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AEROSPACE NEWSLETTER

Centre for Air Power Studies conducted the 'Annual Space Security Dialoge' on the theme "Security in the Changing Space Environment" on 26 May 2022. The seminar saw wide participation across the three services, academia and veteran fraternity.

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Who controls low-earth orbit controls near-Earth space. Who controls near-Earth space dominates Terra. Who dominates Terra determines the destiny of humankind.

- Everett Dolman

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Fighter Acquisition For The IAF: Options For India

Air Marshal Anil Chopra (Retd)

Director General, Centre for Air Power Studies | 01 May 2022

Source: SP's Aviation | https://www.sps-aviation.com/story/?id=3132&h=Fighter-Acquisition-for-the-IAF-Options-for-India

The LCA MK2 is under development and would be an enlarged variant of MK1. The 'roll out' of the first prototype is scheduled for december 2022 and IAF plans to induct 200 aircraft beginning in 2028.

In a media interaction in October 2021, after taking over as the Chief of the Air Staff, Air Chief Marshal V.R. Chaudhari said, "The Indian Air Force (IAF) is focused on future warfare. Offensive strike capability will become even more potent with the induction of weapon systems of cutting edge technology. With the upcoming induction of Tejas Mk1A and S-400 missiles, the IAF will be even stronger. Restoring the strength of fighter squadrons is a priority. Meanwhile, the serious showdown with China in Ladakh that continues has brought greater focus and discussion on the IAF's growth and its challenges.

State of IAF Fighter Fleet

The IAF is today at a low of 32 fighter squadrons vis-a-vis the authorised 42. The numbers would go down further when MiG-21 Bison are phased out. The Jaguar will be in service for at least another decade. The process to acquire 126 Medium Multi-Role Combat Aircraft (MMRCA) initiated in 2007 was finally cancelled. Instead, the government sanctioned emergency procurement of 36 Rafale jets from Dassault of France. Most of these have arrived and remaining will be inducted by mid-2022. Meanwhile, after 21 years since the first flight of the indigenous Light Combat Aircraft (LCA) 'Tejas', only around 32 LCA Mk1 aircraft of the 40 ordered have been delivered. Other than two LCA squadrons, the IAF today has two squadrons of Rafale, 12 of Su-30 MKI, three of Mirage 2000, three of MiG-29s, four of MiG-21 Bison and five of Jaguar.

The Air Threat

China is investing heavily into the aerospace industry and today the People's Liberation Army Air Force (PLAAF) has two homegrown stealth fighters, the J-20 and the J-31 and is to induct the H-20 stealth bomber. It currently has 50 J-20s and targets to have 200 by 2027. It also has 24 Su-35, 500 J-10s and a large number of Su-27 and Su-30 variants. Pakistan has nearly 20 combat units, and is inducting the JF-17 Block III. It has also placed orders for 25 Chinese J-10C in fly-away condition. It is imperative that the IAF quickly rebuild its fighter fleet.

Unfolding Fighter Inductions

Delivery against the IAF's order of 40 LCA Mk1 will get completed by mid-2022. The Jaguar fleet is being modernised to DARIN III standard. The fleet of MiG-29 and Mirage 2000 have also been upgraded and 21 upgraded MiG-29s are being procured. The IAF is planning to acquire few second-hand Mirage 2000 to cater for the requirement of spares.

272 Su-30 MKI air-superiority fighters ordered have been delivered and 12 additional Su-30 MKI are being acquired, primarily to replace those that had crashed over the years. Initially, 40 Su-30 MKI aircraft will be upgraded to include the ability to carry the BrahMos cruise missiles and nuclear-capable Nirbhay missiles, get an Active Electronically Scanned Array (AESA) radar, more powerful on-board computers and a new Electronic Warfare (EW) suite. The process is still evolving.

The LCA MK1A

An operationally better, version called the LCA Mk1A has been evolved. It would have an advanced AESA Radar, an EW suite, mid-air refuelling capability and incorporate weight reduction along with easier maintainability. The order for 83 LCA Mk1A was placed in February 2021. The first flight of the Mk-1A aircraft was earlier scheduled for March 2022, is now rescheduled for June 2022.

At the current pace of acquisitions and indigenous development, the Indian Air Force can at best restore the authorised strength of 42 fighter squadrons earliest by 2038.

LCA MK2

The LCA Mk2 under development would be an enlarged variant of Mk1 with the more powerful General Electric F-414-GEINS6 engine. The 'roll out' of the first prototype is scheduled for December 2022 with its first flight in 2023. The IAF plans to induct 200 aircraft beginning in 2028.

The Tejas Mk2 Medium Weight Fighter will have a compound delta wing with close-coupled canards. The longer fuselage will allow for more internal and external fuel. The weapon stations will increase from seven to 11, with carrying capacity increase from 5.3 to 6.5 tonnes. It will also feature an indigenous integrated life support system, a built-in integrated electro-optic electronic-warfare suite and other improvements to avionics. It will have an infra-red search and track system and a missile approach warning system and a modern AESA radar. It is said to be designed for swing role, with BVR and close-combat capability and precision strike.

The Aeronautical Development Agency (ADA) completed Mk2 Critical Design Review on November 15, 2021. From 62 per cent in Tejas Mark 1A, 70 per cent indigenisation is targeted for Mk2. Also, the Mk2 will imbibe some of the technologies being developed for Advanced Medium Combat Aircraft (AMCA). The aircraft is meant to replace the Jaguar, Mirage 2000 and MiG-29 in the IAF.

LCA Production

HAL currently has a production capacity of 12 aircraft a year. HAL has indicated that they will be able to deliver 12 to 14 aircraft in financial 2021-2022. The Ministry of Defence (MoD) had set a target of 16 aircraft per year. The rate at which IAF squadrons are depleting, the desired rate is at least 18 to 20 per year. Even though the indigenous content of the Tejas is increasing, major systems such as engine and radar are still of foreign make.

AMCA – India's Fifth Generation Aircraft

The AMCA is the fifth generation fighter aircraft being developed for the IAF. Being designed by ADA, it is expected to be produced by a public-private joint-venture between the

DRDO, HAL and the private sector. It will be a single-seat, twin-engine, stealth, all-weather, swing-role fighter aircraft. Two variants of AMCA are planned. AMCA Mk1 will come equipped with fifth generation technologies and Mk2 will have the incremental sixth generation technology upgrades. It would one day be a replacement for the Su-30 MKI.

The AMCA design will have shoulder-mounted diamondshaped trapezoidal wings and an all-moving Canard-Vertical V-tail with large fuselage mounted tail-wing. ADA is working on major technological issues like thrust vectoring engine, an advanced AESA radar and low radar cross section and supercruise capability. The AMCA will initially fly with two GE-414 engines. Eventually, it is planned to be powered by two GTRE, 90 kN thrust, K9 or K10 engines which are successor to the troubled Kaveri engine.

The project entered the detailed design phase in February 2019. The first flight is expected to be by around 2025 and serial production might begin by 2030. The IAF is planning for two squadron of AMCA Mk1 and five squadron of Mk2 variant. There is also plan for a light combat aircraft variant of AMCA. After consultations in November 2021 between IAF, HAL, DRDO, ADA, MoD and Ministry of Finance, the final design of AMCA prototype is getting ready for approval from Cabinet Committee.

Rafale Numbers

Operationally, for a large air force, just 36 aircraft is too low a figure. The IAF has the infrastructure in place for two more squadrons. Also, considering India has made many one-time payments such as for India-specific modifications, that expenditure will get amortised and the cost of additional orders should be lower.

Many countries have ordered Rafale fighter jets recently, with Indonesia becoming the new entrant. One scenario could be that 36 more Rafale are acquired and thereafter, India puts all its energies on developing an indigenous aircraft. It is time to make the appropriate call.

114 New Fighter

Responses for the IAF's Request for Information for 114 4th generation plus fighters were received in July 2018. The seven contenders are Dassault Rafale, Eurofighter Typhoon, Lockheed F-21, JAS 39 E/F Gripen NG, MiG-35 and Su-35. The Request for Proposal (RFP) has still to be issued. Even if the process is hastened, the earliest these aircraft can arrive is 2027. The US is pushing the case of Boeing F-15 EX. It is time that the RFP is sent out without further delay.

The Task Ahead

At the current pace of acquisitions and indigenous development, the IAF can restore the authorised 42 squadrons earliest by 2038. If India were to succeed, the IAF's end state should be two squadrons of Mirage 2000, two of Jaguars, 14 of Su-30 MKI, two of Rafale, 14 of LCA MkI & II, two of AMCA and six of the newly selected fighter, making a total of 42 squadrons. The LCA and AMCA projects need to be hastened. The variables and anxieties will continue to hit the AMCA. Joint ventures or technology transfers may be required for the engine, AESA and EW systems. Time to act is now, lest India be left behind in its global ambitions.

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Russia's Military Understanding of Air Power: Structural & Doctrinal Aspect

Air Marshal Diptendu Choudhury (Retd) | 23 May 2022

Source: VIF India | https://www.vifindia.org/article/2022/may/23/russia-s-military-understanding-of-air-power

The fog of war continues to hangover Ukraine even after eighty days, especially with facts difficult to discern amongst the information war running in parallel, biased reportage, and contradictory narratives based on the wide swath of international political agendas. In this war of shifting objectives and seemingly endless attrition, showcased in destruction, death and human misery, it is extremely difficult to discern cogent military lessons with a significant degree of certainty. As much analysis continues on the larger Russian strategic goals, miscalculations, shifting military aims, and the conduct of warfare, this follow-up piece retains its focus on the air operations. It hopes to address some of the larger structural and doctrinal aspects of the Russian Aerospace Force (VKS) which have affected the war aims and put to question the efficacy of the Russian military strategy. The focus here is to fit some of the larger visible pieces, amongst the many missing ones on the broad mosaic of air power employment, as they slowly emerge. The less than expected demonstrated performance of the Russian Army, the unclear operational employment concepts of the Air Force and the evident dissonance in integration between the two, have led some analysts to lay the blame on the VKS for its inability to 'support' ground operations, and even question the very need of an independent Air Force. This is a deeply concerning trend of thought which underscores the absence of a deeper understanding of air power in some quarters.

The VKS is not 'missing in action' as many thought after the sudden decline in tempo from the initial surge operations early in the war. It has actually been active throughout, albeit with varying degrees of roles and intensity of employment, with tactical adjustments in their concepts of operations in keeping with shifting war aims and losses. It is currently playing a major offensive role in the new front of Eastern Ukraine region, carrying out extensive air strikes in the battle spaces of cities and towns. It is attacking the Ukrainian military, command and control centres, fuel and weapon storages, power plants, waterworks, and a variety of targets in the combat zone. Importantly, the extensive and ever-expanding Allied support in the form of military materiel logistics supply chains via road and rail networks, which are sustaining the Ukrainian forces, has been added to the target list. But there is no denying the fact that the VKS has underperformed, and –'Analysts have ascribed a variety of reasons which range from inadequacy of precision guided munitions' inventory, inability to manage the contested airspace between Russian Air Force and the SAM (Surface to Air Missile) systems of the Russian Army, low training standards of the Russian pilots due to inadequate flying hours, their inability to undertake large scale offensive missions, poor Army-Air Force coordination, to the reluctance on part of the VKS leadership to engage in operations which would lay bare their capability gaps.' While these

reasons in part or combined have played a part in the underperformance, despite its losses it has continued to carry out extensive operations, causing considerable damage to the Ukrainian forces, both in air and on surface. Though it is premature to draw definitive conclusions on its operational performance, there are some deeper issues in the mighty Russian military machine which have impacted the prosecution of military operations, and their war aims.

The fundamental orientation and posturing of the Russian military over the years, still remains centred on defending its heartland and vital industries and cities, using layered and integrated air defence. Inclusion of offensive air power amongst its multi-layered conventional theatre strike capability showed indications of an offensive shift over the last decade. This was demonstrated in Georgia (2008), Crimea (2014) and especially Syria (2015), but in the absence of any viable air opposition, the offensive use of air power was limited in scale. While Russia has observed air power employment in Western interventions closely over the last two decades, it is the structural and doctrinal aspects of the VKS and its place in the Russian military that remains Army centric. In the Soviet days, the PVO Strany was the dominant military air element which owned all AD forces including its own aircraft. It was the favoured force as it was central to winning ground campaigns, in comparison to the Russian Air Force (VVS) whose role was limited to providing tactical fire power from the air. In 1988 the air assets of the PVO Strany were merged with the VVS and its AD missile element formed the Russian Air Defence Force (VKO). In 2011, the VKO became the Russian Aerospace Defence Force (VVKO) to merge air and space defence. In 2015, Russia merged the VVS and the VVKO to form what is now known as the Russian Aerospace Force. The Russian Defence Minister Army General Sergey Shoigu had then said that the VKS was created because "their formation is dictated by the shift in the centre of gravity of armed struggle into the aerospace sphere."

The VKS is organised, equipped and trained to repel enemy threats, and essentially operates the high-altitude and long-distance AD systems – the S-300s and S-400s.This enables a very strong access denial into Russian airspace. The Russian Army on the other hand owns the battlefield AD systems which are limited to defending against air attacks at the low and medium altitudes. In a 2019 speech at the Russian Academy of Military Sciences, the Russian chief of General Staff, Valery Gerasimov, described Russia's military strategy as one of 'active defence.' This leads to the structural challenge for its military, essentially oriented to defend the nation against a massive multi-domain threat to its heartland, in carrying out large scale orchestrated offensive operations with overwhelming force, which involves extensive participation of the VKS. All of Russia's recent military operations have been on a much smaller scale, with relatively very little involvement of its aerospace force. The lessons learnt in the Georgian campaign in 2008, initiated its military reform and modernisation efforts which are still underway.

Its strategic exercises - Zapad, Vostok, Tsentsr and Kavkaz were introduced as capstone events of its annual training cycle. These large-scale exercises meant to showcase its operational art, military strategy and capability in two front operations, nuclear might, etc., and serves as strategic communication. Zapad 2021 exercised its 'active defence' strategy to counter a massed NATO aerospace attack. The VKS and surface

missile units conducted counter-strikes with long range precision guided weapons against the enemy force, command and control, and key supporting infrastructure, to support large air assault operations employing helicopters in transport and attack roles, concentrating artillery and rocket fire against enemy forces to cause attrition. Russian units then switch to a counteroffensive, with large combined arms assault. Typically, the VKS only supported the surface operations rather than first create conditions offensively to counter the enemy air, as they have in the Ukraine invasion.

The next issue is that, very much like the erstwhile Soviet days even today in Russia, aircraft are extensions of the ground force. Combat aircraft are essentially considered airborne artillery: inflexible vehicles for the delivery of massive firepower. Therefore, the Russian military doctrine doesn't require the VKS to control large swathes of airspace in order to pursue its operations towards surface campaign goals. Aside from long-range high-altitude AD, the VKS owns the long-range bombers for nuclear and conventional strikes (long range aviation), and the military transport fleet. It also has the VVS (frontline aviation or tactical aviation), which till only recently was limited to air operations over the tactical battle areas. The VVS with its modern four plus generation and fifth generation fighters, with a weapon mix of large number of older generation and some advanced ones, has a defensive AD role against aerial threats and an offensive strick role restricted to the surface campaign. Long range air launched precision and stand-off strikes have only recently been included in its offensive capability. These enable it to engage targets deeper inside enemy territory, which its bombers cannot take on in a dense AD environment. Helicopters are an important constituent of the military and are considered as ground weapons (or 'tanks in the air') by the Russian General Staff in their operational planning. Since the reform, these formations are known as 'army aviation brigades', and despite their high vulnerability to SAMs, remain 'major force multipliers during Russian joint operations'. It is commanded by Army General Sergei Surovikin, who unlike his predecessor is from the ground forces.

The Russian military strategy, unlike the American and most modern militaries, does not allow its Air Force the freedom to pursue its own air campaign. Hence its doctrine does not require the VVS to offensively achieve control over the adversarial airspace. Consequently, it is not geared to carry out large scale offensive air operations, where all elements of offensive counter air fighters, suppression of enemy AD (SEAD) aircraft, strike aircraft, ISR and EW elements, AD escorts fighters, combine with AWACS and aerial refuellers come together to offensively seize control of the air and facilitate the surface campaign. The initial Russian air and missile strikes that targeted over a dozen airfields, the Ukrainian Air Force (PSU) and its AD systems were extensive. It severely impacted the PSU's operational capability and its long and medium range AD cover. However, after the initial success, Russia failed to follow to put the PSU and its AD out of action. Total destruction is hard to achieve, unless the massive and sustained air offensives of the likes of Gulf War are carried out, and where there was practically no air opposition. Against an adversary with a much smaller Air Force (AF), the possibility of achieving air supremacy (no interference from enemy air) or air superiority (minimal interference from enemy air) is high. Provided, there is concerted effort by the side on the offensive to do so, and its AF is given a

free hand to execute its air operations against the adversarial AF. Thus, in their effort to carry out swift offensive operations, employing precepts of mass and manoeuvre, without having achieved a viable degree of control of airspace, has led to greater Russian Army and AF losses. According to David Deptula –"Russia has never fully appreciated the use of airpower beyond support to ground forces. As a result, Russia, in all its wars, has never conceived of or run a strategic air campaign."

There have been numerous assessments of the operational performance of AD and AF on both sides, and almost all have tended to look at them either independently or at best as the combat outcomes and effects of being pitted against each other. This approach, while it serves to suit the narrative of some and the vested interests of the weapon industries, may lead to incorrect and incomplete military lessons. Since even media anchors have become 'military experts' eager to pronounce 'breaking news' analyses, there is a real danger of looking at the serious and complex business of offensive air and AD operations simplistically. Offensive employment of air power is the raison d'être of air forces, and air defence is inherently integral to it. They are the con-joined twins of air power as they are not only inter-dependent; they cannot do without each other. The challenge arises when AD operations are looked at only from a defensive perspective against the adversary's offensive air operations, without considering the necessity to counter the adversary's AD to prosecute one's own offensive air operations. Offensive air power remains a vital element of a nation's military power, not just towords effectively 'supporting' the surface campaign, but equally importantly, to take the war deep into the adversarial spaces, towards achieving the larger war aim. And therefore, for offensive air power to succeed in both the roles, it has to defeat the adversarial AF. Simply put, AD is a vital element in both offensive and defensive employment of air power, and cannot be seen in isolation.

The large numbers of Russian helicopter and fighter losses at low levels have been due to the dated and rigid doctrinal approach of air power employment, which is a subset of the surface dominant military strategy. Having lost 333 helicopters to the Stinger shoulder fired SAM and Anti-Aircraft guns in Afghanistan one would have thought there would have been a doctrinal revisit. Interestingly, in the air operations in 2015 where the Russian AF supported Syria against the ISIS, it lost only one fighter to Man Portable AD System (MANPADS) out its total of 19 aircraft losses, in 34,000 sorties over almost two and half years. This was because the VVS, which was deployed independently and was not a part of a combined Russian military campaign, conducted its operations from medium altitudes outside the MANPADs threat envelope. However, this experience does not appear to have translated to any doctrinal changes as was evident in its early air operations in Ukraine, where it followed the scripted operational concepts of the Russian military. The VVS evidently does not have the freedom to evolve and pursue its own air doctrine and concept of operations, when it is employed as a part of a larger military whole. Notwithstanding doctrinal rigidities, substantial aircraft losses which includes high end and legacy assets, has forced the VVS to shift its fighter operations to the medium altitudes very quickly over Ukraine. Helicopter offensive operations over contested airspaces by day have significantly reduced, and shifted into the night where they cannot be

targeted by electro-optical/infrared MANPADS.

Arguably, the shortcomings of the Russian AF employment were inevitable because of two reasons. First, the VVS still essentially remains a 'ground support' force, where its focus was essentially centred on providing the surface campaign with aerial fire power, and not ensuring that the PSU could not interfere with their surface operations. There have been attempts at change from the erstwhile Soviet AF concepts towards those of modern Air Forces, where the military understanding of air power and independence of the air force to prosecute air operations is much more sophisticated, and produces greater integrated military outcomes. But it in the absence of any participation in international air exercises with modern air forces, it appears that the transformation has been limited to organisational restructuring and superficial changes. There have been no independent doctrinal changes in its overarching VKS of which VVS is a part of, as the Russian Army dominant military continues to adhere to its legacy approach to air power of the Soviet era. The second reason is the discernible disconnect in the AD structuring and its employment. The VKS AD centred on defending the heartland is an Integrated Air Defence System (IADS), which enables what the West calls Anti-Access Area-Denial (A2AD). Bronk explains – 'For Russia, the IADS is a fundamentally static construct composed of mobile elements. It is designed to defend Russian airspace and to give the Kremlin an ability to threaten aircraft with long-range missiles some distance inside neighbouring countries' airspace and in the Baltic from behind a multi-layered and sophisticated network of medium- and short-range SAMs. It is also a critical part of the Russian Ground Forces' plans to be ready to fight or coerce NATO forces in Eastern Europe, by forcing NATO's air forces to spend the first critical weeks of any conflict engaged in a protracted, costly and politically high-risk SEAD/DEAD campaign rather than attacking ground forces and strategic objectives inside Russia.'[14]Given the Ukrainian Air Force's incapability to operate over the Russian airspace, the VVS has failed to exploite its own IADS cover, which extends well into the Ukrainian airspace offensivly.

Against an adversary with a small AF which could interfere with its surface campaign, control of the skies should have been a priority for the Russian military. Its initial stand-off strikes against airfields and AD systems in Ukraine, gave the impression that it was part of an orchestrated counter air and SEAD campaign. While it caused serious attrition to Ukraine's AD radars and SAM systems initially, it did not follow through by going after its AF. The PSU fighters which were flying blind without ground control radars guiding it and without the protective cover of its long-range SAMs, were vulnerable to high end Russian fighters armed with Beyond Visual Range (BVR) air-air missiles, whose ranges were more than Ukrainian BVRs. Not having offensively destroyed the PSU's air assets, enabled it to survive and fight on. Russian IADS, whose lethal ranges extend well inside Ukrainian territory, inhibits the PSU from carrying out air operations at high and medium altitudes freely over the battle-spaces. Combined with the Russian Army which owns a variety of AD systems to protect the airspace over the battle zones from medium to low altitude threats, also denied the PSU the opportunity to interdict the advancing Russian forces. This was evident when the long Russian armour columns and logistic convoys which were forced to use roads due to the 'Rasputitsa season',

were not engaged by the PSU. So why did the VVS fighters fail to leverage this to their advantage as well? For the VVS to provide close support inside its Army AD's lethal missile engagement zone, it would need excellent airspace management which de-conflicts friend from foe to prevent fratricide. While it is not clear what kind of interface and integration exits between the VKS and the Russian Army for airspace management, it is evident that there have been serious gaps here as AD operations have remained independent from offensive air operations. Despite losing most of its high and medium level AD assets, Ukraine with extensive ISR and tactical assistance from its Allies, has been effective in employing its surviving mobile AD systems and large supplies of Western MANPADs. Tactical inflexibility of commander's intent and campaign aims, forces the VVS to fly singly or in pairs into and out of hostile airspaces without any tactical routing, decoying or deception to enhance mission survival against the enemy AD.

The depth of the military objective directly affects the time-space-volume of air operations. Deeper the surface campaign objective, means greater is the application of air power that will be necessary. With Kiev as the initial objective, where the surface forces would have taken greater time to reach, compounded by the mobility challenges of the season, also meant more space on ground and larger volume of airspace would have to be covered. Clearly the Russian military strategy, which did not have a counter air campaign coordinated with SEAD and integrated AD in its play book, was unable to achieve the swift outcomes it expected. The disconnect between the long range and stand-off missile attacks, the initial air operations and the ground campaign appears to indicate challenges in the organisational structure, evident in the lack of coordination amongst branches, indicating issues with command and control, both at the tactical and the operational levels. Russian commanders seem to have been unprepared for many aspects of the invasion, including coordination between branches and between units. Absence of joint planning, training and execution have been evident through the campaign, and even necessitated a leadership change midway, with General Alexander Dvornikov taking charge. What could be the problem?

Way back in 2010, Russian Military Districts (MD) were reorganised into Operational Strategic Commands (OSKs), where its frontal and army aviation were transferred from the Air Forces to be directly subordinate to Russia's four new OSKs. According to the then Air Force CINC, General-Colonel Aleksandr Zelin – "The Air Forces will remain a service of the Armed Forces, its Main Command (Glavkomat) will continue functioning, the transfer of four Air Forces and Air Defense commands to the commanders of the new military districts - Western, Southern, Central and Eastern." This was –"just to optimize command and control and concentrate the main forces and means in the troops (OSK)." The new system of command and control was ostensibly created due to 'the realities of the current time and changing international situation, so the state can independently confront possible threats to its security and the security of its allies, and achieve strategic goals'. Defense commentator Igor Korotchenko said the move to four MDs / OSKs has diminished the service CINC's influence: "The role and place of the main commands of the services of the Armed Forces has been reduced accordingly. Practically all aviation, except strategic, will be subordinate to the OSK

commander." It seems clear that the Russian military does not understand airpower, let alone leverage it to its advantage. Western experts echo this view. 'Instead of working to control the skies, Russia's air force has mostly provided air support to ground troops or bombed Ukrainian cities. In this it has followed the traditional tactics of a continental power that privileges land forces. Focusing on ground troops can work if you have almost endless numbers of soldiers and are prepared to lose them. But so wedded is Russia to its history of successes on the ground that it fails to understand the importance of airpower.'

Though the focus has been on the larger pieces of the underperformance of the Russian air power, two aspects which have rightfully earned their place in contemporary warfare – MANPADS and drones, need a mention here. Without taking away anything from the demonstrated lethality of these two weapon systems, the hype of their role being a 'game changer' in warfare, where the future manned combat aircraft are being written off, is certainly overstated. In the brutal business of warfare, the 'game' of war remains the same, nothing 'changes.' The ways to 'kill' proliferate. There are many aspects of the air operations conducted by both sides from which serious lessons can be drawn. But those are deeper operational, tactical and technical aspects and including use of drones and MANPADS amongst many other vital aspects like EW, secure and encrypted communications, advanced weaponry, etc. But for now, one cannot overlook from wider standpoint that despite the losses and inefficient use of air power, the VKS has contributed much to the war despite the shifting war aims. From an Indian context the two larger issues which need greater deliberations are the fact that the Russian Military evidently does not seem to understand air power fully, and that subordinating it in their reorganised OSK twelve years ago, has had serious consequences in the national war objectives. The other is, AD operations and offensive operations are the inseparable twins of modern air warfare, and their close synergy will remain a prerequisite for combat operations of the future, and therefore must form an integral part of a nation's military strategy.

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Scaling New Heights In Defence Production

Air Marshal B.K. Pandey (Retd) | 01 May 2022

Source: SP's Aviation | https://www.sps-aviation.com/story/?id=3140&h=Scaling-New-Heights-In-Defence-Production

In the beginning of April this year, Hindustan Aeronautics Limited (HAL) declared that it has recorded the highest ever revenue of over 24,000 crore in the financial year ending March 31, 2022, registering a six per cent growth over the previous fiscal.

The fact that despite the onslaught of the COVID-19 pandemic that had a crippling effect on the practically all segments of the industry and economy in countries across the globe, the Indian aerospace major HAL has indeed put up a commendable performance, scaling a new peak in its financial earnings for the year gone by. However, while this has been an encouraging development, the aerospace and

defence industry of the nation has still a long way to go to develop the capability to meet with the requirements of the Indian Armed Forces for most, if not all, modern military hardware. Today, the nation is branded as the largest importer of modern weapon systems and other items of equipment that the Indian Armed Forces require to maintain the desired level of operational capability. This is extremely important and critical especially in view of the intimidating presence of the enemy both on the Northern and Western fronts of the country.

The corresponding figure for the previous year stood at 22,755 crore. ''Despite the challenges of the second wave of COVID-19 during the first quarter of the year and the consequent production loss, the company could meet the targeted revenue growth with improved performance during the balance period of the year," said R. Madhavan, Chairman and Managing Director of HAL.

Over the past several decades since the nation attained independence, despite the heavy investments by the Government of India in the nation's aerospace and defence industry, the Indian Armed Forces have been heavily dependent on foreign sources for the acquisition of military hardware. Initially, the list of nations from where weapon systems were procured, included primarily three nations namely the Soviet Union, France and Israel. With the breakup of the Soviet Union in the early 1990s and the emergence of a uni-polar world, the Soviet Union was replaced by Russia and later on, the United States was added to the short list of suppliers of military hardware. Today, the nation has the dubious distinction of being the largest importer of weapon systems and other military hardware accounting for more than ten percent of total global imports.

The company achieved record revenue with the production of 44 new helicopters/aircraft, 84 new engines and overhauled 203 aircraft.

However, certain developments in the recent past, one of these being the ongoing war between Russia and Ukraine, have resulted in some new developments in this segment of acquisition of military hardware by the nation. The Government of India now appears to have understood the need for and the paramount importance of self reliance in the sector pertaining to the defence industry. As a first step, the Indian Ministry of Defence has released a number of negative import lists that contain a total of 310 items of military hardware. The Government of India will no longer permit the import of items of military hardware that figure on the lists. Henceforth, it will be incumbent on the Indian defence industry to produce the items on the banned lists within the country. The list of items on the banned lists for which import licence will not be granted, is fairly exhaustive. This appears to be the initial positive step towards building self reliance that the Government of India has taken to propel the nation to embark on a journey towards the radical transformation of the defence industry infrastructure in the country in the decade ahead to begin with.

It is quite clear that for the Indian defence industry in the public sector that has well developed infrastructure, this decision comes as a boon as it will give the industry the opportunity to finally make productive use of the manufacturing facilities and the related infrastructure that have been set up in the country over the last seven decades or so. But what is also important is that this decision by the Government of India will provide a fresh window of opportunity for the aerospace and defence industry in the private

sector which is still in a nascent stage. The first lot of companies in the private sector that will be in the lead in the exploitation of fresh opportunities arising in the wake the decision by the Government of India to boost the indigenous segment in the private sector would be the Tatas, Larsen and Toubro and Mahindra Aerospace. The smaller companies in the Indian aerospace and defence industry that have the capability to provide the required engineering services which include the Information Technology services and the startup companies will be the major beneficiaries of this move by the Government of India towards indigenisation of the Indian aerospace and defence industry sector through its 'Make in India' programmes.

India is a rising power both economically and militarily. The nation has to be well equipped to be able to take on both Pakistan and China that are military allies and are capable of posing threat not only from conventional weapons but from nuclear weapons as well. It is necessary for India to indigenise defence production and not continue to depend on foreign sources as the nation has been doing so far.

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Air Power

China Commences Test Flights at 1st 'Super-High Plateau Airport' in Xinjiang Region

Raghav Bikhchandani | 20 May 2022

Source: The Print | https://theprint.in/world/china-commences-test-flights-at-1st-super-high-plateau-airport-in-xinjiang-region/964026/

An airplane lands at Taxkorgan Airport in China's Xinjiang | Photo: Twitter/@PDChinaBusiness

New Delhi: At a height of 3,250 metres above sea level, China commenced test flights at what it claims to be Xinjiang region's "first super-high plateau airport" in Taxkorgan, the country's state media reported.

The Taxkorgan airport is being built at a height of 3,250 m above sea level. Equipped with a 3,800-metre runway, the airport is designed to handle 1,60,000 passengers annually.

Xinjiang has been under the international radar for human rights violations with China being accused of committing possible genocide against the Uyghur population and other mostly-Muslim ethnic groups in the region.

The test flights began with the landing of an Airbus A319-115 aircraft at Taxkorgan airport at 9 am Wednesday, Xinhua news service reported. Another Chinese media outlet, People's Daily, shared an image of the aircraft that had landed at the airport, situated on the Pamir Plateau.

According to the Xinhua report, any airport located at a height of 2,438 metres above sea level, or more, is considered a "super-high

plateau" airport.

"Equipped with a 3,800-metre runway, the airport is designed to handle an annual throughput of 160,000 passengers and 400 tonnes of cargo and mail," the report added.

Strategic Significance

As China showcases the readiness of the airport by announcing the commencement of test flights, along with its upcoming opening in July — all these not only represent a first-of-its-kind construction for China but also points to a milestone of strategic significance.

According to the Chinese news site Seetao, the airport's construction began on 26 April 2020 amid the Covid pandemic. It marked the breaking ground of a 1.63 billion yuan investment by the Chinese government, as part of its thirteenth Five-Year Plan.

Throughout the construction period, Xinhua news kept providing updates on the progress, once in June 2020 and then again in August last year.

Located on the Karakoram Highway, Taxkurgan lies east of China's border with Tajikistan and a little over 200 km north of Gilgit, the capital of the Gilgit-Baltistan province in Pakistan-occupied Kashmir (PoK).

Given the region's close proximity to Gilgit-Baltistan, Taxkorgan Airport is also said to form part of the China Pakistan Economic Corridor (CPEC)'s "series of infrastructure developments".

When China first announced the plans to build the airport in April 2015, then-Chinese Assistant Foreign Minister Liu Jianchao downplayed concerns flagged by India, stating that the airport plan and overall CPEC project "does not concern the relevant dispute between India and Pakistan".

"Taxkorgan has assumed more importance following China's $46-billion economic corridor linking Kashgar in Xinjiang, through Taxkorgan and across into the PoK all the way to the Gwadar port on the coast of the Arabian Sea. The corridor envisages road, rail links as well as pipelines which provide a direct source for oil import for China from West Asia and the Arabian Sea," India Today had reported about the city in April 2015.

According to the director of the think tank Austrian Institute for European and Security Policy (AIES), Velina Tchakarova, the Taxkorgan airport represents "a significant long term investment" for China.

"The construction of Taxkorgan Airport on the Pamir Plateau in the northwestern Uighur Autonomous Region of Xinjiang is a significant long-term investment, as Taxkorgan is "China's only county-level city bordering three countries—Tajikistan, Pakistan, and Afghanistan,"" Tchakarova wrote in an opinion piece for think tank, Observer Research Foundation, citing a report from Chinese TV news network CGTN.

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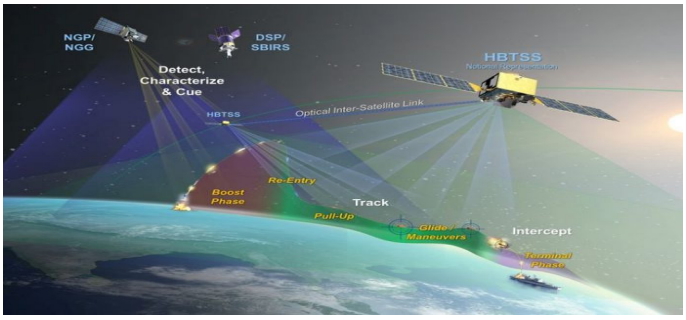
Us Air Force Goes Hypersonic! Tests Another Missile from B-52h Bomber as it Catches Up with Russia & China

17 May 2022

Source: Eurasian time | https://eurasiantimes.com/us-air-force-goes-hypersonic-tests-another-missile-from-b-52h-bomber/



"A US Air Force B-52H Stratofortress successfully released an AGM-183A Air-launched Rapid Response Weapon, or ARRW, off the Southern California coast, May 14," the release said on Monday."

Following separation from the aircraft, the ARRW's booster ignited and burned for the expected duration, achieving hypersonic speeds five times greater than the speed of sound."

The US conducted a successful test of the Air-launched Rapid Response Weapon (ARRW) hypersonic missile.

Brigadier General Heath Collins, USAF program executive officer for weapons, said: "This was a major accomplishment by the ARRW team, for the weapons enterprise, and our Air Force." He added: "The team's tenacity, expertise, and commitment were key in overcoming the past year's challenges to get us to the recent success.

US Hypersonic Missile Program

Earlier on May 4, the US military had tested its hypersonic missile prototype, the Lockheed Martin version of the Hypersonic Air-breathing Weapon Concept (HAWC) that can travel faster than March 5 (five times the speed of sound). It reached altitudes greater than 65,000 feet and flew for more than 300 nautical miles.

This was the second successful flight in the HAWC program of the US Defense Advanced Research Projects Agency (DARPA).

The US successfully tested the first one in mid-March but kept it quiet for two weeks to avoid escalating tensions with Russia as President Joe Biden was about to travel to Europe, according to CNN.

The HAWC, which was launched then from a B-52 bomber off the west coast of America, was termed the first successful test of the Lockheed Martin version of the system. A booster engine accelerated the missile to high speed, at which point the air-breathing scramjet engine ignited and propelled the missile at hypersonic speeds of Mach 5 and above.

After the latest test on May 4, Andrew "Tippy" Knoedler, HAWC program manager in DARPA, said, "This Lockheed Martin HAWC flight test successfully demonstrated a second design that will allow our warfighters to competitively select the right capabilities to dominate the battlefield. These achievements increase the level of technical maturity for transitioning HAWC to a service program of record."

Knoedler then added, "We are still analyzing flight test data but are confident that we will provide the US Air Force and Navy with excellent options to diversify the technology available for their future missions."

Significantly, this second test was conducted just one day before (that is, May 5) the US Congressional Research Service released a report

on Hypersonic Weapons.

It may be noted that the US Department of Defense (DOD) or Pentagon's FY 2023 budget request to Congress includes $225.5 million for hypersonic defense programs and $4.7 billion for hypersonic weapons programs. In FY2022, DOD requested $247.9 million for hypersonic defense programs and $3.8 billion for hypersonic weapons programs.

From the above, it seems that the US is attaching more importance to hypersonic weapons than hypersonic defense programs.

There are two primary categories of hypersonic weapons. One is hypersonic glide vehicles (HGV) that are launched from a rocket before gliding to a target. The other is hypersonic cruise missiles that are powered by high-speed, air-breathing engines, or "scramjets," after acquiring their target.

Unlike ballistic missiles, hypersonic weapons do not follow a ballistic trajectory and can maneuver en route to their destination.

In the process, they could challenge detection and defense due to their speed, maneuverability, and low altitude of the flight. Terrestrial-based radar cannot detect hypersonic weapons until late in the weapon's flight.

This delayed detection compresses the timeline for decision-makers to assess their response options.

Need For Hypersonic Missiles

There is a debate in the US strategic circles about the need for the defense against hypersonic missiles. Some analysts have suggested that space-based sensor layers—integrated with tracking and fire-control systems to direct high-performance interceptors or directed energy weapons could theoretically present viable options for defending against hypersonic weapons in the future.

Indeed, the 2019 Missile Defense Review of the US notes that "such sensors take advantage of the large area viewable from space for improved tracking and potentially targeting of advanced threats, including HGVs and hypersonic cruise missiles."

But, some other analysts have questioned the affordability, technological feasibility, and/or utility of wide-area hypersonic weapons defense.

According to physicist and nuclear expert James Acton, "point-defense systems, and particularly [Terminal High-Altitude Area Defense (THAAD)], could very plausibly be adapted to deal with hypersonic missiles.

The disadvantage of those systems is that they can only defend small areas. To defend the whole of the continental United States, you would need an unaffordable number of THAAD batteries."

In addition, some American analysts argue that hypersonic weapons lack defined mission requirements, that they contribute little to U.S. military capability, and that they are unnecessary for deterrence.

This ongoing debate, perhaps, explains why hypersonic weapons programs in the US are far behind that of the programs in Russia and China. It is only after a series of successful Russian and Chinese hypersonic tests in recent years, exacerbating thus the concern in Washington that the US is falling behind on a military technology considered critical for the future, that the Pentagon is admitting that these weapons could enable "responsive, long-range, strike options against distant, defended, and/or time-critical threats [such as road-mobile missiles] when other forces

are unavailable, denied access, or not preferred."

That explains why Congress requested sanctioning more money for testing them.

However, the debates in the United States are still inconclusive on whether, like programs in China and Russia, US hypersonic weapons are to be nuclear-armed or conventionally armed. At the moment, the emphasis is on conventional nuclear warheads as these will have greater accuracy.

Indeed, according to Acton, "a nuclear-armed glider would be effective if it were 10 or even 100 times less accurate [than a conventionally-armed glider]" due to nuclear blast effects.

So much so that two years ago, when the US Air Force sought ideas for a "thermal protection system that can support a hypersonic glide to ICBM ranges, " the Pentagon responded by saying it "remains committed to a non-nuclear role for hypersonics."

US Going Slow In Hypersonic Technology

Technically speaking, and that could surprise many, at present, the DOD in the US has not established any programs of record for hypersonic weapons.

This suggests that it may not have approved either mission requirements for the systems or long-term funding plans. Indeed, as Principal Director for Hypersonics (Office of the Under Secretary of Defense for Research and Engineering), Mike White has stated not so long ago, "DOD has not yet made a decision to acquire hypersonic weapons and is instead developing prototypes to assist in the evaluation of potential weapon system concepts and mission sets."

This being the case, the Congressional Research Service report draws inputs from the open-source reporting and says that the United States is conducting research, development, test, and evaluation (RDT&E DARPA) on several offensive hypersonic weapons and hypersonic technology programs, including the following:

1. U.S. Navy—Offensive Anti-Surface Warfare Increment 2 (OASuW Inc 2), also known as Hypersonic Air-Launched OASuW (HALO);
2. U.S. Army—Long-Range Hypersonic Weapon (LRHW);
3. U.S. Air Force—AGM-183 Air-Launched Rapid Response Weapon (ARRW, pronounced "arrow");
4. U.S. Air Force—Hypersonic Attack Cruise Missile (HACM);
5. DARPA—Tactical Boost Glide (TBG);
6. DARPA—Operational Fires (OpFires); and
7. DARPA—Hypersonic Air-breathing Weapon Concept (HAWC, pronounced "hawk").

It is to be reiterated that these programs are intended to produce operational prototypes, as there are currently no programs of record for hypersonic weapons.

As regards the Hypersonic Missile Defenses, though investments have been made in counter-hypersonic weapons capabilities, former Under Secretary of Defense for Research and Engineering Michael Griffin has stated that the United States will not have a defensive capability against hypersonic weapons until the mid-2020s, at the earliest.

In January 2020, the US Missile Defense Agency (MDA) had issued a draft request for prototype proposals for a Hypersonic Defense Regional Glide Phase Weapons System interceptor intended to be fielded in the mid-

2030s; however, the program was later canceled in favor of a nearer-term solution, the Glide Phase Intercept (GPI).

It is understood that MDA seeks to field a regional, sea-based GPI capability in the mid-to the late 2020s. In addition, MDA is said to be developing the Hypersonic and Ballistic Tracking Space Sensor (HBTSS)—which it hopes to launch in March 2023—to improve the agency's ability to detect and track incoming missiles. It has requested $89.2 million for HBTSS in FY2023.

Against this background, how will the US Congress respond to the funding requests? The report of the Congressional Research Service says that the principal query of the Congress could be as to how it could act when there is no clarity of "mission requirements" when the DOD says that it has not yet made a decision to acquire hypersonic weapons and is instead developing prototypes to "[identify] the most viable overarching weapon system concepts to choose from and then make a decision based on success and challenges."

Secondly, the Congress may be worried over the "strategic stability" of the hypersonic weapons – the weapon's short time of flight—which, in turn, compresses the timeline for response—and its unpredictable flight path—which could generate uncertainty about the weapon's intended target and therefore heighten the risk of miscalculation or unintended escalation in the event of a conflict.

This risk could be further compounded in countries that co-locate nuclear and conventional capabilities or facilities.

Some analysts argue that unintended escalation could occur as a result of warhead ambiguity or from the inability to distinguish between a conventionally armed hypersonic weapon and a nuclear-armed one.

After all, such concerns have previously led Congress to restrict funding for many weapon programs.

Thirdly, there is the issue of "Arms Control" that Congress would ponder over as hypersonic weapons programs are essentially strategic weapons.

Should the US be a part of the arms race instead of taking measures to mitigate risks by negotiating for a new START with Russia, which, at the moment, does not cover weapons that fly on a ballistic trajectory for less than 50% of their flight, as do hypersonic glide vehicles and hypersonic cruise missiles?

After all, Article V of the treaty states that "when a party believes that a new kind of strategic offensive arm is emerging, that Party shall have the right to raise the question of such a strategic offensive arm for consideration in the Bilateral Consultative Commission (BCC)."

This question is important as many American strategic analysts have even proposed negotiating a new international arms control agreement that would institute a moratorium or ban on hypersonic weapon testing, with a "highly verifiable" and "highly effective" means of preventing a potential arms race and preserving strategic stability.

All told, there is a basic question on the efficacy of hypersonic weapons or their defense when intercontinental ballistic missiles, if launched in salvos, could overwhelm everything, a power both the US and Russia have in abundance.

However, with the worsening of relations with Russia and China over the former's invasion of

Ukraine, all these questions may not be conducive to a rational debate. Congress may grant everything the Pentagon demands, particularly when the US is way behind Russia and China.

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Chinese Scientists Work on Hypersonic Missile that can Hit Moving Car

Stephen Chen | 17 May 2022

Source: SCMP | https://www.scmp.com/news/china/military/article/3177908/chinese-scientists-work-hypersonic-missile-can-hit-moving-car

DRO-IAI developed MR SAM missile test Researchers in China say they are close to solving some of the accuracy problems associated with hypersonic missiles. Photo: Handout

China is developing a heat-seeking hypersonic weapon that will be able to hit a moving car at five times the speed of sound, according to scientists involved in the project.

The research team, led by Yang Xiaogang from the PLA Rocket Force University of Engineering in Xian, said "important progress" had been made towards solving the main problem of how to pinpoint a moving target at extreme speeds.

Yang and his colleagues from the university's College of Missile Engineering have been given a deadline of 2025 to come up with solutions to the seemingly intractable challenges of hypersonic technology.

Because a superfast missile can travel long distances in a split second, a tiny error in the positioning and guidance system can lead to a huge miss, they explained in a paper published in Chinese peer-reviewed journal Infrared and Laser Engineering.

Over distance, the infrared signature of a small moving target "constitutes just a few pixels without detailed information such as shape, texture and structure", making identification and tracking "extremely difficult", they said.

The heat sensor needs an extremely cold environment, but the surface temperature of the missile can reach several thousand degrees Celsius, producing a huge amount of background noise.

But, with the new heat-seeking technology, the Chinese military will be able to eliminate high-value targets from long distances with unprecedented speed, to "significantly expand the scope of application of hypersonic weapons in a regional war", said Yang in the paper, part of a series published by the journal.

'Important progress' has been made towards 2025 deadline to come up with solutions to the missile technology's challenges.

Hypersonic weapons were initially developed to penetrate air defence systems and hit fixed targets on the ground. It was generally believed that limited manoeuvrability at such high velocity would make hitting a moving target impossible.

In recent years, China has shown an increasing capability against mobile targets, including a model aircraft carrier set up on rails at a firing range in the Gobi desert.

But a warship is relatively easy to track, with

its size and predictable movement against a relatively stable background.

The problem is more complex on a street, where many similar vehicles are likely to be present. A car can turn at any time as it travels across a landscape which can also vary significantly, increasing the calculation burden for on-board computers.

According to Yang, his team has come up with a new identification and tracking method as it homes in on the target.

A traditional heat-seeker analyses the images produced by infrared sensors frame by frame. But at Mach 5 or faster, the difference between two adjacent frames can be huge, making it difficult for the computer to find a consistent pattern, especially when the target is small and moving.

The new hypersonic missile does not take a new image for granted, the paper said. Instead, it will use the data collected by motion sensors to adjust every pixel, so that most elements in the new image will remain consistent with those in earlier shots in terms of viewing angle, lighting or size.

This calibration technology is complex, but produces a considerably clearer, more stable background that makes the target stand out sharply, the team said.

The hypersonic heat-seeker would also be able to go after a target in the air, according to a separate paper in the series by Qin Hanlin from the school of optoelectronic engineering in Xidian University.

Qin and his team demonstrated a technology that would allow a hypersonic ground-to-air missile to hit a target as small as a commercial drone. The missile could distinguish the drone hanging low over buildings or trees with nearly 90 per cent accuracy, they said.

A number of hardware breakthroughs have made these achievements possible, according to the scientists, including improvements in sensor technology that mean heat signals can be detected over distance as a unique wave form, producing clear images at hypersonic speeds.

The Chinese scientists also found a low-cost replacement for the precious materials, including diamonds, used for the window of the infrared detector so that it can survive the harsh environment.

Glass made of zinc sulphide, at a fraction of the cost, also provides a crystal-clear view, they said.

The Chinese military increasingly believes hypersonic weapons will change the nature of battle and is investing heavily to achieve an edge in the technology.

According to some recent studies by PLA researchers, senior military commanders could find themselves directly exposed – even if they were more than 1,000km (621 miles) behind the front line and protected by multiple layers of air defence systems.

Expensive military platforms such as aircraft carriers and stealth warplanes would also lose their advantage, with little defence against hypersonic missiles able to manoeuvre and aim with precision.

The PLA's hypersonic programme employs about 3,000 scientists – 50 per cent more than those working on traditional weapons, according to a study published in January by Chinese peer-reviewed journal Tactical Missile Technology.

The average contribution to the increase of China's military strength by a researcher in a hypersonic programme was estimated to be twice as high as a researcher working on aircraft or warships, the study found.

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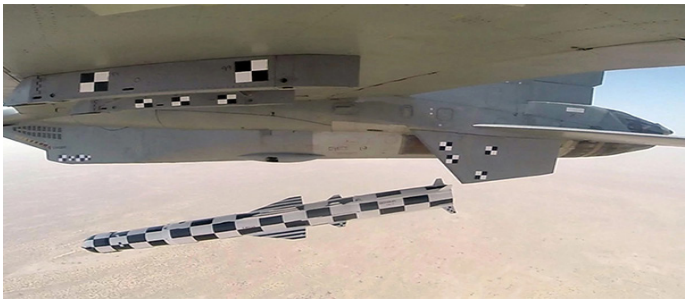
IAF Successfully Fires Extended Range Version of Brahmos Missile from Su-30 MKI

12 May 2022

Source: IMR India | https://imrmedia.in/iaf-successfully-fires-extended-range-version-of-brahmos-missile-from-su-30-n=&gr_s=Bh1gzqm&gr_m=Bh7xPM&gr_x=a62b



A Brahmos cruise missile is released from a Su-30MKI aircraft

The Indian Air Force (IAF) said it has successfully fired extended-range version of the BrahMos Air Launched missile from Su-30 MKI fighter aircraft. The launch from the aircraft was as planned and the missile achieved a direct hit on the designated target in the Bay of Bengal region.

It was the first launch of the extended-range version of the BrahMos missile from Su-30MKI aircraft. With this, the IAF has achieved the capability to carry out precision strikes from Su-30MKI aircraft against a land and sea target over very long ranges.

BrahMos Aerospace, an India-Russian joint venture, produces supersonic cruise missiles that can be launched from submarines, ships, aircraft, or land platforms. BrahMos missile flies at a speed of 2.8 Mach or almost three times the speed of sound.

The range of the advanced version of the missile is learnt to have been extended to around 350 km from the original 290 km.

Last month, an anti-ship version of the BrahMos supersonic cruise missile was successfully test-fired jointly by the Indian Navy and the Andaman and Nicobar Command. In a tweet, the Andaman and Nicobar Command said the test-firing was carried out.

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Amid Ukraine-Russia War, IAF's Rs 35,000 Cr Plan to Upgrade Su-30 Fighter Fleet Put on Backburner

08 May 2022

Source: ANI News | https://www.aninews.in/news/national/general-news/amid-ukraine-russia-war-iafs-rs-35000-cr-plan-to-upgrade-su-30-fighter-fleet-put-on-backburner20220508160232/

Representative Image

New Delhi [India], May 8 (ANI): Amid the ongoing conflict between Russia and Ukraine, the Indian Air Force'splans to upgrade the fleet of its Su-30 MKI fighter aircraft (/topic/su-30-mki-fighter-aircraft) has been put on thebackburner for now.

The deal for the 12 most advanced Su-30MKI aircraft worth over Rs 20,000 crore would also be delayed slightlyas the stakeholders will now

have to add more Made-in-India content in the planes as per the current policy ofthe government to promote Indian defence products over imports, government sources told ANI.

The Indian Air Force was planning to upgrade 85 of their planes up to the latest standards in collaboration withthe Russians and Hindustan Aeronautics Limited (/topic/hindustan-aeronautics-limited). The plan has been put on the backburner for now in view of the present situation, the sources said.

The plan was to equip the Su-30 aircraft with more powerful radars and the latest electronic warfare capabilities to make it more powerful as per the latest standards, the sources said.

The Su-30 MKIs form the mainstay of the Indian Air Force as 272 of them have been ordered by the IAF in different batches as every time shortage of fighter jets (/topic/fighter-jets) in service was highlighted, the Russian manufacturers would receive an order of 30 to 40 of these planes.

The aircraft are supplied by the Russian manufacturers to the Hindustan Aeronautics Limited (/topic/hindustanaeronautics-limited) in semi and complete knocked-down kits and then they are assembled in the Nasik facility.

The ongoing conflict in Russia and Ukraine has also resulted in delays in the supply of spares for the fighteraircraft fleet.

Sources said even though the spares situation is manageable at the moment and expected to remain so in the near future as India had stocked them up in a considerable amount post the Uri surgical strikes and the ongoing China conflict (/topic/china-conflict).

However, it is expected that the supply of these spares and other equipment may become an issue after a year or so and that is why, the force has gone on an indigo ration spree of its imported equipment. (ANI)

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From Missiles to Glide Bombs, India Set to Test Several Advanced Weapon Systems

Rajat Pandit | 07 May 2022

Source: Times of India | https://timesofindia.indiatimes.com/india/india-all-set-to-test-several-homemade-weapon-systems/articleshow/91394150.cms?from=mdr

NEW DELHI: India is getting set to conduct a slew of tests of several indigenously-developed advanced weapons, ranging from air-to-air missiles and anti-radiation missiles to smart anti-airfield weapons and long-range glide bombs.

The tests of at least three weapons, the Astra-1 (100-km range) and Astra-2 (160-km) beyond visual range air-to-air missiles (BVRAAMs) as well as the new generation anti-radiation missile (NGARM) Rudram-1 with a strike range of 150-km, are slated for this month, defence sources told TOI.

The Astra-2 will undergo its “first live launch” from a Sukhoi-30MKI fighter after completion of its carriage and handling trials as well as “dummy drops”. The Astra-1, already under production by defence PSU Bharat Dynamics after the

successful completion of its user trials, in turn will be tested for the first time with an indigenous seeker instead of the existing Russian AGAT one from a Sukhoi jet.

The IAF has already placed an initial order for 250 Astra-1 missiles, which flies over four times the speed of sound at Mach 4.5, to arm its Sukhoi fighters. The integration of Astra-1 with the Tejas and MiG-29 fighters is also concurrently underway.

DRDO is also planning to conduct the first test of Astra-3, based on the solid fuel-based ducted ramjet (SFDR) propulsion to enhance its range to 350-km, by the end of this year, the sources said.

The all-weather day and night capable Astra series of missiles, designed to detect, track and destroy highly-agile supersonic fighters packed with "counter-measures" at long ranges, will eventually replace the expensive Russian, French and Israeli BVRAAMs that are currently imported to arm IAF fighters.

Another test this month will be of the Rudram-1 NGARM that is designed to destroy a variety of enemy surveillance, communication and radar targets on the ground at a 150-km range after being fired from fighter jets.

DRDO is also developing Rudram-2 (350-km range) and Rudram-3 (550-km) air-to-ground missiles, which also have INS-GPS navigation with a passive homing head for the final attack.

"Trials of Rudram-2 should also begin soon. Rudram missiles are designed for suppression of enemy air defences (SEAD) from longer stand-off ranges to allow IAF strike aircraft to carry out their bombing missions without hindrance," a source said.

Then, tests of smart anti-airfield weapons (SAAW), which are precision-guided bombs designed to destroy enemy runways, bunkers, aircraft hangers, radars and other reinforced structures at a range of 100-km, are also in the pipeline.

"These are 125-kg glide bombs, based on two configurations of either satellite navigation or electro-optical imaging infra-red seeker (EOIIR), carried on racks in fighters like Sukhois or Jaguars. A single Sukhoi can carry 32 such bombs. Separately, 1000-kg heavy calibre glide bombs, with a 80-km range, are also being developed," he added.

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Space

India is Quietly Building the Reusable Launch Vehicle, a Swadeshi Space Shuttle

Pallava Bagla | 24 May 2022

Source: News9live | https://www.news9live.com/science/india-is-quietly-building-the-reusable-launch-vehicle-a-swadeshi-space-shuttle-172164

The RLV-TD test flight that took place on 2016. (Image credit: ISRO)

The Indian space agency is literally growing new wings as it gets ready to test a scaled down version of what can easily be described as the `swadeshi Space Shuttle'. The Indian Space Research Organisation (ISRO) calls it the `Reusable Launch Vehicle' or RLV. If all goes to plan very soon it will be seen flying over the Science City in Challakere, Karnataka, where the first landing experiment is being planned. S Somanath, Chairman, ISRO says "We are working silently on reusable rocket technology, with a very low budget, low cost and low investment.".

In the past USA and Russia have flown full-fledged winged space vehicles. Russia/USSR flew its vehicle called `Buran' only once in 1988 and the program was then shelved. USA made 135fl ights of the Space Shuttle and in 2011 it was retired. Since then in a new burst of energy, USA,China and India are the only countries having an active program of re-useable rocketdevelopment. If all goes as per plan India's full-fl edged test of reusable launch vehicle mayhappen only in the 2030's. ISRO's reusability is far more ambitious than the rocket stagerecovery experiments carried out by Space X and hence it will take time to fully master.

The new bird will weigh nearly four tonnes and it will be hoisted into the sky on a helicopter andthen it will be released from about an altitude of about three kilometres and from a distance ofthree kilometres from the runway. "The vehicle then has to navigate, glide and successfullyland unpiloted and autonomously at the defence runway in Challakare" says Somanath. This experiment using the scaled down version is called Reusable Launch Vehicle – Landing Experiment or the RLV – LEX. This is essentially an air drop test to understand theaerodynamics of the air frame which has been developed in-house by ISRO.

As part of the development program for reusable rockets way back on May 23, 2016, ISRO hadsuccessfully tested the Reusable Launch Vehicle – Technology Demonstrator (RLV-TD) when a1.75 tonne orbiter was hoisted into a sub-orbital fl ight on a special rocket some 65 kilometresabove the Bay of Bengal from Sriharikota. The fl ight lasted for 773 seconds and attained themaximum velocity of Mach 5 or fi ve times the speed of sound. The physical landing wasconducted on a simulated runway some 450 kilometres away from Sriharikota on water. On thishypersonic landing experiment in 2016, the RLV-TD HEX, was not designed to fl oat and it sankinto the sea. ISRO called it 'successful' and the era of reusability was born

of the Indian spaceagency. Since then engineers at the Vikram Sarabhai Space Centre (VSSC) inThiruvananthapuram have been steadily working to master this complex technology.

Most recently, three attempts have been made already to test the glide capability and the lastattempt in April, 2022 got aborted because a cyclone and heavy winds played havoc at thelanding site. Somanath says there is one small window available to do this unique experimentbefore the monsoon hits the Chitradurga district and all eff orts are being made to make sure ithappens successfully.

Indian space scientists are trying to master a far more complex reusable rocket says Somanath, since ISRO wants to learn how to recover, bring back to Earth the upper stage of the rocket, which is usually lost in space. "The upper stage of the rocket has the most complex and most expensive electronics and if one can recover the upper stage it would certainly bring down thecost of rocket launching dramatically, also reduce space debris", explains Somanath. Incontrast the much touted reusable rocket demonstrations done by Space X are only of the lowerstages of the rocket which are essentially metal blanks and comparatively much cheaper as theydo not house expensive electronics.

The 'Swadeshi Space Shuttle' is really a two stage to orbit vehicle. The reusable winged vehiclesits vertically atop a rocket which boosts it into space and parks it into an orbit. Once that isdone the winged vehicle separates and orbits the Earth. As its cooking in Kerala the plan is thatonce the mission is completed, the mission control centre sends commands to the still in orbit`swadeshi space shuttle' for it to de-orbit and then successfully land at runway that may bebuilt at Sriharikota.

Sounds very easy but to make rocket leave its orbit and survive the dense atmosphere where theheat generated due to friction can push temperatures on the surface to about 3000-4000°Cneeds mastering of complex materials and the software has to be robust to handle autonomouslanding. Light weight heat resistant silica tiles and carbon-carbon reinforced tiles have alreadybeen developed by ISRO. If the landing experiment succeeds, the next big milestone will be toconduct a re-entry experiment where the scaled down model of RLV will orbit the earth andthen be brought back to India.

If robotic re-usable vehicles is mastered by India then expensive satellites whose fuel has beenexhausted could be plucked back and brought back to send again, costly observation platformscan be used again and again, the uses are many and bringing down cost of access to space is justone factor. In future pharmaceutical compounds could be made in near zero gravityenvironments, biological experiments could be done and recovered from space and who knowseven human organs could be grown in space and brought back to Earth asserts Somanath.

"The upper stage of the rocket is very precious there are also huge strategic advantages ofmastering reusability of the ultra-expensive upper stage", says Somanath. India is steadilyworking to master this important technology so that the country is not left behind in the spacerace of developing economical and frugal space technology.

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Navy to Acquire Gisat-2; Dedicated Satellite to Boost Capability in IOR Region

Chethan K | 07 May 2022

Source: Times of India | https://timesofindia.indiatimes.com/india/navy-to-acquire-gisat-2-dedicated-satellite-to-boost-capability-in-ior-region/articleshow/91384738.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

BENGALURU: As part of its modernisation and network-centric warfare and communications programme, the Indian Navy is looking to acquire a dedicated earth imaging satellite — Geo Imaging Satellite-2 (Gisat-2) — this fiscal. Once operational, the satellite is expected to enhance the navy's operational capabilities in the Indian Ocean region, which is strategically and geopolitically important, especially in the backdrop of increasing Chinese presence.

The Gisat-2, is among 21 planned procurements, including some long-term acquisitions as per information from the ministry of defence (MoD). And, the capability development/modernisation of the navy is being undertaken in accordance with the long-term plans being put in place for the next decade.

"The navy has been allotted Rs 45,250 crore formodernisation under budget estimates for 2022-23.Considering a 10% year-on-year growth, it is likely to beallotted more than Rs 2.7-lakh-crore for modernisation by2026-27. The present total committed liabilities of the navy isRs 1.20-lakh-crore and modernisation schemes for morethan Rs 1.9-lakh-crore and Rs 2.5-lakh-crore (under Part Aand B of the annual acquisition plan) are being progressedfor contract conclusion over the next five years," according toMoD.

Aside from Gisat-2, the navy will procure: Next generationmissile vessels, fleet support ship (FSS), high and mediumaltitude long endurance remotely piloted aircraft systems,multi-role carrier borne fighters, indigenous aircraft carrier-2;next generation fast attack craft; next generation corvettes,destroyers, fast interceptor craft and survey vessel; nationalhospital ship; electronic warfare system; extra largeunmanned underwater vehicle; anti-ship missiles(consolidated case for requirements up to 2030); mediumrange anti-ship missile system, simulator and missiles; MRSAM missiles etc.

While the MoD has listed Gisat-2 for procurement this fiscal,the timeline for development of the satellite and launchhave not been firmed up yet. Among the armed forces, theNavy has been ahead when it comes to acquiring satellites.

Gisat Family of Satellites

The Gisat-2 will be designed to provide near real-timeimages of large areas of region of interest at frequentintervals, which will help the navy not only in surveillance butalso operations planning. Operating from a geostationaryorbit (GEO), the satellite will facilitate near real-timeobservations under cloud-free conditions too.

A 2+tonne class satellite, Gisat-2, like Gisat-1 will beconfigured around the modified I-2k satellite bus. Isro had failed to put Gisat-1 into orbit in August last year after theGSLV-Mk2 carrying it developed glitches in the cryogenicupper stage, rendering the mission a failure.

The August 2021 mission was the space agency's thirdattempt at launching the satellite — the earlier ones werescrubbed for different reasons.

Sources in the know said that the payload specifications ofGisat-2 will differ from that of Gisat-1 and that Isro is working on various payloads. "The first one (Gisat-1) was for civilian use, but Gisat-2 is for strategic purposes and the Nevy has very specific requirement which they (Isro) need to meet, another official said. Isro will be launching the satellite on the GSLV-Mk2 after obtaining financial clearances for the same.

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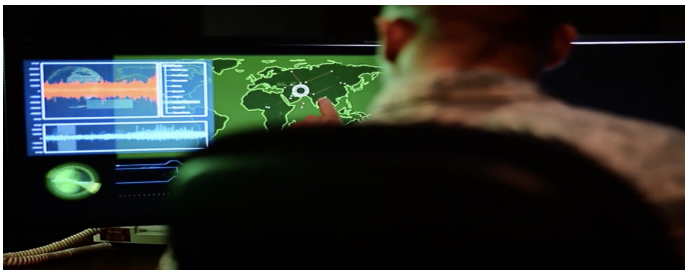
Lockheed Martin Proposes Multi-Layer Space Network for Missile Defense

Sandra Erwin | 18 April 2022

Source: Space News | https://spacenews.com/lockheed-martin-proposes-multi-layer-space-network-for-missile-defense/



U.S. missile warning satellite units operate at Buckley Air Force Base, Colorado. Credit: U.S. Air Force

WASHINGTON – The Pentagon could get far more bang for its missile-defense buck if all the sensor satellites located in different orbits could talk to each other and share data via optical links, according to a proposal floated by Lockheed Martin to create a multi-orbit data transport network in space.

Data collected from every orbit is needed to defend against advanced ballistic and hypersonic missiles, said Eric Brown, senior director of military space mission strategy at Lockheed Martin.

The company says data collected from every orbit is needed to defend against advanced ballistic and hypersonic missiles.

"You can imagine a chain all the way from early warning through intercept without ever having to go to the ground. That's kind of the vision that we have, but that requires connecting all the various orbital regimes," he told SpaceNews.

DoD is spending billions of dollars on missile-warning space sensors located in geostationary (GEO) and polar orbits, but there are no plans to connect them with new constellations that DoD plans to field in low Earth orbit (LEO) and medium Earth orbit (MEO), Brown said.

In DoD the term "data transport layer" is associated with the LEO constellation planned by the Space Development Agency. To defend the U.S. and allies from newer types of hypersonic missiles developed by China and Russia, SDA designed an architecture of low-orbiting sensor satellites that would identify and track these threats. The tracking satellites would determine the location of an incoming hypersonic missile, for example, and pass that information to a constellation of data-relay satellites – known as the transport layer – that the agency also plans to field in LEO.

The location data of the incoming missile would move through space via the transport layer and then downlinked to radar and weapon systems on the ground or at sea so they can try to intercept the incoming missile.

Low-orbiting tracking satellites are needed, said SDA, because heat-seeking sensors in GEO would not be able to detect low-flying hypersonic missiles, as the heat signature dissipates when the target flies lower in the atmosphere.

Lockheed Martin is one of the prime

contractors selected to build SDA's transport layer and also is the prime contractor for the Space Force's new geostationary missile-warning satellites so "we are eager to see that be successful," said Brown. "But SDA's layer doesn't solve the data transport needs at medium Earth orbit and geosynchronous orbit, and the real power of deterrence is when you connect all of the various assets."

The Space Force is looking to deploy missile-warning satellites in medium Earth orbit (MEO) to add another layer of defense.

The ability to use data from multiple assets for missile defense data, known as "tip and cue," means data is passed from one asset to another to keep awareness of a target.

For Lockheed Martin's concept to work, satellites would need optical crosslinks. SDA requires all its transport and tracking satellites to have laser communications terminals. But GEO satellites do not, so they send missile warning data directly to the ground.

"A future GEO missile warning system would need optical links," said Brown. "We are exploring these options and are working with customers to evaluate paths" to incorporate planned satellites into a space data transport architecture, he said.

MEO Layer Could Be GPS

To fill the gap in medium Earth orbit until new satellites are fielded, Lockheed Martin is proposing adding data-relay payloads and optical crosslinks to MEO-based GPS satellites, which also are made by the company.

Another option is to partner with a commercial company that offers data transport services in MEO, Brown said. "There are multiple commercial operators that have a MEO capability."

The SDA transport layer is an important "first step," said Brown. "But the recognition is that it's not going to be sufficient and we want to be able to bring all those other assets."

Every orbit has benefits and drawbacks, he said, "so relying on any one of them independently becomes problematic."

Brown said the data transport network could be applied to other use cases besides missile defense, such as the distribution of intelligence and battle management data. He said the company has conducted "extensive modeling, simulation and analysis of the entire transport tapestry construct – which includes government and other industry partners' capabilities – to help bring multi-orbital communications to life."

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India, France Agree to Cooperate on Secure Access to Outer Space, Space-Based Challenges

Park Si-Soo | 10 May 2022

Source: Space News | https://spacenews.com/india-france-agree-to-cooperate-on-secure-access-to-outer-space-space-based-challenges/

Indian Prime Minister Narendra Modi, right, sits next to French President Emmanuel Macron at Elysee Palace in Paris, May 4, in this video still captured from YouTube.

SEOUL, South Korea — India and France have agreed to cooperate to tackle "contemporary challenges that have arisen in space," including

secure access to outer space.

The pledge was part of a broader set of economic and security agreements reached between Indian Prime Minister Narendra Modi and his French counterpart Emmanuel Macron during their May 4 summit in Paris.

"In order to address the contemporary challenges that have arisen in space, in particular maintaining secure access to space for all, India and France have agreed on setting up a bilateral strategic dialogue on space issues," the two leaders said in a joint statement. "It will bring together experts from space and defense agencies, administration and specialized ecosystem to discuss security and economic challenges in outer space, the norms and principles applicable to space as well as unveil new areas of cooperation."

The two countries will hold the first round of the dialogue this year at the earliest, according to the statement.

Besides boosting space-related cooperation, the two sides have agreed to step up efforts to connect their startup ecosystems and bolster public-private engagement to work together. For its part, the Indian Space Research Organisation (ISRO) has opened its labs, testing and quality facilities to private space companies since June 2020 to help grow India's space industry.

The agreement came nearly one year after the two countries signed another space-related agreement in which France would cooperate for India's first human spaceflight mission, named Gaganyaan. The deal was made at the request of ISRO, seeking France's help to prepare for Gaganyaan's uncrewed and crewed missions. The United States and Russia are also supporting the mission.

Under the 2021 agreement, France's space agency CNES is set to train India's flight physicians and mission control teams, support a scientific experiment plan on validation missions, and exchange information on food packaging and spaceflight nutrition. CNES is also pledged to make French-made consumables and medical instruments available to Indian astronauts.

The Gaganyaan orbital spacecraft project kicked off in August 2018. It originally intended to send three astronauts to low Earth orbit from Indian soil by 2022 to celebrate the country's 75th anniversary of independence. However, the mission has been delayed due to pandemic-induced lockdowns and supply chain disruption.

ISRO is planning to conduct a first uncrewed test flight next year, the Times of India reported late last month. The mission will involve a human-rated version of India's Geosynchronous Satellite Launch Vehicle Mark III rocket with a modified upper stage compatible with a crew module and crew escape system.

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Global Aerospace Industry

Economy Could Dampen Growth of Space Industry

Jeff Foust | 26 May 2022

Source: Space News | https://spacenews.com/economy-could-dampen-growth-of-space-industry/

A Rocket Lab executive said broader macroeconomic issues, like supply chain disruptions and inflation, could slow investment into the space industry and slow its growth. Credit: Rocket Lab

LONG BEACH, Calif. — Broader economic issues as well as the performance of some space companies could slow the growth of the industry in the next few years, executives warn.

During a panel discussion at the Space Tech Expo here May 25, Lars Hoffman, senior vice president of global launch services at Rocket Lab, warned that the industry is not immune from broader economic issues like supply chain disruptions, inflation and growing concerns about a recession.

"We're seeing right now a bit of a chilling going on within the industry," he said. "This heating up of the market that we saw in the last couple of years when times were a little bit better, COVID excepted, is starting to level off a little bit."

"There's going to be a little bit of a lull, if you will, over the next year or two, and then things should start picking back up again," he said. "It's still growing. It's just not growing as fast as we were expecting or hoping two years ago or one year ago."

A factor in any slowdown, he said, could be a decrease in capital available to invest in startups. "If that starts to slow down," he said, "that cools down the progress that a lot of us are making."

Some are worried that investor interest in space companies in general, regardless of economic conditions, could be diminishing. Jordan Noone, co-founder and general partner of Embedded Ventures and a co-founder of Relativity Space, said at another conference panel May 24 that the performance of space companies that have gone public in the last year through mergers with special purpose acquisition corporations (SPACs) could deter more investment. Those companies have, in general, seen sharp declines in stock prices over the last several months.

"The fact that the space SPAC community had some of the worst returns and worst exposure once those companies became public is going to haunt the growth investor community for 5 or 10 years," he said.

Those investors, he said, may go back to "safe investments" in information technology fields rather than invest further in space if it's seen as riskier, causing the industry to lose some of the momentum it's gained in recent years. "The growth investors have all been spooked."

Rocket Lab is one of those companies that went public through a SPAC merger. While it has done better than many of its peers, its stock price has been sliding for several months, and is now at less than half the $10-per-share value of the original SPAC.

"It's a hard path," Hoffman said of going public. "You better have your business in order

before you do that if you want to survive, let alone thrive."

He noted the company has taken steps to diversify its business and serve a wider range of markets. "You're building in diversity because those markets tend to rise and fall on different cycles," he said. "You don't get yourself caught up in just one single cycle."

Not everyone is pessimistic about the market. In a May 24 interview, Max Haot, chief executive of Launcher, said his company is seeing strong demand that likely will remain the case because of the strategic importance of space, citing the role commercial satellites have played in response to Russia's invasion of Ukraine.

"We're very bullish on the market," he said. "We'll see what happens with the economy, but it's certainly the right sector to be in at this time."

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Leolabs to Provide Space Monitoring Service to Japan MoD

Theresa Hitchens | 24 May 2022

Source: Breaking Defence | https://breakingdefense.com/2022/05/leolabs-to-provide-space-monitoring-service-to-japan-mod/

Japan's H-IIA rocket carrying the Kirameki-2 satellite is launched from Tanegashima Space Centre in southern Tanegashima island, Kagoshima prefecture, on January 24, 2017. (Credit JIJI PRESS/AFP via Getty Images)

The WASHINGTON: Japan's defense ministry has signed up LeoLabs to provide space monitoring services for Low Earth Orbit — a first for the US firm whose only foreign customers up to now were civil space agencies, CEO Dan Ceperley told Breaking Defense.

"It's a big acknowledgement that Low Earth Orbit is expanding rapidly. It's of national importance. It's of commercial importance. And there's a need to have more eyes on the sky,".

"It's a huge step forward for both Japan and for LeoLabs," he said in an interview. "It's a big acknowledgement that LEO is expanding rapidly. It's of national importance. It's of commercial importance. And there's a need to have more eyes on the sky."

LeoLabs, which has previously worked with US military researchers and runs a public dashboard tracking LEO space objects, will be providing the Japanese Air Self Defense Force with data on the whereabouts of satellites and space debris in Low Earth Orbit (LEO), warnings of potential collisions and even training,

according to the company's announcement today. The "multi-million" dollar contract was routed through ITOCHU Aviation Co., Ltd, a daughter firm of ITOCHU Corporation, one of Japan's biggest "sogo shosha," which are mega-corporations trading in a wide variety of goods and services.

"That's a big part of the benefit," Ceperley said, explaining that Japanese military personnel will be training on "an actual operating system" for space situational awareness (SSA) — rather than in a simulated environment.

"We're delivering safety services to 60% of all the satellites in Low Earth Orbit, and they're on contract using our safety services. We've supported the launch of over 50% of all the active satellites in Low Earth Orbit," he said. "This is an active operational service for LEO, and to get trained on it means you're actually training for the realities of the space environment and the space industry."

LeoLabs currently has six radars located at sites in Alaska, Texas, New Zealand and Costa Rica. By the end of this year, Ceperley said, the firm will add four more radars at additional sites in Australia and the Azores in the Atlantic. The radar network today can keep tabs on space objects down to 10 centimeters in diameter, but LeoLabs has big plans for improving its capabilities for finding and tracking even smaller debris in the future.

Ceperley noted that the debris being tracked today by commercial firms and governments comprises only some 10% of all the space junk up there that can harm a satellite.

"The analogy that we like to use is if you're driving down the freeway, with what you can see right now, everybody sees the trucks, but they don't see the cars, they don't see the motorcycles. You think you're safe and it just not so," he added.

The Japanese government, including both the defense ministry and the country's space agency JAXA, has gone all in on beefing up its SSA capabilities in the past five or so years.

The defense ministry has been steadily growing its budget for space activities in general, but with a heavy concentration on SSA, since 2019. In 2022, MoD asked for ¥84 billion ($657 million) for all space-related activities, including ¥1.89 billion ($14.9 million) for a new laser-ranging system to help measure the whereabouts of space debris, according to a January report in the Japan Times.

The air force set up its first operational space unit, creatively named the First Space Operations Squadron, in May 2020, tasked with running a ground radar network and providing collision avoidance data that is supposed to become fully operational in 2023. The military currently operates four ground-based J/FPS-5 radar optimized for air and ballistic missile defense, but with space tracking capabilities. According to a study by the Paris-based Institut français des relations internationales [PDF], the MoD intends to build a new, more capable radar facility as well as launch an optical satellite for SSA between 2024 and 2028.

That unit has a specific mission to cooperate with both JAXA and the US. Japan in 2021 signed a cooperative agreement with Space Command and now has a liaison officer at the Multinational Collaboration Office at Vandenberg SFB.

A Second Space Operations is planned to keep tabs on electronic interference with Japan's

satellites sometime later this year, according to multiple Japanese press reports.

Meanwhile, Fujitsu Ltd. announced last month that it had completed development and delivery of an analysis system for JAXA to enable it to predict and report potential on-orbit collisions. JAXA operates a ground-based radar in Kamisaibara for monitoring LEO and a telescope in Bisei for tracking in Geosynchronous Orbit, as well as the Tsukaba Space Data Center near Tokyo — with updates to the system expected to become operational this year, according to the JAXA website.

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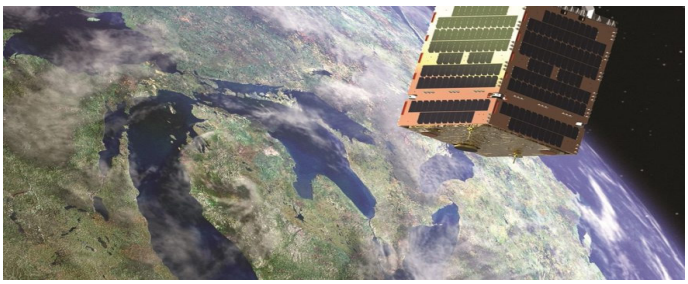
Telesat Tests LEO Broadband Prototype in India

Jason Rainbow | 19 May 2022

Source: Space News | https://spacenews.com/telesat-tests-leo-broadband-prototype-in-india/



Phase 1, Telesat's first LEO satellite that launched in 2018, was supplied by SSTL. Credit: Telesat

TAMPA, Fla. — Telesat said May 18 it demonstrated high-speed connectivity in India last month using a four-year-old prototype satellite

The so-called Phase 1 satellite connected through a teleport operated by local satellite communications provider Nelco, which is part of Indian conglomerate Tata. South Korea's Intellian supplied the 85-centimeter parabolic antenna used in the April 25-29 demo.

According to Telesat, the prototype demonstrated fiber-like 35 millisecond roundtrip latency at speeds fast enough to support applications including video conferencing and streaming.

The Canadian operator's Phase 1 satellite was launched to LEO in January 2018, and has been helping the company configure its delayed Lightspeed constellation.

Plans for Lightspeed were recently downsized by a third to 198 satellites following supply chain issues that have pushed out the service's debut a year to 2026.

Telesat has so far secured about $3.3 billion of Lightspeed's anticipated $5 billion cost.

Dan Goldberg, Telesat's CEO, said May 6 the company is close to securing the remaining funds that it needs before it can sign an order contract with Thales Alenia Space to build the satellites.

India Expansion

Telesat announced plans to partner with Nelco in September 2020, and other satellite operators have since made similar alliances with other local companies as the country looks to ease protectionist measures to encourage foreign investments.

SES said Feb. 14 it has formed a joint venture with Jio Platforms Limited, the holding company for the country's largest telecoms operator, to provide multi-orbit connectivity there.

A month earlier, LEO startup OneWeb said it signed a distribution deal with India-based Hughes Communications India Pvt Ltd, a joint venture between U.S.-based Hughes Network Systems and Jio's Indian telecoms rival Bharti Airtel.

Bharti Airtel is part of the Bharti Global Indian

conglomerate that is U.K.-based OneWeb's largest shareholder, and Hughes is a minority investor in the LEO startup.

SpaceX's LEO network Starlink ran into trouble with India's telecoms regulator late last year when it took deposits from potential customers before getting a license to operate in the country.

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DIU Selects Nuclear-Powered Spacecraft Designs for 2027 Demonstrations

Sandra Erwin | 17 May 2022

Source: Space News | https://spacenews.com/diu-selects-nuclear-powered-spacecraft-designs-for-2027-demonstrations/

Artist rendering of Ultra Safe Nuclear spacecraft selected by the Defense Innovation Unit. Credit: DIU)

WASHINGTON – The Defense Innovation Unit announced May 17 it selected Ultra Safe Nuclear Corp. and Avalanche Energy to develop small nuclear-powered spacecraft for in-space demonstrations planned for 2027.

DIU's small spacecraft demonstrations will complement the work being done by DARPA and NASA in nuclear propulsion for larger spacecraft.

DIU, a Silicon Valley-based Pentagon organization that works with commercial industries and startups, awarded both companies "other transaction" contracts to demonstrate nuclear propulsion and power technology for future DoD space missions. OT contracts, increasingly used in military space projects, are negotiated faster than traditional defense procurements.

The selection of Ultra Safe Nuclear and Avalanche comes just seven months after DIU issued a solicitation for small nuclear-powered engines for space missions beyond Earth orbit.

Seattle-based Ultra Safe Nuclear will demonstrate a chargeable, encapsulated nuclear radioisotope battery called EmberCore.

Avalanche Energy, a venture-backed fusion energy startup also based in Seattle, developed a handheld micro-fusion reactor called Orbitron. "Compared to other fusion concepts, Orbitron devices are promising for space applications as they may be scaled down in size and enable their use as both a propulsion and power source," said DIU.

Ultra Safe Nuclear last year won a contract from the Idaho National Laboratory to develop a nuclear thermal propulsion reactor concept for a NASA space exploration mission. The company also is a subcontractor to General Atomics and Blue Origin in the first phase of the Demonstration Rocket for Agile Cislunar Operations (DRACO) program overseen by the Defense Advanced Research Projects Agency.

DARPA plans to launch the DRACO nuclear thermal propulsion demonstration in 2025.

Air Force Maj. Ryan Weed, DIU's program manager for nuclear advanced propulsion and power, said the two small spacecraft prototypes funded by DIU complement the work being done by DARPA and NASA on nuclear propulsion for larger spacecraft.

"DIU's program is targeted at highly

maneuverable, small spacecraft using fusion and radioisotopes," Weed said. "Bottom line, chemical and solar-based systems won't provide the power needed for future DoD missions."

Nuclear technology has traditionally been government-developed and operated, Weed said, "but we have discovered a thriving ecosystem of commercial companies, including startups, innovating in space."

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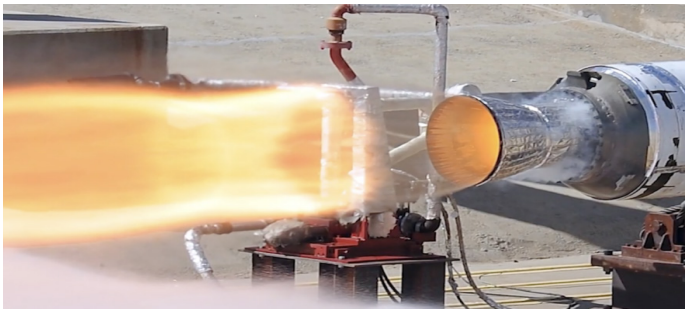
Air Force's Rocket Propulsion Arm Looking to Invest in Technologies for 'Responsive Launch'

Sandra Erwin | 04 May 2022

Source: Space News | https://spacenews.com/air-forces-rocket-propulsion-arm-looking-to-invest-in-technologies-for-responsive-launch/



Rocket engines are tested at the Air Force Research Laboratory's rocket propulsion facility at Edwards Air Force Base, Calif. Credit: AFRL

WASHINGTON — The Air Force Research Laboratory's rocket propulsion arm is asking space companies to help identify technologies and capabilities the military will need to launch missions on short timelines.

The organization known as AFRL's "rocket lab" based at Edwards Air Force Base, California, is "soliciting information and comments from industry on their ability to meet future responsive launch missions and to identify specific investments in technology that would improve responsive capabilities," said a request for information published last month.

The request said AFRL is not looking to address any specific national security launch requirements but wants to better understand what technologies and capabilities are available and which ones need to be developed to help shorten the time it takes to plan and launch space missions.

Congress has been pushing the Space Force to figure out "responsive space" concepts by working with commercial providers in the small launch industry. The thinking is that in a future conflict, if U.S. satellites are damaged by anti-satellite weapons, the military should be able to quickly deploy new ones.

AFRL asked companies, for example, to explain how they would launch a small spacecraft to a specific targeted high energy orbit with only days or weeks' notice. These are orbits considered to be beyond the reach of current small launch vehicles.

Another scenario would be the deployment of up to five small spacecraft in different orbits using multiple vehicles "to provide new capabilities to the warfighter with minimal to no warning to the adversary."

The AFRL rocket lab, created in 1952, has increased the use of public private partnerships to keep its workers and facilities busy. The lab in 2020 signed an agreement with launch startup ABL Space Systems to jointly develop and test rocket propulsion components for future use in launch vehicles

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Indian Aerospace Industry

LEO or GEO: India's Satcom Mission Aims Beyond Boundaries

Lt Gen A K Bhatt | 25 May 2022

Source: Setcom.com | https://telecom.economictimes.indiatimes.com/news/portal-in-portal/satcom/blogs/leo-or-geo-indias-satcom-mission-aims-beyond-boundaries/91780106

New GEO satellites have been serving the humanity for over 50 years, with more than 400 satellites currently operational in the geosynchronous orbit located 35,786km above earth's equator. However, most of the current space investments are targeting the LEO constellation, which has immense potential in areas like satellite broadband, remote sensing and satellite maintenance.

The recent award of $278.5 million in contracts from NASA to Amazon's Project Kuiper and SpaceX's Starlin is yet another testimony to prove how satellite programs are advancing across the globe. As India lays the groundwork for massive investments in satellite broadband space, it is worth comparing the options and making the right investment decisions.

The Epic Journey of GEO Communication Satellites

Geosynchronous equatorial orbit (GEO) communication satellites, also called Geo Stationary Orbit satellites, have orbital period equal to earth's rotational period, one sidereal day, so they appear stationery to a ground observer. This is one of the reasons why GEO satellites are feasible, on both economic and operational aspects. A single satellite antenna on the ground will suffice to provide services across the entire area swept by that satellite. Since the satellite is placed on higher altitude, the problems associated with radiation and orbital perturbations are also minimal. Thus, they require lesser maintenance compared to those in lower orbits. GEO satellites have been enabling critical applications such as communications, weather mapping and defence/ navigation.

LEO Communication Satellites, the mission popular Of late, LEO communication satellites are emerging as a lucrative investment option on many grounds. Recent reports reveal that the market for LEO satellite is projected to grow from USD 9.6 billion in 2021 to USD19.8 billion by 2026, at a CAGR of 15.5 %. The versatility in terms of the size of the satellites and their use cases, lower cost of installation, scope for mass production, and shorter lifecycles are some of the major factors driving these investments. Smaller, compact LEO satellites reused in remote sensing, earth observation an communications. Several advancements are presently working on developing more sophisticated miniature LEO satellites that can also be used in a variety of ground missions.

More importantly, LEO is gaining traction in the wireless satellite broadband because it offers significant improvements in speed and latency. Since LEO satellites move closer to earth, they can off er superior signal strength, and require less power for transmission. They are also characterized by minimum propagation delay

(latency) of about 10ms. Due to their smaller size, they incur less cost of manufacturing. They offer best options for scalability, thereby helping addressing limitations of terrestrial networks.

However, there are drawbacks too. LEO satellites operate close to earth at <1500 km of altitude, so their coverage is much smaller (circa 2000-3000km diameter), hence the need for constellation for continuous coverage. The ground system also becomes more complex and costlier. Since LEO systems operate closer to atmosphere in a much harsher environment than GEO, the interference of radiation and atmospheric drag can have an adverse impact on their life. Typically, LEO satellites have shorter lifetime of 5-10 years or can be even lesser depending on the purpose of the satellite, size and the mission requirements, whereas GEO satellites stay active around 15 years.

"The recent award of $278.5 million in contracts from NASAto Amazon's Project Kuiper and SpaceX's Starlink is yetanother testimony to prove how satellite programs areadvancing across the globe. As India lays the groundworkfor massive investments in satellite broadband space, it isworth comparing the options and making the rightinvestment decisions,".

Despite the shortcomings, investments are moving infamous of LEO satellites. Recently, Amazon's Project Kuiper announced a major deal to carry out about 83launches over a five-year period, a major milestone in Star link, SpaceX's broadband satellite service, has so far launched nearly 2,000 satellites in LEO. The company has already surpassed 250,000 subscribers for its satellite broadband.

India's Rendezvous With LEO

India has been already launching LEO satellites for a longtime, for both scientific exploration as well as remote sensing and recently has also embarked on a mission to launch communication satellites in LEO. The rationale behind this is that low-orbit SATCOM can address the broadband connectivity challenges faced by government, citizens and enterprises. The growing adoption of bandwidth-intensive applications such as gaming, video-conferencing, tele-medicine, tele-education, HD video streaming, and AR/VR is creating tremendous pressure on the country's telecom infrastructure. The higher throughput and lower latency along with seamless scalability offered by LEO constellation will be an attractive USP for SATCOM operators in India. Satellite internet also has the potential to emerge as a major milestone in India's digital empowerment mission by enabling ubiquitous connectivity across the length and breadth of the country.

OneWeb, a Bharti Enterprise company co-owned by UK government, and SoftBank, is on a mission to launch 648LEO satellites by 2022, which would enable the company to connect the entire world with satellite broadband. The company has announced major plans in India's satellite broadband sector. A founding member of Indian Space Association (ISpA), OneWeb has recently entered into an commercial arm of the Indian Space Research Organisation (ISRO), to complete its satellite launch programme. The first launch is expected in 2022, which aims to fulfil the company's target of 428 satellites, which will comprise66 percent of the planned total fleet.

In another major development in LEO segment, Tata-backed Nelco and Canadian provider Tele sat announced collaboration to bring LEO satellite network to India. The

companies are on a mission ton help bridge the digital divide in remote and challenging locations, accelerate 5Gexpansion, and enable new levels of performance for enterprise, telecom, mobility and governmentbroadband connectivity on land, air and sea.

Making the Road Clear

In the Draft Indian Space Policy 2022, the government of India has emphasised the importance of both GEO and LEO satellites to not only develop the country's communications infrastructure to global level, but also enhance economic activities across the borders to even remote islands and for offering reliable, cost-effective and uninterrupted services for governmental, societal and commercial applications which calls for the private sector to establish and operatte communication satellites to meet both national and international communication needs.

With regards to the interference challenges, ISRO believes that any signal interference from the LEO constellation can be easily detected and resolved with proper coordination in the spectrum allocation. Since the fora geostationary satellite, the interference is minimized by design itself.

Lastly, while the commercialization of LEO satellite has not gained full momentum in India, it is believed that LEO is a viable solution to address the digital divide and provide accessibility in future based on its future usages.

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Boost to India's Aircraft Production Ecosystem

Air Marshal Anil Chopra (Retd)

Director General, Centre for Air Power Studies | 01 May 2022

Source: SP's Aviation | https://www.sps-aviation.com/story/?id=3134&h=Boost-to-Indias-Aircraft-Production-Ecosystem

The C295W military transport aircraft will be the first time that a transport aircraft will be built in india and that too by an indian private sect or company

For In the annual budget for 2022-2023, the allocation for defence is 5.25 lakh crore, a 9.82 per cent jump from the previous year. It is 13.3 per cent of the total union budget of 39.45 lakh crore and 2.03 per cent of India's GDP for 2022-2023. The defence allocation excluding pensions is 4.05 lakh crore. Of this, 1.52 lakh crore is for capital expenditure for the modernisation of the armed forces. This is an increase of 12.82 per cent from previous year. A sum of 1.03 lakh crore or 68 per cent of the defence capital budget is allocated for acquiring locally produced weapons. This would thus give a boost to indigenous defence production and 'Atmanirbhar Bharat'. Major amounts would go towards Tejas Light Combat Aircraft (LCA) Mk-1A, Light Combat Helicopters (LCH), basic trainer aircraft HTT-40, Arjun Mk-1A tanks, missiles and other weapons.

The armed forces have recently signed contracts for drones with Indian defence companies and start-ups under the fast-track process for acquisition of new age weapons.

Boost to Defence Industrial Eco System

25 per cent of the defence research and development budget has been set aside for funding the academia, start-ups and private industry. There are additional amounts for the newly created seven Defence Public Sector Undertakings, an Emergency Authorisation Fund and funding of Innovations for Defence Excellence to support innovation and technology development. There is special funding for Defence Testing Infrastructure Scheme to create international standard testing infrastructure. Special Purpose Vehicles will be encouraged between DRDO and private players. Private industry would also be supported for testing and certification through a nodal umbrella. Simplified customs tariffs have been introduced. Existing exemptions on import of defence and security items will be petered off.

All this should support the target of 1,75,000 crore defence production by 2025, and achieve the $5 trillion economy by 2025. In the high technology areas, foreign equipment manufacturers would be more inclined to form Joint Ventures (JV) and bring in Foreign Direct Investment (FDI). Some of these JVs will also support defence exports. With defence manufacturing corridors already in place, the nation is getting seriously into defence production.

The C295 Contract Gets Signed

After nearly ten years of waiting, the 21,000 crore Airbus-Tata project for 56 C295W military transport aircraft for replacing the ageing HS-748 aircraft of the Indian Air Force (IAF) was cleared. An additional six may be acquired by the Indian Coast Guard. 16 C295W aircraft will be delivered in fly-away condition by Airbus Defence and Space (Spain) within two years. The rest 40 will be manufactured in India by the Tata Consortium. It will be the first time that an operational transport aircraft will be built in India and that too by an Indian private sector company.

India's Success in Building Fighter Aircraft

The state-owned HAL began aircraft manufacturing as early as 1942. HAL has been involved in designing and manufacturing of fighter jets, helicopters, jet engine, avionics, software development, spare supply, overhaul and upgrade of Indian military aircraft. HAL licence-produced over 300 de Havilland Vampires, 800 MiG-21 variants, Folland Gnat, MiG-27 M, Jaguar, BAE Hawk and Su-30 MKI.

The HF-24 Marut was the first indigenous fighter-bomber of which 200 were built in India. ADA-HAL Light Combat Aircraft (LCA) "Tejas" is currently under production. It is a fourth generation plus aircraft for which the IAF has committed to procure over 300. 40 Mk1 are already under delivery and 83 Mk1A have been ordered. LCA Mk2 is under development and its first flight is expected by 2024. A fifth-generation stealth fighter, the Advanced Medium Combat Aircraft (AMCA) is under development with a targeted first flight around 2025. India has finally come of age in its fighter aircraft manufacturing eco-system.

Helicopter Production

For many decades, HAL license-built over 300 Aerospatiale Alouette III variants called Cheetah, Lancer and Cheetal Variants, Chetak and Chetan. The big success came with the indigenous Advanced Light Helicopter "Dhruv" nearly 400 of which have been built by HAL. The weaponised variant is the "Rudra", with over 70 built. Also in production now is the Light Combat Helicopter, the attack helicopter variant.

The Light Utility Helicopter variant is under trial. HAL is also developing an Indian Multi-role Helicopter. Clearly, India may not need to import military helicopters.

Other Major Aero-Structure Projects

Large private industrial houses have entered defence manufacturing in a big way. Tata Aerospace and Defence have been making the AH-64 Apache combat helicopter fuselage and aerostructures for Boeing's CH-47 Chinook helicopters. All C-130Js delivered to customers around the world have major aerostructure components from India where 24 C-130 empennages are produced annually. Sikorsky, a Lockheed Martin company, also relies on Hyderabad-based Tata Advanced System Limited (TASL) as the manufacturing base for its global supply of cabin for the S-92 helicopter. The Tata group is working with GE to manufacture CFM International LEAP engine components in India. Lockheed Martin selected TASL to produce F-16 wings in India. There are many private companies making defence electronics, large aero-components, advanced technology components and sub-systems. Dynamatic Technologies makes assemblies of vertical fins for Su-30 MKI fighters. They are also supplying aero-structures to Airbus for A320 aircraft and the wide-body A330 aircraft. Hyderabad's VEM technologies manufactures centre fuselage for LCA Tejas. Many Indian MSMEs and star-ups are entering defence production.

C295 Platform

The CASA C295 is a medium tactical transport aircraft that was originally designed by the Spanish company CASA in the 1990s as Nurtanio CN-235. CASA joined the European aeronautical group EADS in 2000. The now designated C-295 made its first flight on November 28, 1997, and entered operational service in 2001. The aircraft has a rear ramp door for para-dropping of troops and cargo. All 56 aircraft will be installed with indigenous electronic warfare suites. The C295W is the enhanced performance version with winglets and uprated engines. It is powered by Pratt & Whitney PW127 engines, a part of the PW100 family. The C295 also has an AEW&C variant among many other roles.

Of the 40 C295s that Tata will build, eight will be from semiknocked down kits and another eight from completely knocked down kits. The remaining 24 are to be built with incrementally indigenising the assemblies and sub-assemblies. Before completion of deliveries, a D-level MRO facility will be set up in India which will act as a regional MRO hub for various variants of C295 aircraft. Over 165 C295 variants are in service in 30 countries.

Indigenous Transport Aircraft Production

The Saras is the first Indian multi-purpose civilian aircraft in the light transport aircraft category designed by the National Aerospace Laboratories (NAL). The Saras prototype completed its maiden flight at Bengaluru on May 29, 2004. On March 6, 2009, as the first prototype crashed during a test flight, the programme was put on hold but revived in 2016. The new version is a 14-seater instead of 19 and has many improved features. The IAF has contracted with NAL for the purchase of 15 Saras aircraft and may need 45 more later. NAL is also engaged development of Saras Mk2, a 19-seater version of the airliner.

HAL successfully conducted ground-run and low-speed taxi trials of the made-in-India Hindustan-228 aircraft end August 2021. It is a look-alike of the 19-seater DO-228 aircraft which

was so far being manufactured under licence from RUAG for Indian defence forces and European markets.

The Way Ahead

The HAL/NAL Indian Regional Jet is an airliner being designed by NAL and to be by manufactured by HAL. The aircraft is planned to be a turboprop or a jet with a capacity of 80-100 passengers. The 90-seater variant of the aircraft is under design and is targeted to enter service in 2026. Unmanned systems are already being manufactured in the country. The armed forces have recently signed drone contracts with Indian defence companies and start-ups under the fast-track process for acquisition of new-age weapons. India would thus become a global player in all genres of aircraft building.

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8 OEMs Have Responded to RFI of 114 MRFA Jets

13 May 2022

*Source: IMR India | https://imrmedia.in/air-chief-8-oems-have-responded-to-rfi-of-114-mrfa-jets/?utm_source=getresponse&utm_*

Multi-role Fighter Aircraft

Chief of the Air Staff, Air Chief Marshal Vivek Ram Chaudhari, in an interview to a website, has said that the Air Force in response to the Request For Information (RFI) for procurement of 114 jets under MRFA Tender has been offered fighter jets from 8 OEMs and the air force is in the process of framing Request for Proposal (RFP) soon.

Interestingly there has always been Seven foreign aircraft manufacturers in the MRFA tender that includes American firms Boeing and Lockheed Martin, Russia's Mig corporation and Sukhoi bureau, French Dassault Aviation, Swedish SAAB group and the Eurofighter which could mean that there is a new entry in the MRFA tender or it was simply a slip off to mind he also confirmed that the Indian Air Force prefers to take.

Some sources says that there will be a new entrants and that may be a stealth fighter. Speculations are circulating that this will be either American F-35 or Russian Su-75 single engine or Su-57E twin engine stealth fighters.

Air Chief Marshall confirmed that the Indian

Air Force (IAF) would prefer to take the "˜Buy Global Make Indian" route over the strategic partnership policy model to produce the planes within the country just like the C-295 deal with Airbus will be executed with the Tata Systems in India.

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HAL Successfully Integrates & Tests AASM Hammer From Tejas

Adithya | 29 April 2022

Source: Oveer Defense | https://www.overtdefense.com/2022/04/29/hal-successfully-integrates-test-fires-aasm-hammer-from-tejas/

A view of BrahMos supersonic cruise missile. Photo used for representation purpose only. | Photo Credit: R.V. Moorthy

Hindustan Hindustan Aeronautics Limited (HAL) has successfully integrated and tested the AASM Hammer air-to-surface munition from the Tejas light combat aircraft. The AASM Hammer is a Precision-Guided Munition developed by French company Safran Electronics & Defense. The Indian Air Force (IAF) ordered the Hammer for HAL Tejas in 2021. The test of Hammer will soon be followed by that of the Joint Direct Attack Munition (JDAM), around 250 of which were recently ordered by IAF, and the DRDO Smart Anti Airfield Weapon (SAAW).

HAL had stated to Overt Defense during DSA 2022 at Malaysia, on March 29, that the Hammer was to be tested within a few days. Sources at HAL have now confirmed that the 'planned activity of AASM Hammer drop was successful'. AASM Hammer enables Tejas to strike hardened targets at distances of over 70km. A single Tejas will be capable of carrying up to five Hammers. IAF Rafales are already equipped with this weapon.

HAL has all but integrated the planned munitions for Tejas. However, certification of each munition is expected to take more time. Both JDAM and SAAW are slated to be tested this year. Meanwhile the DRDO Astra air to air missile is planned to be tested in a few months. HAL officials expressed confidence of meeting all targets.

The AASM Hammer has three different guidance kits and is compatible with different standard bomb bodies (125, 250, 500 and 1000 kg). The 1000lb JDAM variant which can also hit targets at distances of over 70km as well as the 125kg SAAW, with a range over 90km, will make the Tejas an extremely versatile platform for strike missions. IAF's Tejas fleet, which will eventually number 123 with an order for 83 Mk1A fighters having being placed in 2021, is also capable of using a variety of shorter range precision guided bombs.

Regarding export of Tejas, HAL is currently in talks with Malaysia, while government-to-government talks are ongoing with Philippines and Argentina. Even while offering a vast suite of integrated munitions, HAL is open to integrating any weapon specified by clients. This includes the BrahMos NG, a smaller and lighter version of the BrahMos cruise missile, which is under development. Other components of the aircraft can also be changed depending on user requirements.

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Technology Development

Two Military Satellites Communicated With Each Other Using Lasers

Ameya Paleja | 20 May 2022

Source: Interesting Engineering| https://interestingengineering.com/military-satellites-communicated-using-lasers

Representative image of two satellites

The A pair of military satellites launched last year has successfully completed an experiment to demonstrate cross satellite communication using lasers in space. The company that developed the optical terminals said in a press release.

Even as private players rush to set up constellations of their satellites in orbit, communication technology has mainly remained the same for over six decades. While communication speeds have improved considerably, a satellite still needs to send a message to a ground station on Earth to communicate with another satellite, even if it is orbiting just a few miles away. Reston, Virginia-based CACI International is working to change this and has now successfully demonstrated inter-satellite links.

Communicating With Lasers

CACI deploys the CrossBeam free-space optical terminals on satellites to enable inter-satellite optical communication. The company claims that its technology can allow satellite cross-links as well as bi-directional satellite-to-earth links using systems that are less complex, smaller in size and weight, need less power, and therefore are cheaper to operate.

Working in association with the Defense Advanced Research Projects Agency (DARPA) and Space Development Agency (SDA), CACI launched two satellites, named Able and Baker, equipped with these optical terminals in June last year, Gizmodo reported.

The launch was also part of the Mandrake II program that is being conducted in association with the Air Force Research Laboratory's Space Vehicles Directorate (AFRL SV), the press release said. The Mandrake II program aims to evaluate the pointing, acquisition, and tracking algorithms that will be used in the optical terminals of these satellites.

On April 14 this year, the two satellites set to work their optical terminals over about 60 miles (100 km) and communicated for over 40 minutes. Infrared lasers were used to see over 200 gigabits of data first being encoded and then beamed to the receiver of the other satellite, which was received successfully.

Defense Applications of the Technology

While laser communication is considered faster and more secure when compared to radio waves, you are unlikely to be served by optical satellite communication anytime soon. The technology is still being trialed for defense purposes and the Mandrake II program is also a part of the larger Blackjack project, being run by DARPA.

Under the Blackjack project, a constellation of 20 satellites capable of optical communication will be launched into low-earth orbits and serve as a network mesh in space. This network will be government-owned and serve to connect the U.S.

military to its bases, sensors and weapons across the world, Gizmodo said in its report.

"Our national security depends on advanced, secure technology that enables modernized networks and enhanced intelligence systems for our warfighters using small satellites to operate at the speed of relevance," said John Mengucci, CEO and President of CACI. "In partnership with our mission customers, we are on the path to supporting the contested space domain with faster, more secure satellites."

Space News reported that the SDA plans to launch a tranch of 20 satellites this year and follow it up with 126 satellites by 2024. These satellites will be built by Lockheed Martin, Northrop Grumman, and York Space and feature optical communication between them, with ground stations and airborne platforms.

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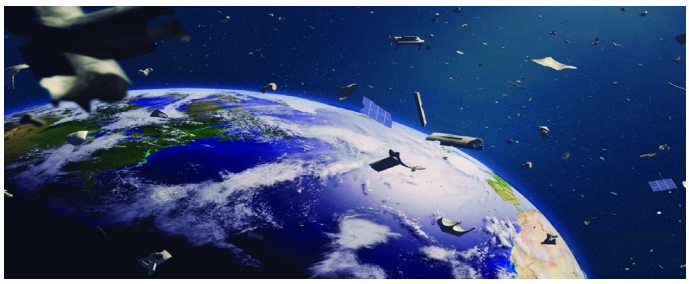
Chinese Scientists Hail Space Radar Breakthrough

Stephen Chen | 16 March 2022

Source: SCMP | https://www.scmp.com/news/china/science/article/3170571/chinese-scientists-hail-space-radar-breakthrough



The lasers could detect debris that poses a threat to satellites. Photo: Shutterstock

A team of Chinese military scientists say they have achieved a breakthrough in laser imaging technology that will allow ground stations to identify and track a target in space with unprecedented accuracy.

Researchers at the National Defence Technology University say their laser imaging technology can identify small objects in space with unprecedented accuracy.

The results suggest that the radar, developed by Professor Han Fei at the National University of Defence Technology in Anhui province, can take images of a thumb sized object in near-Earth orbit with a resolution of up to 3 millimetres (0.1 inches).

This accuracy is two orders of magnitude higher than the best results achieved by similar devices in the United States and other Western countries, according to the researchers.

The technology could also help guide ground-based laser beams to remove small pieces of space debris that threaten satellites and spacecraft, Han and his colleagues wrote in a paper published in domestic journal Acta Physica Sinica last Saturday.

"Centimetre or even millimetre-level resolution for space object imaging in the 100km [62-mile] range can be achieved in the foreseeable future with a performance far superior to those achieved by traditional optical or radar imaging technologies," said the researchers.

Space engineers' biggest headaches come from debris between 1cm (0.4 inches) and 10cm because satellites can be given protection from smaller items while larger objects can be detected using existing technology with enough notice to take evasive action.

In 2016, one of the largest space-based radar systems owned by China lost 4 per cent of its power supply after a tiny piece of space junk, just over 1cm in length, hit the satellite's solar panel, according to a report released last month.

High-power lasers can make these small pieces of debris change course and eventually fall back into the Earth's atmosphere.

The scientists say it could be used to guide laser beams removing small pieces of hazardous space debris

But the laser shots must land precisely and there is only a tiny margin of error – a matter of millimetres, according to Han's team.

In a low-gravity environment, most debris rotates randomly, making identification and tracking more difficult so to overcome these challenges the team used an imaging technology that, according to a counter-intuitive theory in optical physics, does not result in a decrease in resolution when the distance increases.

The technology, known as laser reflection tomography, was inspired by the CAT scans used in hospitals and uses several laser beams to illuminate the target's surface and then reconstructs the image from light particles bouncing in various directions.

The resolution on the images obtained using this method is determined by small differences in the angle of the laser beams when they hit the target, rather than the distance from the observer.

By improving the quality of the laser source and sensitivity of the receiving device, scientists could obtain ultra-sharp images of a tiny object from a long distance away.

The radar built by Han's team fires short laser pulses with a peak power of over 100 kilowatts.

The machine's actual performance in space surveillance remains classified, but the researchers revealed part of its potential in a ground experiment.

The device, mounted on the bank of a reservoir in a suburban area of Hefei city produced sharp images of a 5cm wide, rotating target a kilometre (0.6 miles) away.

The results provided a solid proof to the device's potential to be used in space according to a researcher with the Chinese Academy of Sciences' Xian Institute of Optics and Precision Mechanics who was not involved in the project but familiar with the technology.

"A major challenge to the quality of laser imaging technology is turbulence in the atmosphere," said the researcher who requested not to be named due to the sensitivity of the technology.

The disturbance caused by turbulence within a horizontal, one kilometre range in Hefei was almost equivalent to that within an altitude of 100 kilometres, as the air becomes thinner higher up.

Beyond that there was little atmospheric effect

because the laser would be travelling in space, according to the researcher.

The technology could be also used to study satellites to obtain valuable information about their design, technology, status and purpose, he added.

The technology used was first proposed by American scientists in the late 1980s and researchers around the world have been working to find ways to improve it.

Though a latecomer in this field, China has quickly caught up with some significant progress being achieved in recent years.

Han's team said that their achievement was based on a cutting-edge laser source that significantly reduced the noise that affects signal quality.

They also developed a new algorithm using artificial intelligence to estimate the random movement of a small target and help the radar generate high quality images with incomplete, rapidly changing information.

In December, a research team at the Space Engineering University in Beijing said they had used a different type of laser imaging technology to achieve a resolution of 5mm from a distance of 1.2km.

The Chinese government announced a plan last year to build a defensive system with a number of cutting-edge facilities, including the world's largest radar network and high-powered laser systems.

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Further Reading

1. AWS Picks 10 Startups for 2022 Space Accelerator - https://spacenews.com/aws-picks-10-startups-for-2022-space-accelerator/
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8. No Room For Compromise In Air Safety - https://www.sps-aviation.com/story/?id=3142&h=No-Room-for-Compromise-in-Air-Safety

"The term 'Aerospace' was introduced in 1958 by the USAF Chief of Staff, General Thomas D White, as a new construct that depicted air and space as a seamless continuum stretching from the Earth's surface to infinity."

The Centre for Air Power Studies (CAPS) is an independent, non-profit think tank that undertakes and promotes policy-related research, study and discussion on defence and military issues, trends and developments in air power and space for civil and military purposes, as also related issues of national security. The Centre is headed by Air Marshal Anil Chopra, PVSM AVSM VM VSM (Retd).

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