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Ground Based Air Defence: A Paradigm Shift

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Abstract

In the contemporary world, Air Operations and Air Threat are undergoing a transformational evolution owed largely to the exploding technology that is driving it towards unmanned platforms of various hues and types. The profound migration and its insistent employment in conflicts and war, in the last decade and half, needs detailed examination. The article explores the evolution of air operations— the current paradigm that moves it away from existing belief systems. The air threat, as it manifests now, also translates into exploring new concepts of effecting Air Defence with specific reference to Ground Based Air Defence. The unique challenge thus requires a reoriented AD architecture where emphasis on air space defence and asset defence have to be thought anew in the ambit of Air Space Denial, Deterrence and Destruction of Aerial Assets.

Keywords: Ground Based Air Defence (GBAD), Air Space Denial, Deterrence, Destruction

Introduction

The history of exploiting 'Air' as a medium for delivering destructive ordnance, dates back to pre-World War I period. The use of balloons (UCFC)[1], pigeons (Pigeons of War, 2022) etc. were primarily meant for information sharing and gathering purpose, hence had very limited destructive impact. The invention of manned flying machines by Wright Brothers (December, 1903), revolutionised the thought of exploiting airspaces. The initial proponents of employing aerial machines for warfare were ignored and not taken seriously as these were considered fragile, unreliable, limited in operational capability and doctrinally unacceptable as land and sea forces were considered the primary means of winning conflicts. Brigadier General Billy Mitchell's theory on air warfare propounded a conceptually radical concept of the time i.e. winning wars without the predominant role of land or maritime forces and advocating setting up of an independent air force (Glines, C.V. 2006).

[1] In the nineteenth century, the military used balloons for three purposes. One was for aerial bombing of military targets. The second was for aerial reconnaissance by captive balloons. The third was for communications and to transport personnel, mail, and equipment. (Military Use of Balloons in the Mid- and Late Nineteenth Century. US Centennial of Flight Commission). https://www.centennialofflight.net/essay/Lighter_than_air/military_balloons_in_Europe/LTA4.htm.

Inflection Points

The evolution of air power can be viewed through the prism of four critical inflection points highlighted in succeeding paras.

- ***Inflection Point No 1.*** The setting up of the Royal Air Force in April 1918 established a historical precedent that marked the first inflection point in the history of air warfare— of employing air power as a means of war winning effort.
- ***Inflection Point No 2.*** Air Power, with myriad manned platforms and launch pads, provided the decisive edge during the second half the 20th Century till the second decade of 21st Century. This period witnessed immense transformation of manned aerial platforms— graduating from first generation aircrafts to fifth generation aircrafts. Aircrafts like F-35, redefined air power with stealth and advanced technology converging in own machine. The period also witnessed unequivocal domination of air spaces by air power with a set piece dynamic campaign plan aimed at achieving degrees of air dominance wherein nullifying enemy air forces providing the operational environment and pre- requisite necessary for unhindered operations in other domains (Land and Maritime). Later, Air Forces were accepted as the principal and primary arbiter of defending air spaces and its sovereignty over national territories. This notion is still hardwired into the psyche of strategic practioners. The Air Defence especially Ground Based Air Defence (GBAD) was considered as an afterthought — manned aircraft was considered the most appropriate and first contact platform for destroying adversary aircrafts.
- ***Inflection Point No 3.*** The proverbial 'Billy Mitchel moment' for Air Forces around the world has emerged again a century after, with the advent of Unmanned Intelligent Aerial Machines making decisive entry into the battlefields. Primarily designed as persistent, Intelligence, Surveillance and Reconnaissance (ISR) assets supplementing other assets, their sophistication and vistas of application expands from ISR to networked targeting across all ranges and altitudes, borne out by innumerable examples of unmanned systems delivering battle winning impact on engagements. The Russia- Ukraine, US-Iran, Hezbollah-Israel conflicts have proven that unmanned aerial vehicles in their various avatars offer 'battle equalising' and 'asymmetric equivalence' in effects against superior air forces employing cutting edge platforms as part of

full spectrum air capabilities. The unique abilities of unmanned platforms of being simple to use, limited financial and operational cost is expendable, as losing them does not entail operational or strategic setback; decentralised runway independent operations ability and democratising aerial expertise have served to redefine the conventional air operations. The establishment of separate Drone Forces by Russia (Xinhua, 2025) and Ukraine [2]is testament to the above fact. unique feature of unmanned platforms remains their unique ability to remain in threat even in an intensely hostile Air Defence environments. Words like 'Kamikaze' drone aptly capture this effect and consistent strikes by Ukrainian Drone forces deep in Russian territory and Iranian drones in Israeli and Middle East bear testament to their incessant effectiveness even against advanced layered and tiered air defence systems.

- ***Inflection Point No 4.*** Missiles, Rockets and Artillery have added range, lethality, persistence, penetrability, survivability and precision to the aerial vectors. The 'beyond visual long range capabilities' have mitigated threat of interception to manned platforms from Air Defence Weapons facilitating their operation outside of the contested battlefields. The setting up of a dedicated Rocket and Missile Forces suggests a shift to institutions and organisations that turn 'technology to effects' and eliminates cost and danger to platforms especially manned. The debate on unmanned vs manned platforms has persisted and aggravated overtime. Cogent arguments on either side have largely been inconclusive to drive a consensus on the dispensability or pre-eminence of each of these systems.

A detailed analysis of prevailing threat and counter threat spectrum in the aerial domain leads us to four tenets that underscores approach to Air Defence Operations. These are as under:-

- ***Tenet No 1***. The Artificial Intelligence imbued low cost, high technology, autonomous

[2] Ukraine has invalidated two dominant pre-war myths: that drones would deliver decisive effects through technological superiority, and that they would be rapidly neutralised by air defences and electronic warfare (EW). Instead, drone warfare has emerged as a domain characterised by mass, attrition, and continuous adaptation, with UAS integrated across the full targeting cycle (find, fix, track, target, engage, assess) within distributed kill webs. The Armed Forces of Ukraine (AFU) have often demonstrated that what seems to be a 'myth' can become 'an operational reality'. However, the further from the operational reality in Ukraine, the more myths persist…https://researchcentre.army.gov.au/library/land-power-forum/drone-warfare-ukraine-myths-operational-reality-part-1.

unmanned aerial platforms are expendable, replaceable and their destruction has no or marginal impact on the intensity or persistence of air threat and they can operate with impunity, irrespective of the air defence environment.

- ***Tenet No 2.*** The sophistication of ground based AD systems have the ability to destroy large non-stealth and non-hypersonic aerial platforms like fighter jets, helicopter and high value aerial assets. The Air Defence environments now have disproportionate large deterrent impact on manned platforms.
- ***Tenet No 3***. The democratisation of air threat vectors, especially unmanned vehicles, further expanded to include rocket, artillery and missiles, that have empowered land and maritime force commanders to orchestrate independent offensive air operations up to strategic depth against one's adversary. Further, the launch infrastructure required for unmanned platforms, especially expendable, is sparse and hence can be stated that, dependence on airfields for air offensive has diminished while they may remain relevant for other aspects of air campaigns.
- ***Tenet No 4***. The GBAD weapons will be the principal means of defending not only assets on ground but equally air spaces through deterrence against manned platforms and destruction of unmanned vehicles.

Air Threat Landscape and Inferences

• Medium of 'Air' shall be the key means of executing non-contact warfare across the spectrum of conflicts.

• Migration of air threat from Contact (Proximate) to Non-Contact (Distant) would be the manifestation of aforesaid trend of air threat.

• Persistence of 'Generations of Air Threats — First to Sixth' in multiple combinations over prolonged durations across the spectrum of operations (Grey Zone, conflict and War) is the new reality.

• Air threat vectors have diversified into multifarious mutations with niche effect methodologies requiring specialised AD equipment portfolio. Specific yardsticks may need to be considered for scaling of equipment addressing specific threat types. Need based hybridisation of capabilities need to be thought off.

• The adeptness of unmanned platforms to penetrate through operational areas in critical numbers has expanded despite the GBAD capability architectures in place.

• The depth, saturation and number of targets that can be attacked by unmanned aerial platforms has exploded beyond tactical and operational areas into the hinterland, thus, transferring the ability to disrupt life in adversaries 'heartland' for prolonged periods

without reciprocal risks, making the threat universal across landscapes and impacting threat prioritisation by the defender. This has in fact imposed disproportionate cost on defending assets and air spaces.

- Adaptive unmanned aerial platforms may, in the foreseeable future, be imbued with the ability to predict interception areas based on Artificial Intelligence, thereby challenging the current interception and prediction models embedded in various AD platforms.

- Recreation and resuscitation of air threat in realistic quantities at field formation, is feasible even with limited military industrial complex.

- The development cycle of unmanned platforms are shorter and more dynamic leading to speedy field upgradations of both platforms and weapons.

- The cycle of invention, innovation and fielding of unmanned platforms is challenging obsolescence of GBAD equipment at a much faster rate—invoking disproportionate capital costs in the production and fielding of appropriate weapon systems to tackle the spectrum of non-stealth aerial threat.

- Counter air operations, to generate SEAD/DEAD impact, have limited efficacy against Runway Independent Aerial Platforms and terminal AD weapon platforms which would survive these missions. The execution of these missions against matched air forces / intense GBAD environment would be a challenge.

- The concepts like 'Favourable Air Situation, Air Supremacy, Air Dominance etc. requires doctrinal revisit in the era of unmanned platforms wherein their ubiquitous presence will persist despite the most successful air campaign.

- The air threat, in quantitative and qualitative terms, has acquired an 'infinite' character; moreover, the material cost and axiomatically the logistic challenge of prosecuting sustained GBAD operations have magnified.

- The concept of 'AD Deterrence' built around destruction of manned aerial threat, needs a rethought, as these threat vectors have receded from the AD predominant air spaces.

- The sheer scale of sustained manned and unmanned air operations would challenge the conventional AD supply chain. This would become even more relevant when the AD interceptions are to be orchestrated with specificity of 'Weapon to Target' match on a cost basis.

- The diversity of air threat and the specificity of AD interceptor vector required to destroy each type air threat, entails a fresh set of planning guidelines for GBAD organisation, structures and operations and rearticulation of the philosophy of 'Threat specific Cost Effective Air Dominace'.
- Affordable stealth and field deployable hypersonic vehicles would aggravate the challenge of air defence, underlining the imperative for reconfigured GBAD ecosystem.
- Perception of porous air spaces has profound impact on cognitive outlook of the nation, more so in border areas leading to multiple second and third order effects.
- Active EM based GBAD systems would remain vulnerable to detection and destruction / neutralisation; thus, necessitating the imperative of 'EM silent AD operations' by:-
    - Silent EM and EO detection, tracking and guidance.
    - Multi-static detection configurations.
    - Intelligentisation of AD equipment—automated and adaptive.
    - Imaginative employment of legacy AD equipment as operational/tactical reserve.
- Active Deception will emerge both as a key 'battlefield equaliser', 'strategic force multiplier' and 'critical to survival / graceful' degradation of GBAD architecture.

What Should We Do?

The philosophy of defence relies on edict of 'detect, discern, delay, disrupt, destroy and defeat'. This philosophy translates into 'an architecture of attrition woven with detailed appreciation to defeat the adversary'. The emphasis on defence in territorial construct is focused on inflicting unacceptable casualties on attacking enemy, despite enemy's numerical superiority at the point of decision. Translating the analogy to defence of air involves two aspects viz. defence of air spaces (denial of these to the adversary) and defence of assets from destruction / damage.

The prevailing maxim of Air Defence has two principal vector components controlled centrally through a control and reporting organisation :-

- Airborne AD - Aerial Platform specific.
- Ground Based AD - Ground Based AD Weapon systems.

The concept was structured around the principle of 'Threat Prioritisation' and thus it has a consequent bias towards defending the most threatened as compared to less threatened (being prioritised lower), leading to optimising the employment of resources. The universality

and democratisation of air threat and the operational necessity to achieve oblique cognitive effect on population at large, impacted the prioritisation of air threat However, the following may show the light: -

The concept of GBAD may require to graduate to the following fundamental pillars: -

- ***Zone of Destruction.*** Destruction of unmanned threats in designated 'Zone of Destruction' unique to each of the unmanned aerial threat profile (some may be in proximity and some in distant zones) by specifically assigned GBAD vectors. GBAD in 'Zone of Destruction' requires to be reorganised to destroy hybridised unmanned autonomous system of air threat in DRAMS (Drone, Rocket, Artillery, Munitions systems) configuration that has precision, preponderance and simultaneous application at standoff, limited stand off and proximate ranges, invoking the need for concurrent neutralisation / destruction of multiple threat types. Omnipresence and near permanence of unmanned threats makes 'deterrence' ineffective and asset allocation for the defence difficult. Hence, each layer of GBAD has to be quantitatively empowered to assure destruction of hybrid air threat at the tactical, operational, theatre and national level.
- ***Zone of Denial.*** The access of manned aerial threats to their respective '**Zones of Launch of Weapons**' has to be denied by deployment of GBAD weapon platforms. Such Zones require to be promulgated to push adversary manned platforms beyond their preferred BVR launch zones.
- ***Zone of Deception.*** Preponderant employment of multipurpose GBAD active and passive deceivers at 'Battlefield Equalisers', and at disproportionate scale, to draw adversary SEAD and DEAD efforts, ensures the survivability of GBAD weapon platforms in an asymmetric air threat environment.
- ***Air Space Management.*** Dual use of airspace over 'Zones of Destruction' would be restrictive and curtail the freedom of GBAD. The management of air space needs to be merged with the Land or Maritime force operational priorities with bias towards 'total freedom of usage of GBAD weapons' in promulgated 'Zone of Destruction'.
- ***Ecosystem Review.*** The threat vector that would require neutralisation in immediate future would be Stealth, Hypersonic and Ballistic Missile. The prevailing GBAD ecosystem around the world are not organised for defeating stealth and hypersonic threats and have restrictive capabilities against ballistic missile threats. The need for induction of passive sensors, optimised for stealth target detection and destruction,

multi- static radars, upgrading legacy systems for next generation threats, induction of expendable and autonomous sensors etc., would require institutional push to round the GBAD capability against these threats.

Conclusion

The air war is witnessing rapid modernisation with both manned and unmanned platforms acquiring destructive capabilities. The air threat therefore is considered to be confined to a war like situation and has found an expression in the entire spectrum of operations even in the South Asian context. Of immediate concern is the 'intelligentisation of unmanned threat' with artificial intelligence leading to autonomy and 'economy of scale' providing low cost, high technology, expendable and sustainable aerial vectors that can penetrate the most sophisticated air defences by sheer saturation if not technological superiority, providing very attractive cost benefit advantages vis-à-vis manned platforms. This unique challenge requires a reoriented AD architecture wherein emphasis on the air space defence and asset defence have to be thought afresh with redefined understanding of Air Space Denial, Deterrence and Destruction of aerial Assets. The Air Space Management, to include its usage and defence, may not remain purely a service specific responsibility but requires a 'Service' approach especially when seen in the context of the national mission of 'Sudarshan Chakra'.

Works Cited

Glines, C.V (2006, June 12). William 'Billy' Mitchell: Air Power Visionary. *Historynet*. https://historynet.com/billy-mitchell-air-power-visionary/.

Russia plans to create separate UAV forces: Putin (2025, June 13). *Xinhua*. https://english.news.cn/20250613/397376b4e449413b892eaf20666cf363/c.html.

The Austro-Hungarian Military's Pigeon Service: 1875-1918 A.D. *Pigeons of War*. https://pigeons-of-war.com/2022/05/13/the-austro-hungarian-pigeon-service-1875-1918.

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