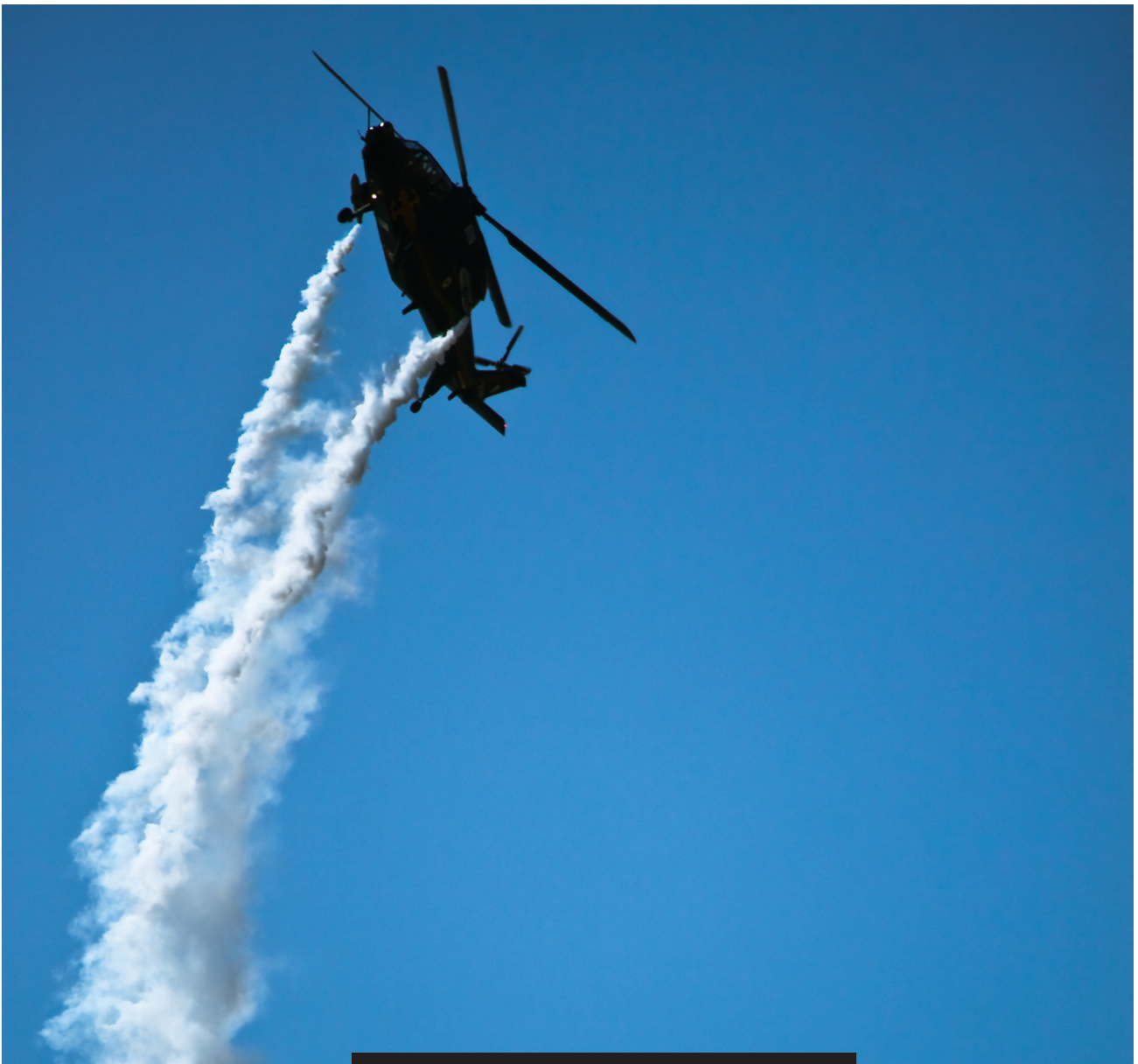


SPECIAL **REPORT** no. 202

A Conceptual Relook at the Indian Army's Terminal Air Defence

Ashok Kumar



DECEMBER 2022

Abstract

The ongoing Russia-Ukraine war has underlined the emerging realities of states' air defence needs, including those for medium- and long-range air defence missile systems. The most important facet in the domain of air defence relates to terminal air defence—or the defence of a single object or a limited area like a ship, building or an airfield, now usually against air attacks and guided missiles. This report underscores the need for India to refocus its planning on air power, especially in the context of potential collusive threat from China and Pakistan. Ground-based air defence needs to be calibrated and carefully planned alongside air operations for a comprehensive defence of India's skies.

Attribution: Ashok Kumar, "A Conceptual Relook at the Indian Army's Terminal Air Defence," *ORF Special Report No. 202*, December 2022, Observer Research Foundation.

Introduction

As missiles entered the air space in the 1950s, it became imperative for a country's air defence to include the capability to defend not just against an attacking aircraft, but also an adversary's missile systems.¹ With the advent of more weapons utilising the air to cause an adversary's destruction, the scope of air defence has also been expanded. Indeed, with the use of aerospace for the launch of weapons systems such as hypersonics and triad-based missiles, air defence has become one of the most challenging requirements for a country, both for preserving its own assets as well as destroying those belonging to the adversary. The challenge has become more complex with the entry of drones, swarm drones, and Unmanned Aerial Vehicles (UAVs).

For an optimal outcome, an adversary's strike capability—whether in the form of an aircraft, missile, or any other weaponry—should be destroyed or neutralised before it takes off or is launched. This may not be possible, however, in most cases. The next best option is the destruction of such resources during transit, before they reach the intended target—this requires high-quality surveillance and tracking ability.² The detection and identification should be made early enough to provide adequate time for the counter-weapons to be launched.

There may be multiple situations where the adversary's weapons system is more efficient, and/or the army's ability to take on such threats either before take-off or during the flight is limited. The terminal air defence, also known as Point Air Defence, therefore, becomes one of the most important tools in a country's air defence matrix. Terminal air defence or Point Air Defence is the defence of a single object or a limited area, e.g. a ship, building or an airfield, now usually against air attacks and guided missiles. While it may be fashionable to procure excessively costly missile defence systems, the terminal air defence does not become redundant or its contribution to the air defence potential of the country does not decline.

China's People's Liberation Army (PLA), for example, has included this requirement in its war-fighting: 'terminal air defence' resources have been grouped down to the unit level despite already having credible area defence resources in its inventory.³

India, despite the increasing availability of stand-off weapons and attack profiles, has yet to give serious thought to this important facet of air defence. A renewed approach will necessitate the provision of more Point Air Defence resources to the war-fighting elements of the country along with the requirement of Control and Reporting (C&R) elements to be made available to the last user for air defence purposes.

“With the advent of more weapons utilising the air to cause an adversary's destruction, the scope of air defence has also been expanded.”

The Evolving Operational Environment

The operational environment for countries' armed forces has undergone substantial change the world over. On India's Western front, Pakistan has almost lost the so-called strategic depth⁴ against India in Afghanistan, with the Taliban government assuming power and questioning even the border alignment with Pakistan along the Durand line.⁵ Even Iraq's attempts to shift its aircraft to Iran during Operation Desert Storm⁶ to save them from US bombing did not bring in any significant advantage. While the aircraft and aircrew were saved from the US onslaught, Iran did not return these resources immediately after the 1991 Gulf War was over, which was carried out piecemeal, thus nullifying the primary purpose for shifting the aircraft out to Iran.

These two examples, seen in the context of the emerging new world order, indicate certain peculiarities that will need to be considered while developing India's air defence plan, in general, and 'Terminal Air Defence', in particular. Both examples highlight the fact that attack profiles and air threats change not only with the physical characteristics of the combat aircraft, but also according to shifting geopolitical situations. In the above mentioned examples, both Pakistan and Iraq faced crucial challenges of a constricted air space which then translated into adverse tactical and operational scenarios.

The following points outline what this report considers as key facets of the current operational environment.

Self-reliance is an imperative.

Every country is required to generate resources and needs to be self-sufficient to meet its national air defence needs. While some support may come from friendly countries, a conflict of national interests can quickly change the narrative. A recent example is that of the United States which is re-energising the F-16 fleet of Pakistan, ostensibly for counter-insurgency operations.⁷ Such events will continue to occur in the days ahead and it is essential for India to develop indigenous capability.

Short, swift wars are archaic.

With the advent of more destructive weapons and power precedence, it was becoming an accepted norm that wars and conflicts are going to be short and swift. This belief has resulted in countries opting for different kinds of equipping, mission reliability, and employment tactics. Yet, the notion has been belied by the Russia-Ukraine war which shows no signs of abating despite the wide disparities between the two forces. The majority of India's borders with

China are in the mountainous region, as well as at the Line of Control (LOC) with Pakistan, also in similar terrain; India should therefore plan for a long-term war against a potential collusive threat from the two fronts. Air defence resources will be under severe stress in such conflicts, including those deployed for terminal air defence.

Indigenous capability is an inescapable need.

In a statement he made in September, the current Chief of the Army Staff (COAS) General Manoj Pande highlighted that India's dependence on imported technologies for defence has emerged as a "strategic vulnerability".⁸ He stressed the need for self-sufficiency in the defence sector, saying the country's security can neither be outsourced nor become dependent on the largesse of others.

Indeed, a significant proportion of India's air defence resources, including the currently contracted S-400 missile defence system, is from Russia. However, the sustenance of the supply is under stress due to Russia itself fighting a war. In the first step towards developing indigenous capability, terminal air defence resources—be they guns, missiles, or a combination of the two—must be manufactured domestically, even if rudimentary.

Maintenance, Repair and Overhaul (MRO) support is required.

On one hand, India has to struggle with a very high percentage of air defence equipment imported predominantly from Russia; on the other hand, it has to look at spares as well as Maintenance, Repair and Overhaul (MRO) support, which has to be done indigenously. The ongoing Russia-Ukraine conflict has compounded this challenge. While the replacement of imported air defence equipment cannot be done with indigenous production in a shorter period, comprehensive spare support and MRO support must be built for the entire range of equipment, in general, and that of terminal air defence equipment, in particular. *MRO Digest Forum*, an informal, online platform in India can provide valuable inputs to this national effort. Once such capability is developed, it can serve as a precursor to indigenous equipment production.

Reliance on Terminal Air Defence is increasing.

The missile defence system the world over has come under stress in recent years. Newer missiles including the hypersonic variety, as well as the rockets which do not get detected early enough to activate the response mechanism, have been posing a huge challenge, resulting in increased need for more potent terminal air defence systems. The area air defence should be considered as a bonus despite being important and a vibrant network of terminal air defence should be implemented to defend India's important assets, including indispensable human resources.

Many other factors influence the operational environment, among them the advent of drones/UAVs. There is a requirement, therefore, for a fresh reappraisal of air defence, in general, and terminal air defence, in particular.

Challenges to Terminal Air Defence

Multiple limitations can impact the type of terminal air defence equipment that India would opt for.

Budgetary Support

The majority of air defence systems are cost-prohibitive. For instance, India has spent some INR 40,000 crores on the procurement of five regiments of the S-400 missile defence systems from Russia.⁹ All other procurements are also fairly costly irrespective of the source country, putting severe stress on the meagre defence budget available for capital outlay. Indeed, the Army has inadequate budget, overall, which shrinks further once it comes to the Army Air Defence (AAD). In the process, the entire air defence, to the ground forces, get compromised to a degree; the brunt is borne by the ground forces. There have been cases where budgetary constraints

have adversely affected the procurement of air defence systems: two examples are related to the indigenous Akash missile system, and the Air Defence Gun Missile System (ADGMS).¹⁰

The Part-Lease Model

Since the area air defence weapons are costly, some part of it can be taken on a leased model to reduce the budgetary requirement and allow focus on terminal air defence, with which the battlefield is required to be saturated. The part-lease model has the potential to address certain gaps from area air defence as well, if a networked mesh is created with a weighted threat profile that is suitably engineered and implemented.

Special Conditions for Storage of Missiles

Whether for area air defence or terminal air defence, missiles invariably need temperature-controlled storage which can become a limiting factor under specific field conditions. The storage constraints for terminal air defence would be eliminated if the optimum use of such a missile has to be done in the field under battlefield conditions. Guns do not place such a serious storage condition restriction and therefore the guns should also form an important part of terminal air defence.

Special Testing Needs

The current missile system needs specialised testing before use despite being within a serviceable life span. Such a requirement also works as a limiting factor for the employment of missiles under field conditions. More testing equipment is needed in case of dispersed deployment.

Control and Reporting

Control and Reporting (C&R) constitutes the most important facet of effective employment of air defence resources by the Army. The Air Force (AF) is a senior partner and has the wherewithal to provide this information, through the Integrated Air Command and Control System (IACCS).¹¹ Full-spectrum compatibility between the Indian Air Force and the Army in the C & R domain is a huge challenge and puts serious constraints on the

employment of air defence resources. This is more pronounced for the terminal air defence and will be even more so once the Tactical Battle Area (TBA) is planned to be saturated with terminal air defence weapons systems. These limitations put serious functional constraints and need to be addressed in the short term.

Command and Control Arrangements

Command and Control arrangements have historically been a serious limitation and continue to be so. The Air Force is showing more lien on air defence resources, be they for area air defence or terminal air defence. The more professional approach could be the Air Force shifting to a strategic domain including aerospace, whereas all other guns, missile systems, and gun-missile systems must be bought under the purview of Theatre Land Commander irrespective of ranges, height coverages, and technologies employed. This should include the S-400 and other such missile defence systems as well. The Land Forces commander can employ the entire AD resources through their AAD advisers at all levels. There are many more such limitations that need to be considered by the planners of Air Defence, especially those in the terminal air defence domain.

Shortcomings of the Current Systems

There are a large number of air defence systems in the Army that are required to function in the current environment of operational constraints. Furthermore, there are certain weapons-related limitations that need to be considered before a potent terminal air defence architecture is adopted.

Missile Systems

- a. Except in the case of the shoulder-fired category, all others are cumbersome. Those could be used in the terrain having mobility but are less suited in mountainous and difficult terrains.
- b. Those in the non-active guidance category have the potential of causing fratricide in case they are launched before identification. The Indian Air Force experienced this in February 2020 when an MI-17 was downed by friendly fire.¹² A more robust C&R is therefore needed.

- c. These are susceptible to jamming if a stronger source of 'lock on' is created based on the system of detection on which it operates.
- d. Though these have higher single-shot kill probability (SSKP), they remain a dumb system unless an effective 'lock on' is achieved.

Limited Ranges in Case of Passive Systems

In the case of terminal air defence, especially those of shoulder-fired missiles, these invariably lock on the heat source. Being oriented towards the general area in which the aircraft/missile is likely to appear is essential as only then can an early 'lock on' and timely launch be possible. Invariably, such requirements need an early warning from radars at a very early stage. This becomes more crucial for shoulder-fired or man-portable air defence systems (MANPADS).

Gun Systems

In contrast to the missile systems, gun systems have their shortcomings and peculiarities that need to be considered for their effective employment in the terminal air defence meshed network. The following are some of the important aspects in this regard.

- a. Except in the case of the ZU-23 twin barrel category of weapons, all other gun systems can be cumbersome due to their linkages with radar and generator systems. This precludes their employment in mountainous and inaccessible terrains, leaving ZU-23-2B category of guns being the only potent weapon available for use.
- b. Despite a high rate of fire, guns invariably have very low SSKP.
- c. There is no requirement of 'lock-on' for firing. The firing is operator-controlled and it is so in the case of radar-controlled guns wherein they can fire once such a decision has been taken by the operator. Though of deterrence value, they offer the flexibility of at least assured fire.
- d. Invariably, the terminal air defence weapons system needs to open fire before the attacking aircraft/missile reaches the weapon release line (WRL). With stand-off capabilities being added, WRL is shifting away from the deployed location of the asset to be protected. In the process, the

guns with relatively short ranges are unable to neutralise the threat before WRL is breached. They will therefore require a meshed network of terminal air defence weapon systems that work not only as terminal air defence for the asset for which they are deployed, but also trap the threat before it manifests for others. This approach will ensure threat mitigation in the earliest time frame.

- e. These are not susceptible to jamming except when linked to radar systems which can be jammed. The guns can still be fired in the process, however, losing the radar-controlled advantage of accurate and long-range firing.

Gun-Missile Systems

These systems address the crucial handicap of missile systems that cannot be launched unless the 'lock on' on the target is achieved as well as lower SSKP of gun systems. These allow a tiered response to the threat, wherein missiles are launched first, followed by the opening of gunfire. These systems are also relatively cumbersome and are therefore more suited to areas having less terrain friction.

Capabilities Needed for the Indian Defence Forces

The discussions in the preceding sections of this report bring some clarity on the kind of weapons systems needed for India's terminal air defence. This report offers the following recommendations.

Command and Control. Strategic employment of air resources including those in the aerospace domain should be with IAF; whereas all other air defence resources must shift under the Field Formation Commander, to be operated by Army air defence units.

Three Systems Approach. Terminal air defence should have a ZU-23-2B category of guns,¹³ an Igla-1M category of shoulder-fired missiles,¹⁴ and a Pantsir-S1 type of anti-aircraft gun-missile system.¹⁵ India need not go in for only these weapon systems and their variants but any system in such categories. The availability of these three systems in adequate numbers will address the terminal air defence comprehensively.

Indigenous Products. India must produce these terminal air defence systems comprehensively. The existing industrial base and technological know-how can make it happen.

- **Indigenous MRO.** With the indigenous approach to production, indigenous MRO should also be configured to make the products mission-reliable throughout their life cycle.

Areas of Employment:

- **Pakistan:** 50 percent gun missile systems and 25 percent guns and 25 percent shoulder-fired missiles should be employed. Gun-missile systems should be employed in areas providing the requisite mobility, whereas guns and shoulder-fired missiles should be deployed in LOC areas. The percentages can be modified after a detailed examination by the decision-makers.

- **China:** Given that the majority of areas are mountainous and inaccessible, one model can comprise 10 percent gun-missile systems, 20 percent gun systems, and 70 percent shoulder-fired missiles. However, the proportions can be determined more precisely by the planners.

Allocation. Each unit, down to the infantry battalion level should have organic terminal air defence resources. Two guns and one section of missile launchers (consisting of two detachments) should comprise the basic allocation forming part of the war establishment or the official inventory of the unit. These must be given C&R support and could be operated by the air defence gunners and missile operators.

Networked Mesh. With the recommended allocation, a meshed network of terminal air defence systems should be created to ensure that the adversary's attack resource is trapped for assured destruction. Terminal air defence systems should be looked at to destroy the ingress of attack resources, in addition to the defence of own assets.

Meeting the Threat. Based on an assessment of the adversary's resources, tactics and likely employment methodology should be worked out. The number of terminal air defence weapons systems required to be deployed in an air ambush role/ extended mesh network needs to be decided to ensure that the attack resources are neutralised before becoming effective.

- **Munitions:** Higher quantum of munitions/ missiles should also be considered, in addition to increased number of platforms.

Crew Training. The crew behind the machines matters substantially. Comprehensive training will hone the requisite skills.

Conclusion

Terminal air defence or point air defence remains the most important link in ensuring the safety of the Indian Army's troops and in preserving national assets. These can be game-changers if employed effectively with indigenous weapons systems, combined with innovative and pragmatic deployment.

All infantry battalions and equivalent units must have organic air defence resources for their terminal air defence. The gun systems can address both the ground threat and aerial threats. These can be highly effective owing to the flat trajectory and will enhance the potency of the Indian Army. [ORF](#)

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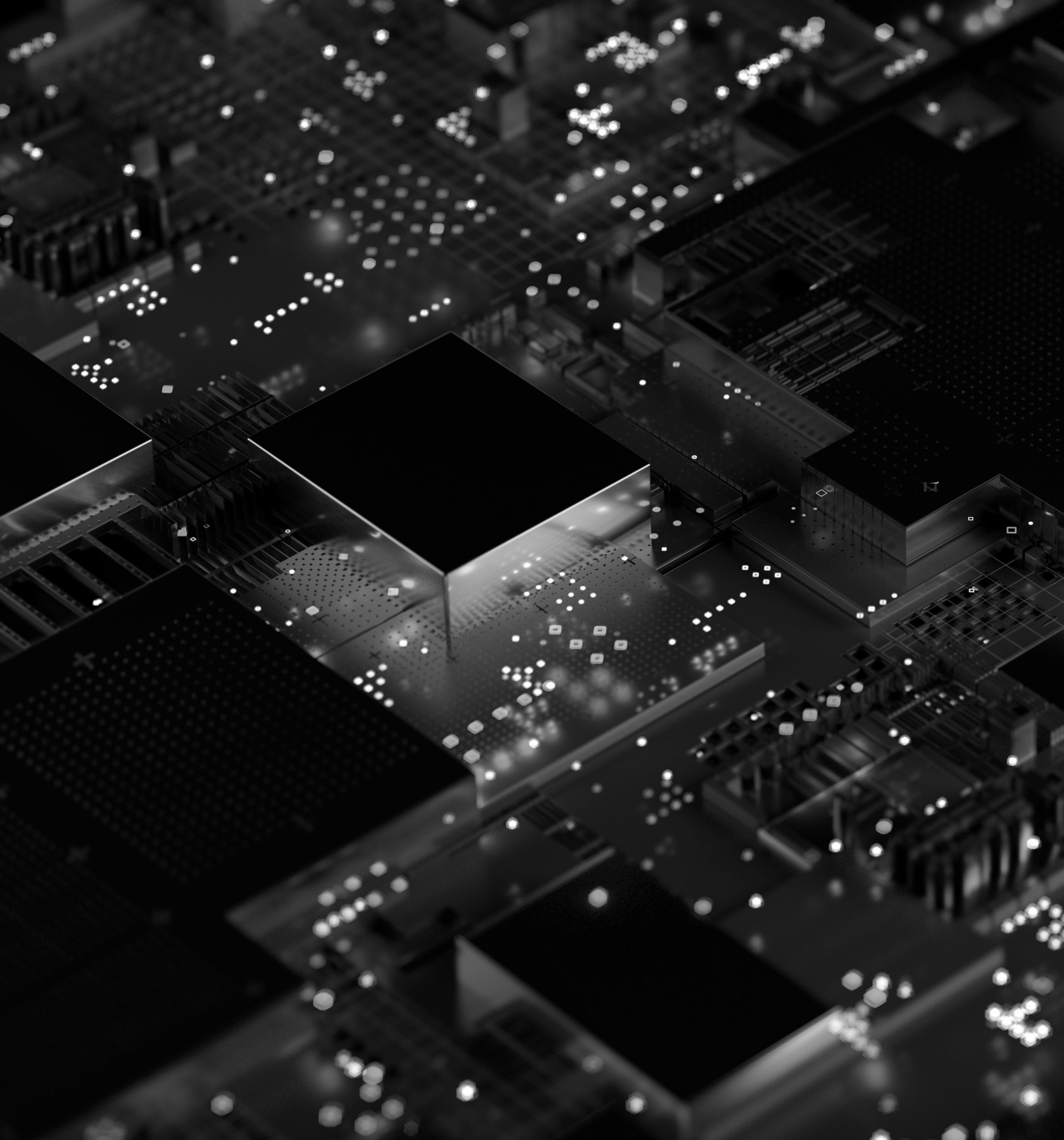
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About the Author

Maj Gen (Dr) Ashok Kumar, VSM (Retd) is a Kargil War veteran, Visiting Fellow at CLAWS, and a Defence & Strategic Affairs analyst.

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