

Clearing the air: India progresses counter-UAV capability

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Author: Oishee Majumdar, Bangalore

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India is accelerating the development of counter-unmanned aircraft systems to tackle expanding security threats posed by hostile unmanned aerial vehicles. Oishee Majumdar reports

The proliferation of unmanned aerial vehicles (UAVs), and the ways in which these platforms are leveraged by [India's](#) adversaries, has pushed the country to prioritise the development of counter-unmanned aircraft systems (C-UASs).

On the one hand, [India](#) is concerned about [China](#) and [Pakistan's](#) growing arsenal of military UAVs, which are often operated in an intelligence, surveillance, and reconnaissance (ISR) role along disputed borders with [India](#). On the other hand, [New Delhi](#) is wary about the increasing use of UAVs – however crude – by non-state actors, particularly in areas bordering [Pakistan](#) such as Jammu and [Kashmir](#) and Punjab.

A militant attack in June 2021 targeting the Indian Air Force (IAF) Station Jammu using two explosive-laden UAVs proved to be a wake-up call for the Indian Armed Forces to improve C-UAS capabilities.

In the past two years, there has been a sharp rise in the frequency of detected or captured UAVs dropping weapons, money, or narcotics into [India](#). According to *Janes* data, in January and February 2023 alone, there were at least 11 incidents where security forces intervened and disrupted the operations of such UAVs. The Indian Armed Forces and the Border Security Force (BSF) allege that most of these UAVs are launched by non-state actors from [Pakistan](#).

The development of C-UAS capabilities is deemed necessary by the Indian Armed Forces not only to have a military edge but also to enhance its asymmetric warfare capability.

Indian military sources told *Janes* that the IAF is the “lead agency” directing the adaption and implementation of new C-UAS measures in the country.

The IAF said in its revised doctrine released in February, “[C-UAS] usage needs nuanced assessment, considering various factors of capabilities, benefits, costs, and vulnerabilities in a contested battlespace.”

In the doctrine, the IAF also stressed the need “to adopt an offensive air defence posture by forward deployment” of C-UAS technology and surveillance by aerial or space-based platforms to deter the increasing aerial incursions by adversaries or non-state actors during ‘no war no peace’ scenarios.

The IAF's Deputy Chief of the Air Staff Air Marshal Narmadeshwar Tiwari told *Janes* in February that the IAF solely relies on locally developed and produced C-UASs to fulfil its requirements.

“We were considering [a] foreign C-UAS initially. But having gone around and seen the [domestic] defence ecosystem on this, I think most of the capabilities exist in our country today,” he added.

The IAF has also been collaborating with the Indian Army to develop and procure C-UAS capabilities, particularly under the Ministry of Defence's (MoD's) Innovations for Defence Excellence (iDEX) initiative, Air Mshl Tiwari said.

“[The Indian Army and IAF] were working together to understand each other's requirements [in iDEX], and in many cases, we decided to buy the same systems. So there is a fair amount of synergy if our requirements are similar,” Air Mshl Tiwari added.

“However, sometimes the army's requirements can be a little different because they are more focused on defending border areas, whereas for [the IAF], the protection of airbases holds primacy. In such cases, we end up buying different systems suiting our respective requirements,” Air Mshl Tiwari said.

IAF research and development

The IAF's 9 Base Repair Depot (9 BRD) unit in Pune has developed a “low-cost” C-UAS with soft-kill capabilities to improve the security of vital areas and vital points (VAs/VPs) against hostile UAVs, Project Officer Wing **Commander** Ranjith Unnikrishnan told *Janes* in February.

The C-UAS, which has not yet been named, can jam a hostile UAV's radio frequencies (RFs), disabling its communication with the ground control station (GCS). However, according to Wg Cdr Unnikrishnan, jamming can prompt the UAV to crash, potentially causing collateral damage. Because of this, a more convenient response would be spoofing, which the C-UAS is also capable of.



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The IAF has developed a low-cost C-UAS that can jam and spoof hostile UAVs. The C-UAS was unveiled at Aero India 2023 in Bangalore in February. (Janes/Oishee Majumdar)

The C-UAS includes a micro-doppler radar that has a range of 7–10 km. The radar is supported by a camera and acoustic sensors to get an accurate detection of UAVs, he said.

Given the range of the radar, one C-UAS unit is not sufficient for a typical airfield. It is estimated that around 20 C-UAS units will be required for one airfield, he added.

“We intend to install multiple units [of the C-UAS] at an interval of 250 m in an airfield. This will be done by mounting the jammers on the light posts around the airfield,” Wg Cdr Unnikrishnan said.

Once the radar detects a UAV, a small computing device placed between the camera and the acoustic sensors will automatically turn on the jammer, he added.

The radar has an inbuilt artificial intelligence (AI) algorithm, which can discern UAVs and birds. The IAF's 9 BRD is also working to enable the radar to identify different UAVs, he said.

Wg Cdr Unnikrishnan said the IAF is collaborating with local industry to manufacture the C-UAS. Bangalore-based Avgarde Systems will produce the micro-doppler radar, jamming and spoofing solutions, and Noida-based O2i Technologies will manufacture the camera and acoustic solutions.

Production of the C-UAS has already started. The first prototype of the system will be delivered by the end of March, after which user evaluations will be conducted, Wg Cdr Unnikrishnan said.

The IAF's 9 BRD is also “developing a long-term evolution (LTE)-based passive radar that will use existing electromagnetic waves present in the environment to detect aerial threats”, Wg Cdr Unnikrishnan told *Janes* .

It will complete the development of the LTE-based passive radar by July, and the IAF will partner with local industry to manufacture this radar, he said.

The IAF's 9 BRD is currently not planning to develop hard-kill capabilities mainly because of the risks involved during their application such as fratricide and other collateral damage, Wg Cdr Unnikrishnan added.

iDEX winners

Air Mshl Tiwari told *Janes* that Chennai-based Big Bang Boom Solutions and Maharashtra-based Gurutvaa Systems – both winners of the MoD's iDEX initiative – have been two of the IAF's initial partners, supporting the force's efforts to augment its C-UAS capabilities.

“The C-UAS solutions provided by both companies have been successful [in achieving their objectives], and the companies have already been contracted to supply their systems to the IAF,” Air Mshl Tiwari said.

Big Bang Boom Solutions will provide 25 units of its Anti-Drone Defence System (**ADDS**) to the IAF, and 20 units of the same to the Indian Army, **Gaurav** Sharma, chief government relations officer of the company told *Janes* in March.

The deliveries are expected to start by June and be completed over the next year, Sharma said.

The company claims that the **ADDS** can jam a UAV in less than five seconds within a range of 16 km. The RF jammer works on dual mode – auto and manual – to disable links between the UAV and its GCS.



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Big Bang Boom Solutions has been contracted to supply 25 units of its Anti-Drone Defence System (pictured) to the IAF and 20 of the same system to the Indian Army. (Big Bang Boom Solutions)

The **ADDS** has a detection range of up to 20 km; a wide frequency detection band (400 MHz to 6 GHz); AI-enabled pattern recognition; and is equipped with a day and night camera that can capture an image of the UAV up to 3 km.

A three-dimensional (3D) radar helps to provide precise data for target co-ordinates, both in elevation and azimuth, while tracking multiple UAVs simultaneously.

According to Big Bang Boom Solutions, the **ADDS** has detected swarms consisting of around 25 UAVs during company trials of the system. Sharma told *Janes* that the **ADDS** is likely to be deployed in **India's** Northern Command.

The company is also developing hard-kill capabilities for the **ADDS** including directed energy weapons (DEWs) such as high-energy lasers and microwave systems. A total of 60% of the development has been completed, and the hard-kill solutions are expected to be ready by June, he said.

The C-UAS can launch nets to capture and bring down a rogue UAV. However, the units being delivered to the IAF have only soft-kill capabilities.

The IAF is also procuring an undisclosed number of the '**Dronaam**' C-UAS developed by Gurutvaa Systems. According to the company, the **Dronaam** C-UAS can jam the RFs of hostile UAVs and interrupt their access to the global navigation satellite system (GNSS).

The **Dronaam** C-UAS can be configured as a fully integrated rifled-style (handheld) device, can be operated from a backpack, or can be mounted onto a pole or vehicle.



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The IAF is procuring an undisclosed number of Gurutvaa Systems' **Dronaam** C-UAS (pictured), which is a rifled-style (handheld) device that can also be mounted onto a pole or vehicle. (Gurutvaa Systems)

“[The **Dronaam** C-UAS] is an all-weather system capable of operating in day and night conditions with a disruption range in excess of 500 m (1,640 ft),” Sandeep Dawkhar, vice-president of Gurutvaa Systems told *Janes* in mid-2022.

Gurutvaa Systems dispatched the first bulk production lot of the **Dronaam** C-UAS to the IAF in November.

DRDO's D4 system

The state-owned Defence **Research** and Development Organisation (DRDO) has developed a C-UAS that can detect, classify, and neutralise hostile UAVs during the day and night. It has an automatic mode and can also be operated manually.

The C-UAS – named the Drone Detect, Deter, and Destroy (D4) system – includes an X-band radar that has a detection range of 4 km for micro-UAVs. The radar has an azimuth coverage of 360° and an elevation coverage of 50°.

According to the DRDO, the D4 system can detect radio frequencies of UAVs – operating at 400–6,000 MHz – up to a range of about 3 km.



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The DRDO has partnered with Adani Defence and Aerospace to manufacture its D4 C-UAS, which has automatic detection, classification, and neutralisation capabilities. (Janes/Akshara Parakala)

The D4 system's electro-optic/infrared (EO/IR) system has a detection range of up to 3 km. It comprises a laser rangefinder (LRF) and is available in cooled and uncooled configurations.

The D4 C-UAS has both hard-kill and soft-kill capabilities, the DRDO said. It has a GNSS jammer with a maximum effective range of 3 km. The system can also jam industrial, scientific, and medical (ISM) radio bands having a frequency range of 400 MHz to 6 GHz.

The D4 system also has a laser-based DEW system that accepts external cues from the radar. It can neutralise targets up to a range of 1 km; can be operated in stationary mode as well as from mobile vehicles; and is portable.

Indian Defence Minister Rajnath Singh handed the D4 system over to Air Mshl B R Krishna, chief of Integrated Defence Staff, in December 2021. The D4 system has since been deployed to enhance security at government events.

An official from Adani Defence and Aerospace told *Janes* in February that the DRDO had partnered with the company to produce the D4 system. Under the arrangement, the DRDO transferred technologies to Adani, and production of the system started in 2022.

Janes understands that the DRDO and Adani have secured orders for the D4 system from security agencies under the MoD and the Ministry of Home Affairs (MHA).

The DRDO has also developed a maritime version of the D4 system for the Indian Navy, called the Naval Anti Drone System (NADS). According to the MoD, the Indian Navy signed a contract in 2021 with Bharat Electronics Limited (BEL), which manufactures the NADS, to procure an undisclosed number of this C-UAS system.

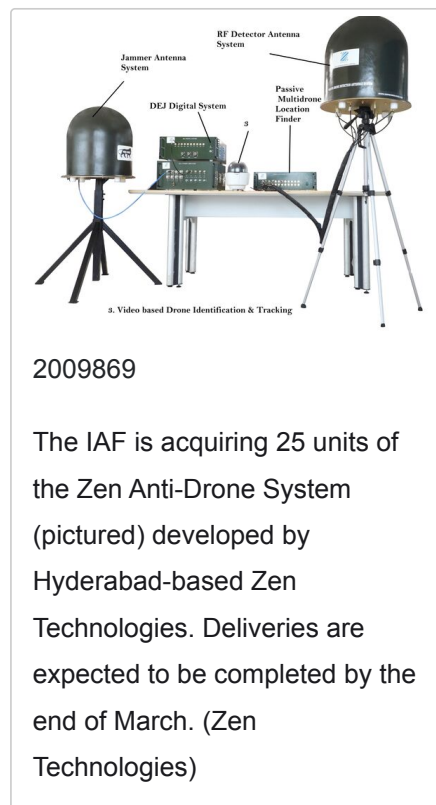
The MoD said that multiple laboratories of the DRDO collaborated with the Indian Navy to develop the NADS. These included the Electronics and Radar Development Establishment (LRDE), Defence Electronics Research Laboratory (DLRL), Centre for High Energy Systems and Sciences (CHESS), and Instruments Research and Development Establishment (IRDE).

Zen Technologies

The IAF is acquiring 25 units of a C-UAS developed by Hyderabad-based Zen Technologies under a INR1.55 billion (USD18.9 million) contract in September 2021. The units supplied to the IAF have only soft-kill capabilities.

The C-UAS, named the Zen Anti-Drone System (ZADS), includes a jammer, RF detector, antennas for the jammer and detector, and a video-based drone identification and tracking (VDIT) system.

According to Zen Technologies, the ZADS has a detection range of 5 km and a jamming range of 4 km. The jammer can disable a hostile UAV's link with its GCS by simultaneously jamming ISM radio bands, GNSS signals, mobile signals, and any other intercepted frequencies.



The ZADS can identify UAVs with the help of an inbuilt library, which can be regularly upgraded, the company said. The operator controlling the jammer can also differentiate between friendly and hostile UAVs by utilising the system's RF detector and VDIT. The ZADS also uses an X-band 2D/3D radar to detect and track UAVs. The ZADS has the capability to detect up to 100 UAVs in a swarm, according to Zen Technologies.

A company official told *Janes* in February that 30% of the delivery to the IAF has been completed. The remaining deliveries are expected to be completed by the end of March.

The ZADS has cleared a few trials conducted by the Indian Army, and has also been demonstrated to the Indian Navy, the official said. "A dedicated team is ready to make the modifications to adapt [the] ZADS for maritime needs," the official added.

The ZADS has also been demonstrated to some countries in the Asia-Pacific and the Middle East, the official said.

The official said that the ZADS has achieved a detection range of 8 km in internal trials. Zen Technologies will work to increase the detection range of the ZADS to 10 km and expand its jamming range.

The company is also developing a manportable version of the ZADS and is working to enable the system to incorporate position information from the Indian Regional Navigation Satellite System (IRNSS), the official said.

At present, Zen Technologies is integrating hard-kill capabilities into the ZADS by using existing Indian weapons such as medium machine guns (MMGs).

Hawking Defence

Hawking Defence has collaborated with Israeli company Skylock to develop a wearable C-UAS system. The two companies have a memorandum of understanding (MOU) and transfer of technology (ToT) agreement. The C-UAS units are manufactured at Hawking Defence's facility in Chennai.

The C-UAS weighs about 1.5 kg and is suited for close-quarters battle (CQB). It can detect and jam a hostile UAV's RFs and GNSS, **Captain** Amber Singh Uban (retd), co-founder and director of the company, told *Janes* on 1 March.



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Hawking Defence has collaborated with Israeli company Skylock to develop a wearable C-UAS system (pictured) that can jam a hostile UAV's RFs and GNSS.
(Janes/Amit Kalra)

The wearable C-UAS has an omnidirectional detection range of 3.5 km (without any line of sight) with support from an external antenna. Without the antenna, the C-UAS has a detection range of 2 km. The detector has an endurance of eight

hours, Uban said. “The directional range of the jammer is 73° and it has a battery life of two hours,” Uban added.

The detector and jammer work in two modes – automatic and manual. “In the automatic mode, there are three ways in which the C-UAS tells us that it has detected a UAV. The first one is through the earphone. If the UAV detected is a part of our library, the C-UAS will identify it, otherwise it will alert the operator by announcing ‘drone, drone, drone,’” he said.

“Besides that, we have a light that flashes and the detector also vibrates. All three will be activated whenever a UAV is detected,” he added.

In the automatic mode, the jammer automatically starts transmitting the signals at the same RFs used by the incoming UAVs. “If it is in a manual mode, the operator would have to press a button for about two seconds, and it takes another two to three seconds for the jammer to get activated,” Uban said.

The wearable C-UAS has been tested to simultaneously detect at least eight UAVs “flying on different latitudes and longitudes”, he said.

In February, the system was tested by the Indian Army's Eastern Command in northern Sikkim, at an altitude of 14,000 ft, Uban added.

Uban told *Janes* that the company has been “approached by one of the paramilitaries to procure more than 150 units of the C-UAS”, adding that, “we are in the final stages of negotiations”.

Hawking Defence's wearable C-UAS is deployed along the western borders of **India** by the **BSF** and is also used by the Jammu and **Kashmir** Police force in the volatile **Kashmir** valley, he added.

The C-UAS has been tested by the Special Protection Group (SPG), National Security **Guard** (NSG), Indian Army's Western Command, Assam Rifles, and multiple state police forces, Uban said. The company has also demonstrated the C-UAS to the armies of **Cambodia**, **Oman**, and **Vietnam**, Uban added.

Hawking Defence does not plan to integrate hard-kill capabilities into its systems at present.

Grene Robotics

Hyderabad-based Grene Robotics has developed a capability named 'Indrajaal' to command and control countermeasures against rogue UAVs.

Wg Cdr MVN Sai (ret'd), director of emerging technologies at Grene Robotics told *Janes* that Indrajaal can manage a network of subsystems to detect and counter low radar cross-section (RCS) aerial threats including medium-altitude long-endurance (MALE) and high-altitude long-endurance (HALE) UAVs, loitering munitions, UAV swarms, and precision-guided munitions that have a range of around 40–60 km.

Sai said the company envisages the operation of one Indrajaal C-UAS system defending an area of around 4,000 km² “instead of deploying nearly 20 separate C-UASs to do the same”. Such an area could include military bases or critical infrastructure.

Kiran Raju, founder and CEO of Grene Robotics told *Janes* that the first prototype of Indrajaal will be demonstrated to representatives from the Indian Armed Forces, paramilitary, MHA, and industry at an airfield in Hyderabad by the first half of 2023.

The company has developed the algorithms that will enable communication between the various systems Indrajaal will employ to counter aerial threats. Such systems could include jammers, DEWs such as lasers, net launchers, conventional weapons such as light machine guns and MMGs, and expendable UAVs, Sai said.

“We are also working to integrate active short-range missiles and boron pellets in Indrajaal for use against aerial threats,” he added.

“In [the] case of a swarm attack, you can't jam the entire sector and hope that none of your friendlies will get affected. So, we need more kinds of munition to counter various aerial threats,” he said.

“The user can decide and select the ideal combination of weapons depending upon the requirement,” Sai said.

Other developments

The Indian Army's Army Design Bureau (ADB) signed an MOU with the Drone Federation of [India](#) (DFI) in August 2022 to collaborate on research and development (R&D), testing, and manufacturing of UAVs and C-UAS technologies with the help of academia and industry. The ADB is also working with the Indian Institute of Technology (IIT) Bhubaneswar to develop C-UAS technologies.

Some Indian firms are also trying to collaborate with foreign companies to develop C-UAS technologies for the Indian market.

Gurugram-based Jugapro has partnered with Fortem Technologies in the [US](#) to launch a C-UAS in [India](#) based on Fortem's DroneHunter, which is an AI-enabled UAV that intercepts other UAVs using a net tether.

DroneHunter is a part of Fortem's broader SkyDome system, which uses TrueView radar and other sensors to autonomously monitor an environment to detect 'dark' UAVs that emit low or no RF or other signals.

Godrej, a company headquartered in Mumbai, has reportedly partnered with French company CerbAir to develop a lightweight, handheld, C-UAS jammer based on the latter's '[Chimera](#)' system.

The [Chimera](#) system comprises an 8 kg antenna box equipped with an omnidirectional very-high frequency (VHF) antenna, electronics, and Bren-Tronics rechargeable lithium-ion battery, which powers a 60 cm long, 5 kg effector, equipped with a directional antenna. It can detect and neutralise UAVs by transmitting a beyond visual line-of-sight (BVLOS) electromagnetic disruption signal from the handheld effector.

Challenges

Air Mshl Tiwari told *Janes* that the challenges faced by [India](#)'s armed forces in countering UAVs along the border with [Pakistan](#) are “very different” from what they face near the border with [China](#).

Unlike along the [Pakistan](#) border, where there are regular incursions by “small quadcopters” carrying “up to 5–10 kg payloads” of arms or drugs, the UAVs detected along the [China](#) border are high-performance, advanced UAVs “flying at high altitudes for surveillance”, Air Mshl Tiwari said.

The latter is treated “almost like an aircraft”, he said. There are usually strict protocols in place, and incursions are relatively rare. If protocols are violated, then “we are free to take action” against such UAVs. However, by and large, the C-UAS

C-UAS capabilities along the **Pakistan** border are, by contrast, focused on jamming systems to counter the small quadcopters, he said.

“The biggest challenge for the armed forces is detection and airspace management,” Air Mshl Tiwari said. UAVs have become increasingly commonplace, making it difficult to monitor traffic and ensure that users adhere to the established regulatory rules. It is a challenge to identify, particularly in an urban environment, which UAV may have been deployed by an adversary and is a security threat, he added.

“Bringing down a hostile UAV can be another challenge,” Air Mshl Tiwari said. For example, the jammer of a big C-UAS system can also disrupt communication of friendlies including civilians, and civilian or military facilities. “To defend while also ensuring that common people do not face any inconvenience is a big challenge,” he added. This challenge is highlighted as a major concern for the armed forces by an Indian Army officer, who did not want to be identified.

Speaking to *Janes* in February, the officer, who has years of experience in air defence, said that the detection and identification of rogue UAVs continue to be a challenge because these activities are mostly conducted manually by soldiers on ground.

There also needs to be better co-ordination between the triservices, paramilitary, and various state police to integrate data for improved detection and identification of UAVs, the officer added.

There is a need to define where, when, and what C-UAS capabilities need to be used depending upon the surrounding environment and the kind of targets involved, the officer said. For example, “we do have shoulder-fired missiles, which can counter UAVs, but why would you want to use a missile that costs hundreds of thousands of dollars to neutralise a USD1,000 UAV?”, the officer added.

Air Mshl Tiwari and the Indian Army officer had a positive outlook about the training given to soldiers for enhancing C-UAS capabilities.

“Our people now are much more aware about the threats from UAVs,” Air Mshl Tiwari told *Janes*. “We have worked out a fairly robust standard operating procedure, and in most of our stations it's working well. We do centralised monitoring, but decentralise the execution by giving orders to soldiers deployed,” he said.

Comment

For the Indian Armed Forces, the development of C-UAS capabilities is crucial to defending border areas, strategically important areas, and critical infrastructure, given the growing use of different kinds of UAVs by state and non-state actors.

At present, the armed forces are focusing on domestic development and production through collaboration with industry and academia or through in-house R&D to fulfil their C-UAS requirements.

However, the armed forces need to acquire more modern C-UAS systems, expand the capabilities of the existing ones, and improve interagency co-ordination to better counter the increasingly sophisticated UAV systems developed and employed by adversaries, particularly along **India's** long and often inhospitable border areas.

In domestic R&D, there should also be an increased focus towards developing hard-kill capabilities to facilitate quick elimination of rogue UAVs.

The development of a C-UAS doctrine outlining the MoD's policies, priorities, and plans can also help to better organise and guide efforts by the armed forces to counter UAVs.