a href="http://synergia.biz/">http://synergia.biz/</a>   |
| <b>Teledyne FLIR Defense</b> | <b>LVSS/ADA</b>       | Detector, ECM | <p>Teledyne FLIR Defense, part of Teledyne Technologies Incorporated, in March 2022 announced the launch of a Lightweight Vehicle Surveillance System (LVSS) with new air domain awareness (ADA) and advanced counter-unmanned aerial system (C-UAS) capabilities. "The LVSS ADA C-UAS is an enhanced addition to Teledyne FLIR's field-proven LVSS platform that features reliable, rapidly</p>  | USA | <a href="https://www.flir.com/products/lvss-c-uas/?vertical=integrated-">https://www.flir.com/products/lvss-c-uas/?vertical=integrated-</a> |

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|                              |  |               | <p>deployable, cutting-edge technology to detect and mitigate the growing threat of small drones,” says a company press release. “The new system leverages a powerful combination of 3D radar, EO/IR camera, and RF detection and mitigation sensors to provide early warning alerts and recognition. Threats are detected and displayed simultaneously, showing position and elevation for all radar tracks.</p> <p>“LVSS ADA C-UAS also can detect drone swarms by allowing operators to monitor up to 500 radar targets simultaneously. A multi-spectral imager captures key UAS elements that help identify high risk targets for a pinpointed response.”</p> <p>Other major features of the LVSS ADA C-UAS include:</p> <ul style="list-style-type: none"> <li>• Rapidly relocatable perimeter protection from the system’s ability to quickly deploy, stow and redeploy the sensor suite</li> <li>• Advanced, high performing video analytics that allow operators to precisely identify, track and engage threats</li> <li>• On-the-move C-UAS counter-measures with full non-kinetic kill chain capability; operators can obtain threat assessments while the system is static or while driving the vehicle</li> <li>• New Cameleon™ V5 command and control software integrates all onboard sensors and supports advanced device features and bi-directional communications</li> <li>• Increased cyber security tools to resist hackers</li> </ul> <p>In March 2022, DroneShield and Teledyne FLIR announced a partnership</p> |           | systems&segment=uis   |
| <b>TeleRadio Engineering</b> | <b>SkyDroner 1000/<br/>SkyDroner 500</b> | Detector, ECM | <p>SkyDroner is an anti-drone surveillance system designed to detect, distract and disable any anonymous drone from flying into a protected area. It consists of multiple sensors to monitor the range of radio signals and identify the different characteristics of a drone's signature, distracts the drone by taking over the command and control frequencies and can immobilise it in an emergency. The variants are: SkyDroner 500, designed for urban installation with a detection range of up to 500m. Applications include building surveillance in a city environment. SkyDroner 500 can be deployed at the rooftop to provide 24 hours monitoring of surrounding drone activities; and SkyDroner 1000 which has a detection range up to 1000m. It is designed to perform long-range surveillance of drone activities in a desert environment. The system is built to meet IP65 standard and operated up to 60 degrees with minimum maintenance.</p>  | Singapore | <a href="http://www.skydroner.com/product">http://www.skydroner.com/product</a> |

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| <b>Thales</b> | <b>EagleSHIELD</b> | Detector, ECM | <p>In October 2019 Thales announced a new integrated drone countermeasures solution to protect and secure sensitive sites such as airports, sports arenas, critical infrastructure and large-scale events in urban areas. EagleSHIELD is a multi-sensor solution that detects, identifies, classifies and neutralises rogue drones flying at low altitude at ranges of up to 7 km. The 360deg airspace surveillance coverage is provided by the Gamekeeper holographic radar developed by Aveillant. Complementing the radar, infrared and radiofrequency sensors refine the system's threat identification and classification performance, using real-time data fusion techniques to determine the exact type of unmanned aircraft involved. EagleSHIELD displays real-time information in a cohesive view of the airspace.</p> <p>Horus Shield offers numerous information to the user on a single screen; and a capacity to integrate sensors from different manufacturers. The Thales Horus-Shield anti-drone system has been deployed for more than three years in different customers monitoring critical infrastructures both in urbanized areas with disadvantaged populations and hostile groups with high technological level, as well as being used in the protection of major sporting events.</p> | France | <a href="http://www.thalesgroup.com">www.thalesgroup.com</a> |

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| <b>Theiss UAV Solutions</b> | <b>EXCIPIO</b>                             | Intercept drone, capture       | <p>Theiss UAV Solutions, LLC has released the EXCIPIO, a patent pending non-electronic, non-destructive Anti-Drone system. The EXCIPIO (Latin for “I Capture”) is an interception and neutralizing system that allows for surgical removal of a potential threat. Though the initial system concept was focused on intercepting and neutralizing an airborne UAS (or “Drone”), the conceptual applications have expanded to include manned aircraft, ground vehicles, people, and animals (whether airborne or on the ground).The EXCIPIO Aerial Netting System can be mounted to a variety of fixed wing or rotorcraft platforms for use. The EXCIPIO is launched when a threat target has been identified and then flies to intercept the target. When the EXCIPIO has reached the threat target, it fires a net upon the target when commanded by the EXCIPIO System operator. Once the target has been “netted,” the EXCIPIO can either release the net with the neutralized target ensnared (utilizing a small drag chute to slow the fall of the neutralized target) or keep the net tethered to the System for the purpose of relocating the net and neutralized target to a desired location before releasing them to the ground.</p>  | USA | <a href="http://www.theissuav.com/researchanddevelopment/">http://www.theissuav.com/researchanddevelopment/</a> |
| <b>T-Worx</b>               | <b>I-Rail/IXI Drone Killer integration</b> | Detector, ECM, intercept drone | <p>In May 2018 T-Worx reported that IXI EW had entered into a Product Development and a Licensing Agreement with T-Worx Holdings to provide for the integration of the IXI Drone Killer handheld counter UAS technology onto the T-Worx Intelligent Rail® (“I-Rail®”) system with its Rifle Operating System™. According to T-Worx: “Developed under the US Army Small Business Innovative Research (SBIR) Programme, the I-Rail provides both power and intelligent control of electronic devices when attached to an I-Rail integrated Picatinny Rail. Following an extensive competition, the I-Rail also became the NATO Powered Rail standard in 2015...The current IXI Drone Killer employs software-defined radio technology to detect and affect class 1 and class 2 UAS (sUAS) devices without the use of broadband jamming. Because the Drone Killer does not employ broadband jamming, once a sUAS is detected by the Drone Killer, it can affect the sUAS with low power signal transmissions. All Drone Killer signals are pre-programmed and can be updated in the field by the user.</p> <p>The Development Agreement encompasses the redesign of the IXI Drone Killer into a small, lightweight, and low power consumption assembly that attaches to the I-Rail. This integration reduces the Size, Weight, and Power (SWaP Reduction) of the current system by more than 50% – to just over two pounds.</p> | USA | <a href="http://www.tworx.com/#">http://www.tworx.com/#</a>   |



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|                                     |                |                           | <p>Integrating the Drone Killer onto the I-Rail gives soldiers counter sUAS capabilities without the burden of carrying a separate, heavier device.”</p> <p>In September 2021 IXI launched its wide-angled static counter-consumer drone system which provides up to 360 degree interdiction of consumer UAS and other target emitters. It operates at ranges of up to 5000 metres.</p>   |     |   |
| <b>Vector Solutions</b>             | <b>Artemis</b> | Detector, ECM             | <p>The ARTEMIS Drone Defense Solution is a fully autonomous, portable device designed to detect and defeat the majority of commonly proliferated group 1 and 2 commercial drone systems. Through passive interrogation of known drone control frequencies utilizing an automated spectrum analyzer and proprietary HUNTER algorithm, the ARTEMIS identifies potential targets; implements control measures and forces the drone into its pre-programmed loss-of-link profile. The ARTEMIS targets only the drone control frequency and does not interfere with any other frequency in the spectrum. By precisely isolating the drone controller and cross-referencing a known control database, the system yields maximum effectiveness with no false positives. While the majority of current drone systems operate via remote control and generally in the same spectrum, next generation threats become much more robust. In order to combat autonomous drones operating solely on GPS signals or outside of the normal operating spectrum, the company relies on a portable threat defence tool capable of defeating autonomous drones.</p> | USA | <a href="http://vectorsolutions.us/counter-drone/">http://vectorsolutions.us/counter-drone/</a> |
| <b>Verus Technology Group (VTG)</b> | <b>SkyView</b> | Detector /directed energy | <p>In January 2019 Verus Technology Group announced that it has received its first individual multi-million-dollar purchase order from U.S. Special Operations Command (USSOCOM) for its next-generation SkyView-MP C-UAS. VERUS has delivered a small number of its SkyView-MP V2 systems to other customers and has already started shipments for this significant order. The SkyView-MP (Mobile Platform) is a small, lightweight, mobile drone detection system that provides 360° detection capability for long range “fact of” detection of the presence of a drone. The SkyView-MP is delivered with the necessary accessories to be powered via MILSPEC battery, shore power or vehicle power as well as a quickly deployable magnetic mount to transition the antenna to a vehicle/mobile application. SkyView CUAS systems provide operators with long-range detection and tracking of small unmanned aircraft systems. The first production unit was delivered in 2017 and since then, more than 60 SkyView systems have been purchased and deployed globally by multiple U.S. Government entities.</p>                              | USA | <a href="https://www.verustechnologygroup.com/">https://www.verustechnologygroup.com/</a>       |

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|  |  |  | <p>The US Naval Surface Warfare Center, Port Hueneme Division, a field activity of the Naval Sea Systems Command, in 2021 awarded VTG an additional contract to equip more ships in the US fleet with an innovative laser designed to counter threats from unmanned aerial systems. Under the prime, single-award contract, VTG will install and integrate the AN/SEQ-4 Optical Dazzler Interdictor, Navy (ODIN), a directed energy weapon, aboard five US Navy Arleigh Burke-class destroyers.</p> <p>In 2020, VTG successfully integrated the ODIN laser aboard the USS Stockdale (DDG 106) and USS Spruance (DDG 111) through a separate sole-source contract, completing both projects on time and on budget, and setting the standard for future directed energy weapon installations aboard US Navy ships.</p> <p>ODIN, a member of the Navy Laser Family of Systems, is a laser used to counter adversary UAS-mounted intelligence, surveillance and reconnaissance capabilities. This laser for the optical dazzling of adversaries' long-range and very long-range surveillance systems is being developed and built by the government at NSWC Dahlgren Division, and rapidly fielded to meet an urgent Fleet need. The ODIN laser will be employed on surface combatants to counter asymmetric threats and to provide a scalable response for escalation of force.</p> |  |  |
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| <b>Van Cleve</b> | <b>DroneRanger</b> | Detector /ECM | <p>DroneRANGER's key components are a 360° scanning radar and a positioning system on which images (visual and thermal) and radio frequency (RF) jammers are integrated. The radar detects the drones and the RF jammers block radio frequencies, thus neutralizing the drones. Components comprise:</p> <ul style="list-style-type: none"> <li>• Co-Aligned Radar, Thermal, Near-IR, &amp; Visible Cameras</li> <li>• Safety &amp; Security for Valuable Properties &amp; Remote Assets</li> <li>• Photonic Deterrence Bore Sighted to Cameras</li> <li>• Automatic Wide Area Protection</li> <li>• 24 Hour All Weather Operation – Day or Night</li> <li>• Low Power for Remote Installations</li> <li>• Interfaces to Central Station Monitor</li> <li>• iPad / iPhone View, Command, &amp; Control</li> <li>• Elegant Installation &amp; Operation</li> </ul> <p>Features:</p> <ul style="list-style-type: none"> <li>• 1.7 Mile Line-of-Sight Operation</li> <li>• Radar &amp; Camera Detection</li> <li>• Authoritative Photonic Deterrence</li> <li>• Embedded Processor &amp; DVR</li> <li>• 20 foot Mast, Integrated Lowering System</li> <li>• IP Ethernet Communication</li> </ul> | USA | <a href="https://www.vcasecurity.com/">https://www.vcasecurity.com/</a> |
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| <b>Vigilant Drone Defense</b> | <b>Advanced Counter UAV Defense System/Vigilant Drone Denial System</b> | Detector /ECM | <p>Vigilant Drone Defense products create a secure and impenetrable zone of protected airspace, protecting people and assets from invasive drones. The Vigilant Drone Denial Systems comes in several configurations to meet any deployment and operational requirement: Handheld Units, Vehicle &amp; Vessel Mounted, Man-Packable, Temporary Fixed and Permanent Mounted units. Products are enclosed in IP66 certified cases that ensure the system can be used in harsh environments. Products are suitable for military defense purposes, as well as other government, commercial industry and private sector purposes that requires protection from invasive and malicious drone activity. Vigilant Drone Defense products establish an invisible and completely secure no fly zone of airspace with an effective protective radius of 500 meters – to over 8 Km, with over 1 Km in altitude protection. This invisible no fly zone is quickly and easily deployed to protect sensitive and secure locations, as well as property and personnel. The company states:</p> <ul style="list-style-type: none"> <li>• VDD systems work 100% of the time</li> <li>• VDD systems create a secure airspace and is effective against all commercially available drones</li> <li>• VDD systems DOES NOT affect GPS, or communications of other aircraft</li> <li>• VDD systems do not rely on detection</li> <li>• VDD systems has many different configurations</li> <li>• VDD systems are a HIGH STRENGTH/LOW POWER REQUIREMENT units</li> <li>• VDD systems can be manufactured to end user requirements</li> </ul> | USA | <a href="http://www.vigilantdronedefense.com">http://www.vigilantdronedefense.com</a> |
| <b>WhiteFox Defence</b>       | <b>DroneFox Tactical, DroneFox Fortify, STRATUS</b>                     | Detector /ECM | <p>WhiteFox Defense Technologies (WhiteFox) has developed a comprehensive, intuitive, man-portable, readily integrated, high-performance, low-impact, small footprint, personnel efficient, and cost-effective drone threat detection, identification, and mitigation device called the DroneFox. As a single integrated system, the DroneFox detects, tracks, identifies and defeats (DTID) sUAS. The DroneFox detects drones in an airspace, with a range extending even kilometers beyond visual line of sight. A forensic threat analysis is executed on target drones based on variables including its payload capacity, model, location, pilot's location, and live video feed, thereby extending operator's ability to protect others from the ground into the airspace above. DroneFox operators are able to safely mitigate the threat by taking complete control of the drone and rerouting to any desired location. According to the company: "The DroneFox, as a defensive counter-sUAS solution, is produced in a form factor that is man-</p>   | USA | <a href="https://www.whitefoxdefense.com/">https://www.whitefoxdefense.com/</a>       |

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|  |  |  | <p>portable and easily fixed to a secure location. The WhiteFox team has developed a C-sUAS protocol library that encompasses virtually 100% of the currently identified critical threat drones, and ~90% of the worldwide commercial drone market. This library includes the encrypted Lightbridge 2: the most popular drone communication protocol in the world, by both consumers and terrorists. WhiteFox has been confirmed by top government officials within the U.S. Department of Defense and intelligence community to be the only entity who can accurately claim and defend the ability to safely mitigate Lightbridge 2 drones.”</p> <p>In May 2021 WhiteFox launched a cloud-based system to detect and track drones called STRATUS. WhiteFox has adapted its core technology that stops drones from operating unsafely or illegally, such as smuggling drugs into prisons and surveilling nuclear power plants, says a company press release.</p> <p>STRATUS is designed to create a virtual bubble of protection to track drones and perform risk assessment in real-time. The system enables users to define geofences and notification criteria. Users can track, report, and log drone activity as it occurs with instant text or email notification. Users can also access historical drone traffic over their facilities and produce reports showing exactly what has happened.</p> <p>WhiteFox sensors provide coverage in major metropolitan cities across North America. Customers need a computer or phone connected to the Internet to use STRATUS and instantly track drones intruding in their airspace.</p> <p><b><u>Partnerships</u></b></p> <p>In February 2018 Gryphon Sensors agreed a partnership with WhiteFox Defense Technologies, so WhiteFox’s non-jamming, non-kinetic mitigation and analysis capabilities is now integrated within Gryphon’s Skylight system. The resulting RF-based sensor-driven system provides an unclassified and exportable counter-UAS system.</p> |  |  |
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| <p><b>Zen Technologies</b></p> | <p><b>ZADS</b></p> | <p>Detector, ECM,capture</p> | <p>The anti drone system from Zen Technologies works on drone detection, classification and tracking on passive surveillance, camera sensors and neutralization of the threat through jamming the Drone communication. The Zen Anti Drone System (ZADS) is a multi-layer multi sensor Architecture aimed at providing comprehensive security against drone attacks.</p> <p>Modules of Multi sensor setup include:</p> <ul style="list-style-type: none"> <li>• RF Based Drone detector (RFDD)</li> <li>• Video based Drone Identification &amp; Tracking (VDIT)</li> <li>• RADAR</li> <li>• Data fusion and Command Center (DFCC)</li> <li>• Drone RF Jammer (DRFJ)</li> <li>• Hard kill</li> </ul> <p>RF Based Drone detector (RFDD)<br/>RFDD detects the drone using Radio Frequency (RF) communication between drone and Ground control center (GCC). This System is on continuous search mode on wide band of frequencies that are typically used by Drone and its GCC. Whenever a frequency of interest is identified, the system locks and monitors the signal. Based on the identified signal, system estimates the direction of Drone and its GCC. An array of receive antenna is used for estimation of direction of signal.</p> <p>Video based Drone Identification &amp; Tracking (VDIT)<br/>The day and night camera sensors are mounted on an automatic servo-based positioning system. This system receives commands for position from RFDD. Once positioned in the direction of interest, captures video and images of drone. VDIT is capable of capturing and tracking video up to a range of 3 Km. Video feeds are given to software module and video processing algorithms in the software automatically confirm the presence of drone and imitate tracking.</p> <p>RADAR<br/>Detection of autonomous drones (flying without a link between drone and operator) using RFDD is not possible. RADAR forms the best choice to detect such threats. An X band 3D RADAR detects the drones as per the max range chosen and provides precise data about the target coordinates. RADAR provides both Azimuth and elevation data of the drone. The feed from the RADAR is integrated to the data fusion center for effective remote monitoring of the threats.</p> <p>Data fusion and Command Center (DFCC)</p> | <p>India</p> | <p><a href="https://www.zentechologies.com/zads-zen-anti-drone-counter-drone-system.php">https://www.zentechologies.com/zads-zen-anti-drone-counter-drone-system.php</a></p> |
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|  |  |  | <p>User interface presents the comprehensive picture of threat situation. Data from RFDD, VDIT and RADAR is integrated at the command center. Detection and classification algorithms based on RF data as well as visual data are built into this system. An integrated display system enables the display of the threat situation. This display system integrates the Map with zones of threat. Provision to define the area of monitor, zone of threat, zone of identification of threat etc are given in the console. Spectrum and waterfall screens are also part of the software, which provide the complete picture of the detected emissions. A list of detected signals and Parameters such as Frequency and type of drone etc are displayed.</p> <p>Drone RF Jammer (DRFJ)</p> <p>Drone RF Jammer (DRFJ) is capable to disable the link between GCC and Drone, by jamming simultaneously ISM bands, GNSS signals, mobile signal and any other intercepted frequencies. The frequencies detected by RFDD are automatically taken and jamming waveforms are generated and radiated using the directional antennas. The system also supports user configured frequency to carry out the jamming action. A provision to manually feed the jammer frequencies is also given.</p> <p>Hard kill</p> <p>Zen Anti Drone system is offered with hard kill options. Kinetics based kill and a Net based drone catcher are the two options available in hard kill. Kinetic based neutralization is supplied with a gun which can auto align to the target and fire bullets against the target to destroy the same physically. In order to capture the drone and land it at a safe place, net-based drone capture option can be employed. For this option, a dedicated drone with a hanging net will be launched to capture the rogue drone. This option is suitable for small rogue drones carrying potentially damaging explosives.</p> |  |  |
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## Intercept drone

| Company | Product     | Type            | Description   | Country | Website   |
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| AerialX | DroneBullet | Intercept drone | <p>Designed to be portable, deadly, and cost-effective, the DroneBullet is a fully autonomous multi-rotor using kinetic energy to intercept and defeat hostile drones. It can counter a single or a swarm of target drones entirely autonomously using proprietary onboard AI and advanced machine vision processing. The DroneBullet is a simple-to-operate, fire-and-forget, beyond visual line-of-sight counter-drone solution that can operate as a standalone unit or as part of any third-party drone detection system.</p> <p>In May 2019, Jane’s reported AerialX was finalising the development of DroneBullet, “an intuitive, high-speed multi-rotor kinetic energy interceptor solution designed to counter small multirotor and fixed-wing UAS threats.” DroneBullet has a take-off weight of 910 g, is 269 mm in length, and 160 mm in diameter. Housed in a carbon fibre casing, the system is furnished with a nose-mounted day/night camera and a GPS/INS/IMU navigation assembly. Terminal guidance is delivered by an onboard ‘deep learning and machine vision’ system.</p> <p><b><u>Partnerships</u></b></p> <p>Defence and security technology company KWESST Micro Systems has signed an ‘amended and restated license agreement’ with AerialX Drone Solutions for counter-drone technology. In October 2019 KWESST signed a non-exclusive worldwide license with AerialX and has now gained exclusive rights to the technology for US and Canadian militaries. The product which is based on the licensed technology is being marketed under the name GreyGhost and is an autonomous soldier-portable micro drone missile system that defends against small hostile drones including swarms using high-speed kinetic impact. Under the agreement, KWESST’s also retains its non-exclusive worldwide rights. KWESST has agreed to issue AerialX 100,000 shares of KWESST in consideration of the new exclusive rights and an additional 100,000 shares of KWESST upon AerialX meeting certain technological milestones.</p> | Canada  | <a href="https://aerialx.com/">https://aerialx.com/</a><br><a href="http://www.kwesst.com">www.kwesst.com</a> |



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| <b>Almaz-Antey</b> | <b>Volk-18</b>                      | Intercept drone | The Volk-18 (Wolf-18) interceptor drone developed by Almaz-Almaty will be used to protect civilian airports from intruder drones, Deputy CEO Dmitry Savitsky told the news service TASS in August 2021. The drone measures 60x60 cm, has a takeoff weight of up to 6 kg, and a flight time of about 30 minutes. Its armament includes three small rocket launchers that shoot nets at enemy drones, entangling them and bringing them down. If that fails, the drone rams the enemy UAV, breaking it up in mid-air.  | Russia                 | <a href="http://www.almaz-antey.ru/en/">http://www.almaz-antey.ru/en/</a>   |
| <b>ECA Group</b>   | <b>IT180 drone detection system</b> | Intercept drone | ECA Group and Groupe Gorgé subsidiary have developed a drone able to locate, identify and track offending operators and aircraft. It is based on the use of ECA Group's IT180 drone, including several transponders. After detecting the offending drone through land-based resources, the strategy consists of activating the IT180 drone: first, it will locate the operator using its on-board technology; second, it will approach and identify the operator using its cameras.  | France                 | <a href="https://www.ecagroup.com/en/event/neutralization-malicious-drones-eca-group-innovating-and-validates-unique-technology-locate">https://www.ecagroup.com/en/event/neutralization-malicious-drones-eca-group-innovating-and-validates-unique-technology-locate</a> |
| <b>Exponent</b>    | <b>Drone Hunter</b>                 | Intercept drone | A UAV programmed to intercept rogue drones   | Dubai                  | <a href="http://exponent-ts.com/drone-hunter/">http://exponent-ts.com/drone-hunter/</a>   |
| <b>Iron Drone</b>  | <b>Drone interceptor</b>            | Intercept drone | Iron Drone is a patent-pending drone interception technology. An interceptor drone flies towards the target and is capable of physically eliminating it by collision or other means. Unlike radio-based solutions, the technology does not rely on an the link between the hostile drone and its operator and the Iron Drone interceptor can eliminate targets that are flying a pre-programmed mission or using secure radio links. The system incorporates Artificial Intelligence for computer vision, situational awareness, flight planning and precision maneuver. | Israel                 | <a href="http://www.irondrone.com/">http://www.irondrone.com/</a>   |
| <b>MARSS</b>       | <b>MARSS Interceptor</b>            | Intercept drone | MARSS has created an AI enabled autonomous interceptor that offers an intelligent, cost-effective and low collateral solution to neutralising hostile drones. Fully integrated with NiDAR CUAS, this high-speed craft is capable of  | Monaco/UK/Saudi Arabia | <a href="https://www.marss.com/marss-interceptor">https://www.marss.com/marss-interceptor</a>   |

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|                            |                   |                 | <p>defeating category I &amp; II drones head on from up to 5km plus, according to the company.</p> <p>The Interceptor vehicle features:</p> <ul style="list-style-type: none"> <li>• No explosives or jet fuel</li> <li>• Onboard AI IR video analytics</li> <li>• High speed interception rates</li> <li>• Fully automatic vertical launch</li> </ul> <p>The MARSS company website describes the C-UAS interceptor concept of operations:</p> <p>“Interceptor housed in vertical smart launcher. Connected to NiDAR sensor infrastructure. Operator launches Interceptor via a vertical smart launcher. Interceptor acquires target using onboard AI imaging infrared seeker. Positive identification of targets, Interceptor pursues with dogfight maneuverability, at altitudes exceeding 2km, and high speeds over 80m/s. Interceptor is capable of engaging and neutralizing multiple CAT I and CAT II UAS at high speed using kinetic force.”</p> <p><b><u>Partnerships</u></b></p> <p>In December 2021 MARSS announced a collaboration with Thales for the delivery of system solutions to provide protection of critical infrastructures against multiple threats.</p> |        |  |
| <b>Military University</b> | <b>Quadcopter</b> | Intercept drone | <p>A report by RIA Novosti says specialists of the Military University of the Ministry of Defense have invented a counter drone solution comprising a small quadcopter “equipped with a control unit, a multi-barrel weapon station and four telescopic rails that face horizontally to the sides and are interconnected by a network. The latter “sprays” the ammunition into small fragments flying in different directions,” says RIA Novosti.</p> <p>The system is designed “to cover protected objects with a fragmentation field. In a combat position, the drone hangs in the air above an object with a net open on the rails. Network sensors read the movement of the attacking “swarm” and send a signal to the electric capsules of the charges of the multi-barrel combat</p>   | Russia | <a href="http://www.ria.ru">www.ria.ru</a> |

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|                                 |                                       |                 | <p>module. After that, all of its barrels fire at the same time, and the fragmentation field created in this way destroys enemy drones.</p> <p>“The drone, in a combat position, hovers in the air with its net open. When sensors detect the movement of an attacking ‘swarm’, the quadcopter’s barrels fire a simultaneous salvo and a shrapnel field destroys the enemy drones.”</p>  |            |   |
| <b>My Sky Technologies</b>      | <b>Man-portable counter UAV drone</b> | Intercept drone | My Sky Technologies based in Adelaide, South Australia, is developing a man-portable, field-deployable fire-and-forget counter UAV drone. The 600 gram drone is stored in a soldier’s pack and launched when an enemy drone is detected. The drone carries a range of sensors including RF, infrared, video and GPS and is equipped with saw-like rotors to bring down the enemy drone. The counter-attack drone reaches speeds of up to 250kmh, can fly to an altitude of 5000m and has a range of about 8km.   | Australia  | <a href="http://www.myskytech.com.au/">http://www.myskytech.com.au/</a> ),              |
| <b>Rajant</b>                   | <b>Swarming counter-UAS</b>           | Intercept drone | According to press reports from the October 2017 AUSA event Rajant Corporation is one of the companies developing a Mobile Ad Hoc Networking (MANET) counter-UAS system under evaluation with the US Army’s Program Manager for Counter-Rockets, Artillery and Mortars (PM CRAM). Rajant’s concept is for a swarm of approximately 20 vertical take off/landing UAVs which are launched when RAM and UAS targets are detected. The platforms are networked by secure broadband communications via the company’s Kinetic Mesh radio system.   | USA        |   |
| <b>Search Systems</b>           | <b>SparrowHawk</b>                    | Intercept drone | SparrowHawk is a C-UAV system designed to capture and recover intact a rogue UAV and its payload safely. SparrowHawk will stop fully autonomous UAVs and glide attack UAVs up to 20kg, both rotary and fixed wing, and can be re-armed in just a few seconds for repeat sorties. Batteries can also be swapped in seconds, minimising downtime. The SparrowHawk system is portable, reliable, quick to deploy and easy to operate. It comprises a SparrowHawk multi-copter UAV, weighted entanglement system, parachute, compressed air firing system complete with inbuilt safety mechanisms, EO and IR camera aiming and target selection system. Fast computerised battery charging is included in each system. | UK         | <a href="http://searchsystems.eu/sparrowhawk/">http://searchsystems.eu/sparrowhawk/</a> |
| <b>University of Luxembourg</b> | <b>Anti-swarm system</b>              | Intercept drone | Press reports says researchers at the University of Luxembourg have developed a new counter-UAS system which comprises a swarm of self-organizing drones which surround and escort the intruder away from the protected airspace. “Over the next years, thousands of drones will hit the skies to fulfill all kind of services   | Luxembourg | <a href="https://arxiv.org/abs/1808.06900">arxiv.org/abs/1808.06900</a>                 |

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|  |  |  | <p>such as food and package delivery, surveillance and maintenance,” Matthias Brust, one of the researchers who carried out the study, was reported as saying. “Now, many cities are working on establishing designated drone flight zones. However, the deployment of a large number of drones comes with risks and security issues, in particular because of the speed, flexibility and autonomy of drones. Our research focuses on the question of how a drone defence system can act quickly and autonomously against rough or malicious drones entering the flight zone, and take appropriate counter-measures....We developed a modular and local algorithm, which runs on each drone to enable it to make the right decision autonomously based on the state of its neighbouring drones—forming a so-called ‘intelligent swarm’ of drones,” Brust explained. “After initial deployment and detection of an intruder, the defense drones form a self-organized network and intercept the intruder by isolating it through a local encapsulation algorithm from its environment to escort it out of the flight zone.”</p> <p>According to the reports, the researchers developed a new auto-balanced clustering process, which ensures that the UAV swarm arranges itself in an effective formation to intercept and capture rogue drones. Once captured, the swarm can then safely escort the malicious vehicle outside of the flight zone. “The most challenging task was to develop a local algorithm that doesn’t require a system-wide consensus to function,” Brust said. “Additionally, we needed to make sure that each drone is able to switch into the correct phase of the defence manoeuvres in the right moment. We approached this problem with a modular design which creates balanced swarm-wide interception structures for the capture and escorting formation.”</p> |  |  |
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| <b>Vepr</b>   | <b>Counter-UAS drone launched from a shotgun</b> | Intercept drone | C4ISRNET reports that on 12 March 2019, Russia’s Federal Service for Intellectual Property posted the registration of a novel counter-drone drone, an unmanned aerial interceptor vehicle built around a rifle. According to the news service: “This still-unmanned interceptor is a tail-sitting drone. With two rotors, it can take off and land vertically, and then level off to fly horizontally, the lifting rotors now working as propellers. It has a wingspan of nearly 10 feet, a total weight of around 51 lbs, and a total flight time of 40 minutes. The flight time is short for vehicles of its size but longer than that of the cheaper commercial quadcopters that are its likely targets. Once it gets close to those targeted drones, the interceptor is built to fire shells from the Vepr 12 shotgun (a variant of the AK rifle series) built into its fuselage.”                              | Russia | <a href="https://www.c4isrnet.com/newsletters/unmanned-systems/2019/03/18/russia-working-on-flying-gun-drone/">https://www.c4isrnet.com/newsletters/unmanned-systems/2019/03/18/russia-working-on-flying-gun-drone/</a> |
| <b>X-TEND</b> | <b>SKYLORD GRIFFON</b>                           | Intercept drone | <p>XTEND’s signature SKYLORD GRIFFON, is a SMART hard-kill C-UAS platform that allows any operator with no flight experience to kinetically intercept aerial threats using a resilient, ultra-fast drone system. SKYLORD GRIFFON seamlessly interfaces with any detection or command and control system for total control. Fusing edge technology with human-centric cognitive capabilities— such as 3D navigation, visual HMI spatial translation, and augmented reality API—operators can deploy multiple drone teams to detect, identify, and intercept enemy drones. SKYLORD GRIFFON is designed to defeat Group 1/2 COTS UAS in ranges of up to three miles from the launch point. It flies up to 80 miles per hour and uses a single</p> <p>In early 2021 XTEND announced it has delivered dozens of SKYLORD GRIFFON systems, for operational usage to the United States Army Special Operations Command.</p> | Israel | <a href="https://xtend.me/products/griffon/">https://xtend.me/products/griffon/</a>   |

## Missiles

| Company                 | Product | Type    | Description  | Country | Website   |
|-------------------------|---------|---------|--|---------|---|
| BSVT – New Technologies | TRIO    | Missile | <p>In April 2019 Russia’s news agency TASS reported that Belarus had developed a new air defence missile system dubbed TRIO to fight small-size drones. According to the republic’s State Military and Industrial Committee: “The new surface-to-air missile system developed by specialists of BSVT – New Technologies has been created to provide air defence for military and industrial facilities, land troops’ units and formations, and also to strike small-size air targets, including unmanned aerial vehicles,”</p> <p>The system uses the modernized combat vehicle of the 9K35 Strela-10 short-range missile system and the ZSU-23-4 Shilka self-propelled surface-to-air missile complex. They also added the Berserk robotized machine-gun system based on quick-firing aerial guns. “The TRIO’s guns supplement each other, which allows it to efficiently destroy small-size air targets of various types, including mini-drones,” the developer company said.</p> <p>“The new system’s weapons are mounted on the tracked chassis, which enables it to move confidently across terrain with different types of soil. As its specific feature, the new air defence system features an information and computer complex that allows making the operation of a team of a platoon (battery) command post and its combat control fully automated. The system’s radar can carry out an all-round search for air targets in real time within the angles of site ranging from minus 7 to plus 70 degrees while the round-the-clock optical-electronic station is capable of spotting and tracking targets in the passive mode at a range of 20 km.</p> <p>“The developers have also adapted the TRIO for firing modernized air-to-air airborne missiles capable of striking targets with a dimension of no less than 30 x 30 cm. The robotized machine-gun module with a firing range of up to 500 m and the firing rate of 12,000 rounds per minute is also designed to strike small-size drones.</p> | Belarus | <a href="http://tass.com/defense/1054947">http://tass.com/defense/1054947</a> |

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|---------------------|----------------|---------|---|-----|--|
| <b>Raytheon</b>     | <b>Stinger</b> | Missile | The Cruise Missile Defense Systems Project Office, in conjunction with the Armament Research and Development Engineering Center, has completed testing on a new Proximity Fuze warhead for the Stinger missile aimed at improving Stinger performance against unmanned air system (UAS) targets. The approval will lead to fielding under an urgent materiel release.   | USA | <a href="http://www.raytheon.com">www.raytheon.com</a>       |
| <b>Smart Rounds</b> | <b>SAVAGE</b>  | Missile | <p>SmartRounds has launched a counter drone missile which can be fired from the ground or UAV. The Smart Anti-Vehicle Aerial Guided Engagement (SAVAGE) missiles are self-guided 'fire-and-forget' projectiles designed to give military, homeland security and law enforcement the ability to deal with threatening UAVs. SmartRounds. has been issued a US patent "Non-Lethal Smart Weapons with Computer Vision" for these munitions.</p> <p>SAVAGE missiles are solid fuel propelled, titanium nose cone equipped, long range guided missiles that can be fired at high velocity (~350 mph) and equipped with computer vision object detection and target tracking, a form of artificial intelligence AI. The missile impacts the enemy drone with enough kinetic energy to disable or destroy it, and is equipped with a parachute to safely return to the ground for reuse.</p> <p>SmartRound's proprietary computer vision algorithms along with an electro-optical sensor allow the missile to follow the target after it leaves the launcher by adjusting the missile's aerodynamics and changing its direction. This ensures that the projectile will reach its target even if the UAV is moving at high speed. The on-board CPU/GPU microprocessor along with pre-programmed algorithms keep the UAV in its "sights" by means of MEMS activated fins. AI algorithms also give multiple SAVAGE missiles the ability to communicate with each other in flight to maximize their effectiveness in dealing with a "swarm."</p> | USA | <a href="http://www.smartrounds.com">www.smartrounds.com</a> |

## Munition

| Company     | Product                 | Type     | Description  | Country   | Website   |
|-------------|-------------------------|----------|--|-----------|---|
| AMTEC       | ALS12SKY-Mi5/Skynet     | Munition | The ALS12SKY-Mi5 is a 12 gauge anti-drone round designed to be rapidly deployed against commercially available drones being utilized for illegal purposes; i.e. illegal surveillance and contraband delivery. Upon firing through a 12ga rifled choke barrel, the five tethered segments separate with centrifugal force and create a five (5') foot wide 'capture net' to effectively trap the drone's propellers causing it to fail.   | USA       | <a href="https://www.lesslethal.com/products/12-gauge/als12skymi-5-detail">https://www.lesslethal.com/products/12-gauge/als12skymi-5-detail</a>   |
| Nammo       | Programmable ammunition | Munition | Nammo produces a range of programmable ammunition aimed at addressing the threat of ISIS-controlled weaponised commercial drones. This makes it possible for any larger gun to fire shells that can be programmed to explode with pinpoint accuracy, either before, above or inside a target, says the company. Adaptable to several weapon platforms, including 40 mm grenade launchers, 30 mm guns, 120 mm tank ammunition and M-72 rockets, this makes the technology ideal for dealing with a number of different threats, including drones. | Norway    | <a href="https://www.nammo.com/newsroom/#/news/keeping-soldiers-safe-from-drones-how-nammo-can-help-257674">https://www.nammo.com/newsroom/#/news/keeping-soldiers-safe-from-drones-how-nammo-can-help-257674</a>                   |
| ST Kinetics | C-UAS Grenade           | Munition | ST Kinetics' CUAS grenade has been designed to defeat small, commercially available, multirotor UAVs. The 40mm grenade disperses streamers delivered to the flightpath of a UAV disabling its propellers, forcing it to crash. It is compatible with a wide range of grenade launchers on the market including the STK 40GL, HK69A1, M203, M79, AG36, MK13, M32A1, Milkor and Rippel Effect MGL. The round has a stated maximum range of 600 m, but the typical engagement range is around 200-300 m when targeting small UAVs.                  | Singapore | <a href="https://www.janes.com/article/77676/singapore-airshow-2018-st-kinetics-unveils-speciality-40-mm-ammunition">https://www.janes.com/article/77676/singapore-airshow-2018-st-kinetics-unveils-speciality-40-mm-ammunition</a> |



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|--------------------------------|-----------------------------|----------|---|-----|---|
| <b>US Army Armament Center</b> | <b>40mm C-UAS cartridge</b> | Munition | US Army's Armament Center researchers have invented novel 40mm grenade cartridges capable of kinetically disabling or destroying small UAVs. The development is made up of two actions. The first 40mm cartridge fires shotgun-style buckshot from a newly designed cup, the second fires a stack of aerodynamic rings. US Patent 10,584,947, issued to the Army on March 10, 2020, describes the sub-projectile carrier developed by the engineers to control the spread of the buckshot BBs, which extends the maximum effective range of the munition. U.S. Patent 10,408,591, issued to the Army on Sept. 10, 2019, describes the munition containing six ring-shaped projectiles, which spread out to cover a large area and can create punch holes in the UAVs. | USA | <a href="https://techlinkcenter.org/technologies/40mm-counter-drone-munitions/007d8665-ff71-436f-9a92-daa757e53e71">https://techlinkcenter.org/technologies/40mm-counter-drone-munitions/007d8665-ff71-436f-9a92-daa757e53e71</a> |
|--------------------------------|-----------------------------|----------|---|-----|---|

## Others

| Company     | Product                  | Type  | Description  | Country | Website   |
|-------------|--------------------------|-------|--|---------|---|
| Black River | C-sUAS research          | Other | In May 2019 Black River Systems was awarded an USD88.7 million cost-plus-fixed-fee contract for operational counter-s-UAS open systems architecture software/hardware systems. This contract provides for system analysis, simulation and modelling, technique development, hardware and software rapid prototyping, integration, test, demonstration, data analysis, transition, operational assessment, and hardware and software enhancement relative to the objective. Work will be performed in Utica, New York, and is expected to be complete by May 1, 2022. | USA     | <a href="https://dod.defense.gov/News/Contracts/Contract-View/Article/1834495/">https://dod.defense.gov/News/Contracts/Contract-View/Article/1834495/</a> |
| Dronengle   | RF detection systems     | Other | Dronengle markets a wide number of C-UAS products from OEMs to a primarily French market   | France  | <a href="https://www.dronengel.com/c-uav-solutions">https://www.dronengel.com/c-uav-solutions</a>   |
| DroneLess   | RF Sensors, DroneTracker | Other | Provides DEDrone products  | Spain   | <a href="http://www.droneless.net/en/droneless-en/">http://www.droneless.net/en/droneless-en/</a>   |

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|------------------------------|---|-------|---|-----------|---|
| <b>DroneSec</b>              | <b>Notify Threat Intelligence</b>       | Other | In June 2020 DroneSec released a new Software-as-a-Service (SaaS) platform for the drone, counter-drone, and UAS Traffic Management (UTM) system industries. The DroneSec Notify Threat Intelligence system combines traditional human threat intelligence gathering with machine learning and big data to deliver customised alerts alongside in-depth analysis reports. According to the DroneSec press release, the platform offers a searchable artefact database supported by a knowledgebase of whitepapers and industry reports. The platform receives updates daily from over 100 sources, curated and analysed by a team of drone security experts with backgrounds in cyber security, intelligence, and defence. DroneSec Notify is already utilised by organisations across the world operating in the drone space. Notify’s tracking engine combines Open-Source Intelligence (OSINT) techniques with DroneSec’s proprietary tracking software to enable operators to monitor locations for drone activity even if a physical counter-drone system is not in place. For prisons, airports or stadiums where defeating drone systems may not be regulatory approved, Notify combines Standard Operating Procedures (SOPs) with field-tested mitigation strategies. | Australia | <a href="https://dronesec.com/blogs/articles">https://dronesec.com/blogs/articles</a> |
| <b>DSNA Services</b>         | <b>UWAS</b>                             | Other | See JCPX  | France    | <a href="http://dsnaservices.com/">http://dsnaservices.com/</a>                       |
| <b>Hex Horus</b>             | <b>C-UAS operations and consultancy</b> | Other | The company operates C-UAS equipment and portable systems, maintains persistent detection, provide early warning, and conduct demonstrations during CUAS training exercises. It serve in the form of dedicated air guards or air sentries utilizing an array of CUAS equipment including but not limited to: CORIAN, SKY-VIEW, MADS-K, LIDS, DRAKE and DRONE DEFENDER.  | UK        | <a href="http://hexhorus.com/">http://hexhorus.com/</a>                               |
| <b>Six3 Advanced Systems</b> | <b>See comment</b>                      | Other | Six3 Advanced Systems Inc., Dulles, Virginia, has been awarded a USD48.6 million indefinite-delivery/indefinite-quantity contract that provides integration, installation, sustainment, and engineering services to the AIRWorks Rapid Development Capabilities Integrated Product Team in support of the deployment of new and existing counter unmanned aerial systems capabilities and hardware “to high priority and sensitive government sites that protect assets vital to national security.”<br><br>According to the US Department of Defense: “This contract provides technical, engineering and project management support services to include modeling and simulation, hardware integration, software integration, and command and   | USA       | <a href="http://www.caci.com">www.caci.com</a>  |

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|--------------------|---|-------|--|--------|---|
|                    |   |       | <p>control integration. Materials and equipment to be integrated may be procured under this contract or provided as government furnished equipment. Work will be performed in San Diego, California (19 percent); Washington, District of Columbia (9.5 percent); Norfolk, Virginia (9.5 percent); Sterling, Virginia (9.5 percent); Seattle, Washington 9.5 percent); Jacksonville, Florida (9.5 percent); China Lake, California (6.3 percent); Leonardtown, Maryland (4.8 percent); Yuma, Arizona (3.2 percent); Dugway Proving Ground, Utah (3.2 percent); and various locations outside the continental U.S. (16 percent).</p> <p>This contract was not competitively procured. Six3 is part of the CACI International Group of Companies</p> |        |   |
| <b>Terra Hexen</b> | <b>Droneblocker System Omnidirectional/ SAFESKY/ Unidirectional Neutraliser</b> | Other | Terra Hexen is a Business Partner of the manufacturer of the CTRL+SKY system, the Advanced Protection Systems company, and represents it on numerous markets around the world.   | Poland | <a href="http://terrahexen.com/en/home/">http://terrahexen.com/en/home/</a>   |
| <b>Vaereos</b>     | <b>Counter drone methodology</b>  | Other | Vaeros implements a methodology for counter-drone operations that focuses on four key areas: technology foraging, situational awareness, active detection and response, and training and education.  | USA    | <a href="http://vaeros.org/capabilities/uas-counter-uas-testbed/">http://vaeros.org/capabilities/uas-counter-uas-testbed/</a> |