CENTRE FOR AIR POWER STUDIES (CAPS)
Forum for National Security Studies (FNSS)

AEROSPACE NEWSLETTER

Source: www.pib.gov.in

VOL III NO 6 01 June, 2023

Centre for Air Power Studies | @CAPS_India
Centre for Air Power Studies | Centre for Air Power Studies

"Tomorrow's wars cannot be fought with yesterday's ways."

-Air Chief Marshal VR Chaudhari PVSM AVSM VM ADC
Chief of the Air Staff, Indian Air Force.

Contents

Opinions and Analysis

Air Power

Space

Global Aerospace Industry

Indian Aerospace Industry

Technology Development

Opinions and Analysis

Why 'Atmanirbharta' in Aviation is the Highest Dividend of Indigenisation

Air Marshal Anil Chopra (Retd)
Director General, Centre for Air Power Studies |
15 May 2023

Source: First Post | https://www.firstpost.com/opinion/why-atmanirbharta-in-aviation-is-the-highest-dividend-of-indigenisation-12597952.html

India's stride towards indigenisation in aviation

Defence research and development has been the leading route to many technologies, that later became common civil applications. These included, the internet, space-based applications including the global position system (GPS), radar, lasers, microwave, thermal imaging, among many others. Some other technologies are now being listed as dual use technologies, such as cyber, artificial intelligence (AI) and robotics, hypersonic etc. Most technologies require high research and development (R&D) investments. Many get patented. Most countries do not share such technologies, and even if they do, it is at a very high cost. Abdul Kalam, in the opening remarks of his biography says, "Economic and technological supremacy equates to power and world control". Just demonstration of technological know-how more than physical application of force can amount to military superiority. The diffusion of military technology also affects the wider economy and society. Technology superiority is increasingly going to be the decisive factor in future battles. Superior technology has to be converted into affordable and critical military capability.

Pricing of defence products is most complex. The mark-ups are often in multiples of 100s. India has finally taken the path of self-reliance "Atmanirbharta" in defence with all sense of purpose. India is already the fifth-largest economy of the world and slated to be the third by 2027. India's GDP is $3.737 trillion in 2023, and $13.033 trillion by purchasing power parity (PPP). The target of $5 trillion is highly achievable by 2025. India is the fourth most powerful military power. India's civil aviation sector is the fastest growing in the world. Aviation requires much higher and more complex technologies, higher than even space flight, and obsolescence sets in faster. The sector requires continuous attention and higher investments.

Government Driving Indigenisation

Defence ministry's positive indigenisation lists already cover 458 items. Clearly not just to make, but design in India is the target. In India's annual defence budget for 2023-24, out of the total defence capital budget of Rs 1.62 lakh crore ($20 billion), 75 per cent amounting to Rs 1.21 lakh crore ($15 billion) was earmarked to acquire only locally produced systems. Significant part of the defence R&D budget is set aside for giving to the academia, start-ups. The Defence Acquisition Procedure (DAP), is continuously being refined to improve environment for domestic industry growth. Special Purpose Vehicles (SPV) are being encouraged between DRDO and private players. Increased defence production will also open avenues for exports and amortize costs. It

will also generate jobs. Policies are supporting Foreign Direct Investment (FDI) in defence production. The defence manufacturing corridors should also push defence manufacturing. Defence exports reach an all-time high of approx. Rs 15,920 crore in FY 2022-23. Over 10-times increase since 2016-17. India exported defence items to over 85 countries. The target of $22 billion defence production and $5 billion export by 2025 can be achieved with a little effort.

Fighter Aircraft Production Coming of Age but more Required

Around 35 LCA Mk 1 are with the Indian Air Force (IAF). Eighty-three LCA Mk1A are on order. Mk1A made its first flight on 20 June 2022. HAL claims to be on track to deliver first Mk 1A by early 2024. All will be delivered by 2029 at the production rate of 16 per year. The Medium Weight Fighter (MWF) LCA Mk 2 design is frozen, the metal cutting is taking place and first flight is scheduled for end 2023, and the aircraft should induct in 2028-29 by when the Mk1A supplies would complete. Tie-up for production of engine in India under license is still to be evolved. The aircraft will be a 4.5 generation fighter of Rafale class. IAF requires nearly 200 LCA Mk 2 to replace the Jaguar, Mirage 2000, MiG 29 aircraft. The other LCA variant is the Twin Engine Deck Based Fighter (TEDBF) for Indian Navy. Significant LCA assemblies have been outsourced to the private sector. Many LCA systems like the aero-engine, ejection seat, radar, avionics, and weapons are still imported. Indian replacements are evolving. As of 2022 indigenous content in the Tejas Mark 1 is 59.7 per cent by value and 75.5 per cent by number of line replaceable units. The indigenous content of the Tejas Mk 1A is expected to be 50 per cent and rise to 60 per cent by the end of the program. Meanwhile the rate of production needs to go up to around 24 aircraft a year for IAF to get back numbers. A new production line is coming up at Nashik. Before India can export LCA, indigenous content must increase and so must production numbers.

Future aerial platforms will have to be penetrating dense integrated AD environment that is backed by electronic and cyberattacks.

The AMCA Preliminary Design Review (PDR) has been completed. The Critical Design Review (CDR) is expected to be cleared soon. The approval from Cabinet Committee on Security (CCS), will happen next, likely by mid-2023. The physical metal cutting will start thereafter. DRDO Chief announced at Aero India that first flight may take place seven years from now. The aircraft will be produced in Public-Private-Partnership (PPP). Most parts of the airframe are being made in India. Some systems like aero-engine (GE F 414) will still be imported. There are some other avionics and airborne radar that are being made through joint ventures with friendly foreign companies. The weapons would mostly be indigenous. Sixth-generation technologies will be imbibed. IAF needs 200 AMCA.

Helicopter Design and Production Under Control

Notwithstanding the recent ALH accidents and some continued technical problems, nearly 340 indigenous Advanced Light Helicopter (ALH) 'Dhruv' have been built. Over 90 armed ALH 'Rudra' are flying, and 75 more are on order. The Light Combat Helicopter (LCH) 'Prachand' are already flying with IAF and Indian Army. There are 200 confirmed orders between the two

services. The Light Utility Helicopter (LUH) is also flying. The same will also induct in all the three services in large numbers. HAL plans to produce nearly 1,000 military helicopters in the coming years. The Indian Multirole Helicopter (IMRH) is a medium-lift helicopter currently under development by HAL. In February 2023, PM Modi dedicated the new helicopter factory at Tumkur, to the nation. Clearly India is now well placed in helicopter development and production. However, repeatedly emerging technical problems and production quality issues need to be resolved. We are still dependent on imported components. Also we have low success in exports, which need to be driven.

Transport Aircraft Production Catching Up

The 56 EADS-CASA C-295MW transport aircraft for the IAF and six aircraft for Coast Guard have been contracted. Sixteen will come in fly-away condition, and 40+6 will built in India by a Tata Consortium within 10 years. This will be the first time an operational transport aircraft being built in India, and the first by an Indian private sector company. If successful, these could also replace the An 32 aircraft one day. India had earlier built the HS-748 and Dornier 228 in India under license production and has production experience. However, the National Aerospace Laboratories (NAL) 19-seat Saras continues to struggle despite assured IAF orders. Similarly, the 80-100 seat Indian Regional Jet (IRJ) being evolved by NAL and HAL is still on drawing board. Meanwhile China has already inducted over a 100 home-built Comac ARJ-21 (90 seat) regional jets, and have begun inducting the Comac C919 (160-seat) narrow-body airliner. India thus has a long way to go. Considering that Indian civil aviation requires large number of airliners, this needs acceleration. IAFs additional AEW&C aircraft are proposed on six pre-owned A321 Airbus platforms. Similarly IAF's multi-mission tanker transport (MMTT) requirements would also be meet by converting pre-owned airliners. The process needs hastening. India must produce a Y-20 class of transport aircraft soon enough.

Indian Private Sector – Significant Entry in Aircraft Production

A few big private industrial houses are now well-established in aircraft defence manufacturing. Tata Aerospace and Defence have been making the AH-64 Apache combat helicopter fuselage; aero-structures for Boeing's CH-47 Chinook helicopters; and C-130J and Pilatus PC-21 major aero-structure components for global customers. Sikorsky, a Lockheed Martin company, also relies on Tata Advanced System Limited (TASL) for global supply of S-92 helicopter cabins. 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 Sukhoi 30 MKI fighters. They are also supplying aero-structures to Airbus for its A320 family of aircraft and the wide-body 330 aircraft. Hyderabad's VEM technologies manufactures central-fuselage for LCA Tejas. Many Indian MSMEs and start-ups are in defence production, and their presence was visible in Aero India 2023. Private sector needs to be inducted much more in the eco-system.

UAVs and Drones

Indian armed forces have a huge requirement of large and medium unmanned aerial vehicles (UAV). India needs drones for civil and military

markets. Manned Unmanned aircraft Teaming (MUMT) has been tested globally, and operational concepts put in place. Drones are already being used for all roles including ISR, logistic delivery, armed attack against ground and aerial targets, laser lasing, and as electronic warfare and communication platforms, among other roles. Indian DRDO's Tapas medium altitude long endurance (MALE) and Ghatak UCAV look promising but are far behind schedule. DRDO must find private partners for UAVs. Adani Elbit Advanced Systems India Limited is producing Hermes-900 UAVs in India. Many start-ups have entered drones and counter drone manufacturing. These include Newspace Research and Technologies, Paras Aerospace, Throttle Aerospace, General Aeronautics, Redwing Labs, Dhaksha Unmanned Systems, UrbanMatrix Technologies, Thanos Technologies, and Auto Micro UAS, among many others.

As per the Drone Federation of India, the manufacturing of drones and related systems is picking up in India, but key components like battery, motor, sensors, semiconductor, GPS and camera are still being imported. This needs early resolution.

Task Force Approach for Aero-Engine

DRDO's Gas Turbine Research Establishment (GTRE) has struggled to make a turbo-jet aero-engine for many decades. There are very few aero-engine manufacturers in the world and they closely guard technologies. World over, many engines are being made by consortiums or joint-ventures. India has a significant market for both civil and military engines. India may best get into a Joint Venture that could be win-win for both side. India also needs small engines for UAVs and cruise missiles. Electric and hybrid engines is where the future is. India must set up a Task Force under PMO to develop the aero-engine.

Next Generation and Disruptive Technologies Approach

India has to master next-generation aviation technologies for the network-centric future battlefield. These include all-aspect, multi-spectral stealth: high-bandwidth low-probability of intercept AESA radars; Infra-red Search and Track (IRST); modern electronic warfare systems, and cyber warfare capabilities; integrated secure communications, navigation, and identification (CNI); advanced materials and smart structures; centralised 'vehicle health monitoring'; and high-speed computation and data-transmission are important technologies. Additive 3D manufacturing that creates a world with spare parts on demand, faster maintenance and repairs, more effective electronics, and customized weapons. Directed Energy Weapons (DEW) including laser and microwave. Hypersonic flight technologies, artificial intelligence based advanced robotics and autonomous flight capabilities. Long range precision weapons. Microchips are critical for all avionics, electro-optical systems, aerial weapons, DEWs, communications equipment among others. All this requires larger investments in R&D and a whole of nation approach.

Advanced Long Range Precision Weapons

Precision and range are the two critical requirements for both air-to-air and air-to-surface weapons. India has a successful missile program, including the Astra, Akash, BrahMos among others. Astra Mk 3, and BrahMos II need to be accelerated. In many cases we have partnered with Russia and Israel. The JV route is working well. Gradually, critical components like weapon sensor heads and control systems must be

increasingly Indian.

Huge MRO Market

India has a huge Maintenance, Repair and Overhaul (MRO) market for civil and military aircraft and engines. The current airliner fleet of around 750 aircraft will more than double in five years. It will be the third-largest fleet in the world by 2024. As per Niti Ayog report, the Indian MRO industry was $1.7 billion in 2021. The global MRO market was worth US$78.6 billion in 2022. The Indian market is expected to be $4.0 billion by 2031, growing at 8.9% CAGR, faster than any other country. India thus has great potential to be a significant regional MRO hub and gradually strive to establish its foothold in the global supply chain.

The current major Indian MRO players are, AIESL (Air India Engineering Services Ltd), Air Works India, and GMR Aero Technic Limited, among a few others. The airlines growth makes a great case for strategic investors, Original Equipment Manufacturers (OEMs) and global MRO players. Policy initiatives such as the MRO Policy 2021, National Civil Aviation Policy 2016, rationalization of GST, removal of Gross Turnover Tax (GTO), etc. should incentivize. Incremental steps such as joint ventures with established global MRO players, and initial focus on lower IP control (electrical and electronics, avionics, structural repair, etc.) and a gradual shift towards the higher end of the MRO value chain could be a good approach. There is a great scope for military engines overhaul market to go to private players.

Way Ahead India

Future aerial platforms will have to be penetrating dense integrated AD environment that is backed by electronic and cyberattacks. Armed forces need to prepare for asymmetric warfare. Air forces will have to engage in the system-of-systems approach to take on multi-dimension, multi-domain operations. India has a huge, fast-growing, civil aircraft market. India needs to identify and list the critical technologies and make dedicated teams to drive them. The best talent in the country must be tapped for technology development and manufacture. Many Indian start-ups and other private companies are manufacturing major components and sub-systems for global aviation majors. Private sector is in a better position for joint-ventures. A pert-chart must define clear timelines so that the final aerial platform is not delayed. India is a great contender for an aerospace hub. It will have to be a "whole of nation" approach. Undoubtedly, the "Atmanirbharta" campaign will drive indigenisation. The time to act is now, lest it is too late.

***

PLA Air Force: Significant Air Power – Time India Must Act

Air Marshal Anil Chopra (Retd)
Director General, Centre for Air Power Studies |

12 May 2023

Source: Chanakya Forum | https://chanakyaforum.com/pla-air-force-significant-air-power-time-india-must-act/

Like the Americans and the Russians, China realised very early that one who controls the aerospace, controls this planet. They began setting up aircraft building plants, initially with the help of the Soviet Union, and later during their honeymoon with the Americans, they could get better technologies. As they began becoming an economic power, they started aeronautical research and development in a big way. In parallel they made leaps into space.

Today PLA Air Force (PLAAF) fast transiting from a tactical, army-centric, to an air force with a global reach. The state-owned Aviation Industry Corporation of China (AVIC) is developing and producing state-of-the-art airborne platforms and is fast catching up with the best in the world. PLAAF has also reoriented its flying training and tactics. There is much greater emphasis on technological support even for operations. As Xi Jinping drives to create PLA into a "world-class" military, the PLAAF is evolving its operational doctrine, missions and roles, including concentrating on long-range precision strikes, and giving higher importance to personnel development. It is building specialisation for offensive operations, air defence, army support, reconnaissance, early-warning, and surveillance, information operations, and strategic transport forces. PLAAF also wants "integrated air and space capabilities and coordinated offensive and defensive operations." Even though the space-based assets went under the Strategic Support Force (SSF), most PLAAF platforms now use of space-based systems. The newer fifth-generation fighter aircraft, the J-20, and other fourth-generation-plus aircraft are fast replacing the ageing J-7s. The PLAAF is training for the hybrid nature of warfare, including precision and effect-based operations, using network based operational planning. PLAAF has low exposure to military conflict and modern air exercise, but is trying to compensate through state-of-the-art platforms, weapons, and joint training.

PLAAF Doctrinal Shift

The PLAAF is the largest air force in the region and the third largest in the world, with more than 2,500 aircraft (not including UAVs or trainers), of which 1,700 are combat aircrafts. PLAAF is closing the gap with Western air forces across a broad spectrum of capabilities, such as aircraft performance, command and control, and electronic warfare. The 2017 reforms included establishing new airbases and a brigade based structure. The PLAAF also relocated and subordinated some units to different theatre commands and re-designated the 15th Airborne Corps as the PLA Airborne Corps. It is shifting its focus from territorial air defence to forward-postured offensive-defence. The PLAAF is boosting its capabilities for strategic early warning, long-range precision air strikes, air and missile defence, information countermeasures, airborne operations, strategic projection, and

comprehensive support.

PLAAF Coming Out of Army Shadow

For China's global ambitions, President Xi Jinping is driving air, space, and maritime capability. The Chinese air force now has service-specific strategies. The PLAAF primary missions now are air deterrence, air offensive, air blockade, maritime and ground force support operations. Air offensives would entail large-scale strikes with the goal of rapidly gaining air superiority, reducing an adversary's capacity for military operations, and creating conditions for early victory. It would entail attacks on airfields and seaports as well as air, land, and sea transportation routes with the goal of cutting the enemy supply lines by attacking logistics facilities, and key choke points. It would also include battlefield close air support, strategic and theater airlift, and airborne operations.

Fighters

The PLAAF has nearly 1,000 fourth-generation fighters such as J-10, J-11B, J-16, Su-27, Su 30 MKK, and Su-35. The target is to retire remaining legacy fighters and become a fourth-generation-plus force within the next few years. The fifth-generation fighter aircraft, are the developmental Chinese J-20 and FC-31/J-31. China claims to have 150 J-20s. They carry integral weapons and are designed with network-centric warfare technology. China continues to struggle to develop suitable aero-engines.

Bombers

China's bomber force comprises variants of the H-6 Badger bomber, and the PLAAF has worked to maintain and enhance their operational effectiveness. The extended-range H-6K variant features more efficient turbofan engines, and can carry six ALCMs, providing long-range, standoff, precision-strike capability. The PLAAF is developing new medium-to-long-range H-20 stealth bomber to strike regional and global targets. It is planned to reach initial operational clearance (IOC) by 2025.

Transport Aircraft and Force Multipliers

China already has 60 Y-20 large transport aircraft to supplement the nearly 17 Russian Il-76 aircraft (40 tons). Y-20 can lift up to 66 tons and transport up to 2 Type 15 tanks or one Type 99A tank over a distance of 7800km. It uses the same Russian engines as the Il-76. The WS-20 engine is under development. Y 20 has air to air refueller and AEW&C variants. China currently has around 25 AEW&C of KJ-2000, KJ-200, and KJ-500 class. The largest being IL-76-based. These aircraft extend the range of a country's integrated air defence system network. But the numbers are still too few for its continental size and possible confrontation with the USA. Similarly, China has only 20 FRA, including eight Xian YY-20A. Numbers will go up soon. China also has nearly 25 dedicated electronic warfare aircraft.

Helicopters and Training Aircraft

The Z-10 attack helicopter has been co-designed with Kamov design bureau of Russia and is armed with HJ-10 Air-to-Ground Missile (AGM) similar to AGM-114 Hellfire. The Z-19 is the smaller variant. The Z-18 is a Chinese medium transport helicopter that can carry 27 troops or five tons of cargo. The Z-18J is the AEW variant. The Z-20 helicopter is the Chinese equivalent of Sikorsky S-70.

Nanchang CJ-6 has been the basic training aircraft for many decades. Hongdu JL-8 is the Jet trainer. The Karakorum K-8 variant of the same is with Pakistan and is being exported to many countries in Asia and Africa. Hongdu L-15 is a

supersonic lead-in fighter trainer. Chian has done well in indigenous trainer production.

UAVs, UCAVs and Drones

China has a growing high-end military drone force backed by a large UAV industry, including private start-ups. They produce all genres of UAVs including stealth, VTOL, micro-UAVs, unmanned airships, flying wings, sailplanes, UFO-style flying discs and even ornithopters (flapping wings). PLAAF's current in-service Medium Altitude Long Endurance (MALE) drone is the BZK-005 (Giant Eagle). The GJ-1 and GJ-2 are MALE UAVs capable of the strike role and are the variants of the export oriented Wing Loong I and Wing Loong II systems. They are considered equivalents of MQ-1 and MQ-9, respectively. PLAAF high-altitude (HALE) UAV is jet-powered WZ-7 (Divine Eagle). The GJ-11 (Sharp Sword) is the stealthy UCAV, and WZ-8, a supersonic reconnaissance UAVs. GJ-11 could be used for autonomous missions, autonomous swarming, manned-unmanned-teaming (MUMT), loyal wingman, and other concepts. The Divine Eagle AEW variant will augment existing manned AEW&C platforms. The "Anjian" (Dark Sword) UCAV is a delta-winged platform similar to the American Global Hawk HALE UAV. The CH-4 is a U.S. General Atomics MQ-9 Reaper look alike. CH-3 has a semi-active laser, and can carry Anti-Radiation Missile (ARM), and an Air-to-Surface Missile (ASM). The Pakistani Burraq UAV is based on CH3 UAV and been supported by China. Clearly China has a stable of home-made UAVs and are much ahead of India.

Aerial Weapons and SAMs

PLAAF is developing smart, intelligent and precision ammunition with surgical strike capability. KD-88 is an IR/TV guided Air to Surface Missiles (ASM) for ground and sea targets with an estimated range is about 180 km. PLAAF has the supersonic Russian and Chinese made Anti-Radiation Missiles (KH 31P, YJ-91). There is an inventory of laser-guided and satellite-guided bombs. The top end Beyond Visual Range (BVR) Air-to-Air missiles (AAM) include the latest PL-12 and PL-21 which outrange the Western counterparts like AIM-120 AMRAAM, and Meteor. China also has many Russian R-27, R-77, and R-73 AAMs. The extended-range radar-guided PL-15 and PL-21 are termed as AWACS killers. China has nearly 500 DH-10 land-attack cruise missiles with a 2,000 km range. The air launch variants have 1,500 km range. PLAAF's SAMs include Russian-sourced SA-20 (S-300PMU1/2) battalions and domestically produced CSA-9 (HQ-9) battalions. CSA-X-19 (HQ-19) is the domestically produced ballistic missile defence weapon. China has acquired six batteries of the Russian S-400 air defence systems.

Airborne Corps

The PLA Airborne Corps consists of six airborne brigades, a special operations brigade, an aviation brigade, and a support brigade, and is under PLAAF. The airborne troops are envisaged for pre-emptive attacks on the enemy's key military targets in the rear area to disrupt preparations for an offensive. Currently, the PLAAF can lift one division of 11,000 men with light tanks and self-propelled artillery. Airborne Corps has demonstrated it can move a regiment plus of paratroopers with light armored vehicles to anywhere within China in less than 24 hours.

Joint Training and Exercises

PLAAF regularly exercises with other PLA ground and naval forces. These include large force engagements. They do regular exercises in Tibet

region, and of late the frequency of exercises has increased even in winter. With Pakistan Air Force (PAF), PLAAF has been doing regular Shaheen series of exercises since 2011. The exercise helped the two sides for interoperability and gave the PAF exposure to the SU-30 capabilities. The F-16 were not allowed to be used by the Americans. However, Chinese have had adequate inputs about the F-16s during interaction with Pakistani pilots. There are also reports that some PLAAF pilots are learning to speak English. Nearly 60 percent of PAF aircraft and equipment is now of Chinese origin. Pakistan could offer some airbases to China during hostilities.

Key PLAAF Strategic Takeaways

Like all modern air forces, PLAAF places emphasis on long range offensive precision strikes using enablers like FRA, AWACS and satellites, and a combination of air and surface launched weapons. They are building synergy between the PLAAF and the People's Liberation Army Rocket Force (PLARF). PLAAF is building multi-layered air defence systems and the ability to promulgate and enforce Air Defence Identification Zones (ADIZs) and 'no fly zones'. PLAAF has increased capability to cover vast airspace in TAR and is increasing capability to look deep into Indian air space. China's extensive constellation of surveillance satellites with short revisit cycles adds significant punch to target locating and tracking capability. China has a clear lead over India's space programme. PLAAF's increased focus on electronic warfare, cyber and other support forces like 'base protection forces' is meant to make the PLAAF a contemporary and modern force. The newly created PLA Strategic Support Force (SSF) also offers significant force multiplier support to the PLAAF. Indian armed forces are just beginning to harness the space, cyber and information warfare resources.

PLAAF believes in using high tech weaponry for force projection that would allow quick victory in "limited wars". China would execute integrated deep strikes and concentration of superior firepower to destroy opponent's retaliatory capabilities. This pro-active doctrine essentially seeks to take the battle into enemy territory. PLAAF doctrine also points towards the unification of air and space defences requiring integrated command and control.

PLAAF Vision 2035

China has achieved networking and information led operational capability and is working towards Artificial Intelligence (AI) backed intelligent warfare. There is significant progress in the research and development of sixth-generation fighter aircraft which will have artificial intelligence integrated systems and will fly in conjunction with drones. Aircraft is expected to be inducted by 2035. China is investing heavily to develop avionics and jet engines. China's biggest strides are coming in air-to-air missiles. PLAAF believes that with a one or two million dollars weapon, they could destroy a few hundred-million-dollar AEW&C aircraft. China has already demonstrated and operationalised hypersonic weapons capability. China is pushing ahead in cyber, electronic warfare, space, quantum computing and some other technologies.

Implications and Options India

Indian Air Force (IAF) has a clear advantage of much larger number of airfields at much closer distances and at lower altitude. Even though IAF is currently at all-time low in numbers of fighter aircraft, it can currently field more missions across Himalayas. China is building more airfields and will use long-range vectors. IAF has much greater

actual war exposure and is carrying out large number air exercises with all the major air forces of the world, which gives it clear training edge. India needs to rebuild IAF to 42 combat squadrons. While we need to accelerate development and production of indigenous fighters, the process of acquiring 114 fighters must be hastened. IAF also needs much greater number of AWACS and FRA aircraft. Surface-to-surface missiles and Cruise missile inventories must go up, and so has to be ammunition stocking. There is also a need to strengthen infrastructure along the Himalayan border, and at forward airfields. India needs to increase cyber and electronic warfare capability. The number of combat UAVs are inadequate to meet all challenges as of now. India needs many more satellites to increase ISR capabilities. India has to invest much for in defence R&D and new technologies and become 'atmanirbhar' in defence production. Considering that Chinese are literally sitting on our border, out of budget funding may be allotted to hasten purchases of critical capabilities. China is a closed society. A lot of what comes out from the Chinese controlled media is part of Information Warfare and Influence Operations (IWIO) to make adversary under confident. India must guard against this. With the fastest growing large economy, and high level of determination and training, India is well placed to take on any misadventure and must continue to be on guard.

***

Major Global Powers have Merged Air and Space Domains, Time for India to Follow Suit

Air Marshal Anil Chopra (Retd)
Director General, Centre for Air Power Studies | 05 May 2023

Source: Firt Post | https://www.firstpost.com/opinion/major-global-powers-have-merged-air-and-space-domains-time-for-india-to-follow-suit-12549972.html

Dream Chaser. Image courtesy Sierra Nevada Corporation

Space is not only the ultimate vantage point, but man-made satellites have become powerful enablers and enhancers of all activities on planet Earth. The thin line between air and space has shrunk, and also the 'near space' has become an area of interest and action. More objects are transiting through both air and space in the same flight or mission. Ancient Indian texts indicate 'Vimana' the aerospace craft. The day is not far when an airliner flying between London and Sydney may transit through space for a short period and complete the flight in just two hours. There is space tourism evolving. Space will be exploited for minerals, power generation, and zero gravity industrial production and agriculture, and soon there will be colonies on the moon. The militarization of space has been there since the very beginning. Many countries have now begun treating the air and space domains as a single merged entity to be able to harness their

full potential. Since, currently, militaries exploit the two regions much more; let us look at the advantages of merging the two domains.

Domain Definitions

The earth's lower atmosphere is where most of the aviation activity takes place. The troposphere is the lowest layer and goes up to around 15 kilometres, and holds 75-80 per cent of the mass of the atmosphere. The stratosphere extends from 15 kilometres and 35 kilometres and absorbs most of the ultraviolet radiation that Earth receives from the Sun. Thereafter the atmospheric gases begin to thin considerably. It is generally accepted, for purposes of spaceflight, that the Karman line, at an altitude of 100 kilometres marks the beginning of space. But there is no sharp physical boundary. The expression "near space" is often used to refer to a region between 20 and 100 kilometres. Some aircraft and balloons do operate in this region. The vast universe beyond 100 km can be called space. Some term it as "outer space".

The blurring of the air and space domains allows synergy and operations from the inner-atmosphere aviation, near space, and outer space.

Space Support for Military Operations

The elements in space support greatly improve military effectiveness and national security. Sensors in space are crucial for supporting Intelligence, Surveillance and Reconnaissance (ISR) which improves battle-space awareness, adversary capability assessment, adversary course of action assessment, and battle damage assessment in all domains. ISR also supports all space, counter-space, and counter-counter-space operations.

Space allows weapon launch detection; missile tracking, and environmental monitoring. Satellite communications, and positioning, navigation, and timing are powerful enablers. The ability to exploit space for military advantage requires space asset protection by incorporating both active and passive measures to suppress attacks. Space Situational Awareness (SSA) becomes important.

Space-based positioning, navigation, and timing (PNT) have a global utility for economic growth, transportation navigation and safety, homeland security, and military operations. It allows synchronisation of operations and improve communications security. Satellite navigation is used by everyone. PNT allows satellites for "position autonomy" for autonomous operations.

Satellite communication (SATCOM) provides global coverage for both military and civil requirements. Uninterrupted SATCOM capability is critical for providing command and control to forces in operations.

Environmental monitoring is required for both space and earth-based assets. It provides data on meteorological, oceanographic, and space environmental factors that may affect military operations and determine if there could be potential disruptions to space services.

Air and Space Boundaries Become Less Distinct

The 21st century technologies have increasingly blurred the air and space domains. The two allow multi-domain and multi-dimensional operations. Both domains are almost seamless. The two domains are contiguous and with increasing interdependencies. Today, militaries are exposed to effects delivered on earth from space, conversely from air to space.

World over, doctrine and conceptual thinking is looking at how the two would be exploited, as conjoined entities, for better military effect. The fusion of air and space will support the delivery of outcomes above the surface, on the surface and below the surface of the earth from platforms and capabilities that operate in the air, from space, and across the air-space continuum.

The air and space domains have the greatest physical horizontal and vertical spans. These domains are also increasingly vital to both economies and security. Maritime doctrine identifies and looks at the security of maritime trade routes, air and space that are enablers of all activities on earth and the national security challenges must be met together.

Agile and adaptive Command and Control (C2), can be maximised through the combined attributes of height, speed, reach, agility and ubiquity of air power with attributes of perspective, access, persistence and versatility of space power. Synergies between air and space are important. Indian Space Policy 2023 gives emphasis to operational capabilities, Space Situational Awareness and defence of own assets in space.

Systems Transiting Air and Space

Most spacecraft, manned or unmanned, are launched from the Earth and are meant to return to the Earth one day through a controlled re-entry. Re-entry takes place around 100-kilometre altitude. Objects re-entering experience atmospheric drag, aerodynamic heating, and mechanical stress. Reusable spacecraft make more regular transits. The space shuttle was a partially re-useable system. The privately owned Space Exploration Technologies Corporation (SpaceX) makes reusable rockets which regularly transit to and from space. Ballistic missiles also transit from air to space and back. Hypersonic Glide Vehicles (HGV) will ride ballistic missiles and will transit air and space. Spy plane Lockheed U-2 used to fly at 22 km altitude and Lockheed SR-71 Blackbird at 26 km altitude. Fighter aircraft like MiG-31 and F-15 can launch ASAT weapons or launch small-satellite launch vehicles (SSLV). Tourism and spy balloons go up to near space. Concorde supersonic airliner used to fly at 18 km. American companies are once again looking at supersonic airliners. There are many hypersonic aircraft projects.

Operational Imperatives

There are overlapping jurisdictions between air and space for missile defence, especially with a space layer for sensors. Air defence today extends to the limits of space. There are similarities between air defence and space defence. There are similarities between Air Traffic Services and Space Traffic Management. There are SSA overlaps between the orbital and sub-orbital regions including near space. A common air and space situation picture is required for missile defence. Tactical actions in manoeuvre warfare in space are very similar to tactical actions when an air strike force is intercepted by the adversary. The concepts for military space control are drawn from principles of control of the air. And the most critical point is the need to maintain a contiguity in the detection and engagement of incoming threats in the transition zone between space and airspace.

Major Combined Air and Space Forces

The US Air Force Space Command was established in September 1982 with all operational space assets. The United States Space Force Act was passed in December 2019. The

newly created United States Space Force (USSF) along with its sister branch, the US Air Force, remained part of the Department of the Air Force. They work closely with technology development and command and control of the domains. The United Kingdom Space Command (UKSC) was established in April 2021. It is a joint command organised under the Royal Air Force, and headed by an RAF officer. Clearly, the two contiguous domains are considered linked. The French Air Force became the French Air and Space Force in September 2020. The French Space Command is part of it. It reflect an "evolution of its mission" into the area of outer space. The Russian Space Forces were re-established following 1 August 2015 merger between the Russian Air Force and the Russian Aerospace Defence Forces after the independent arm of service was dissolved in 2011. On August 1, 2015, the Russian Air Force and the Russian Aerospace Defence Forces were merged to form the Russian Aerospace Forces. The Russian Space Force is now one of three sub-branches. The People's Liberation Army Strategic Support Force (PLASSF) was established in December 2015 and includes the space, cyber, and electronic warfare. It is the fifth arm of the PLA. Chinese model is somewhat different. It can be seen that most modern armed forces have combined air and space entities.

Way Ahead India

As major future action shifts to the air and space domains, they become a greater part of the national security priority. Air and Space doctrinal leaps must make 'aerospace' a future fused war-fighting domain. The future force concept of merging the two domains needs clear analysis and simulation of such a review. Such a review will then decide the force structures, platforms, capabilities, and weapons. The aerospace craft that will operate in both domains is evolving. Newer technologies will deliver the improvements in speed, reach, persistence, coverage, survivability, and precision necessary to provide an increased range of options across the globe and beyond in space. Hypersonic flight, satellites on operational readiness with the launch on demand are already a reality. Synergetic air-breathing rocket engines are under development that will be capable of Mach 5+ by 2030.

Satellites with quantum technology radar and electro-optical sensors now allow producing a recognised air and space picture. This can be amalgamated in IAF's renamed Integrated Aerospace Command and Control System (IACCS). Each node could now be called an air and space operations centre, capable of directing, commanding, and controlling air and space activities at home and abroad.

High-altitude pseudo-satellites (HAPS) like Airbus's 'Zephyr' allow persistent (months), loitering, and reusable technology to enhance communications and ISR coverage within the upper atmosphere. The application of Directed Energy Weapons (DEW) to air and space operations will also be significant. It will be possible for a high-altitude aircraft to use a DEW against satellites. Developments in Artificial Intelligence (AI) and autonomous technologies may bring about a Revolution in Military Affairs that alters the nature of war itself. Information advantage can best be supported by air and space together. AI and autonomy will support Human-Machine Teaming in air and space and will be a true force multiplier.

The blurring of the air and space domains allows synergy and operations from the inner-atmosphere aviation, near space, and outer space.

IAF is already providing significant support for surface operations of the army and navy. The addition of Space will bring additional support tasks. Wherewithal for the same would have to be created. There is already congruence in air and space industry. Hindustan Aeronautics Ltd (HAL) makes many structures and components for Indian Space Research Organisation (ISRO).

Aviation is around 120 years old, and the first artificial satellite was launched in 1957. Both have come a long way and are today the dominant domains of warfighting. Going forward, air and space power will quite literally know no bounds. The air and space domains are distinct, but they have many potential advantages of a continuum when used as a single entity. Merging the air and space domain is a national security requirement and should not be seen as turf-building activity. We have good global models to learn from the US, Russia, France and UK.

Prime Minister Modi has increasingly been using the term aerospace domain. During many recent seminars, CDS, General Anil Chauhan, and the IAF Chief, Air Chief Marshal VR Chaudhari have called for building offensive and defensive space capabilities to safeguard assets, while stressing that the race to weaponise space has been on, and that the next war would be fought across the land, sea, air, cyber and space. IAF's Aerospace Doctrine 2022 has spelt out the missions. It is time to move from the conceptual to the physical implementation stage.

***

Air Power

MiG-29K Fighter Makes Maiden Night Landing on INS Vikrant; Navy Terms it 'Historic Milestone'

25 May 2023

Source: The Hindu | https://www.thehindu.com/news/national/mig-29k-fighter-makes-maiden-night-landing-on-ins-vikrant-navy-terms-it-historic-milestone/article66893514.ece

A MiG-29K aircraft makes a maiden night landing on INS Vikrant. | Photo Credit: PTI

For the first time, the MiG-29K fighter aircraft undertook night landing on indigenously-built aircraft carrier INS Vikrant, a feat described by the Indian Navy as a "historic milestone".

The Navy said the "challenging" night landing trial demonstrated the resolve, skill and professionalism of the crew of the INS Vikrant and the naval pilots.

The night landing of the Russian-origin MiG-29K took place on May 24 night when the ship was sailing in the Arabian Sea.

Defence Minister Rajnath Singh congratulated the Indian Navy for the successful maiden night landing trials of MiG-29K on INS Vikrant.

"Congratulations to the Indian Navy for successfully undertaking the maiden night landing trials of MiG-29K on #INSVikrant. This remarkable achievement is a testimony to the skills, perseverance and professionalism of the Vikrant crew and Naval pilots. Kudos to them,"

Singh tweeted.

In a statement, the Navy said the aircraft carrier is presently undergoing "air certification and flight integration trials" with rotary wing and fixed wing aircraft for achieving a "combat ready" state at the earliest.

"As part of the trials, the maiden day landing of MiG-29K and the indigenous Light Combat Aircraft (Navy) was achieved on February 6. Since then, day and night landing trials of all helicopters in the Naval inventory have progressed," it said.

"In continuation with the impetus on the aviation trials, the Navy has achieved another historic milestone by undertaking the maiden night landing of MiG-29K on May 24," the Navy said.

It said this "challenging accomplishment" within three months of the maiden day landing demonstrates the resolve, skill and professionalism of the Indian Navy, Vikrant crew and the Naval pilots.

The Navy said the "challenging" night landing trial demonstrated the resolve, skill and professionalism of the crew of the INS Vikrant and the naval pilots.

The Navy said INS Vikrant is a "big boost" to the 'Aatmanirbhar Bharat' (self-reliant India) vision of the government.

In February, Russian-origin MiG-29K and a prototype of the Naval variant of the indigenously developed Light Combat Aircraft (LCA) Tejas jets had conducted day landings on the aircraft carrier.

In September last year, Prime Minister Narendra Modi commissioned India's first indigenously-built aircraft carrier INS Vikrant that made the country part of an elite group of nations capable of manufacturing aircraft carriers above 40,000 tonnes category.

The Navy had said the aircraft carrier would be able to play a role in ensuring peace and stability in the Indo-Pacific region.

Built at a cost of around ₹23,000 crore, INS Vikrant has a sophisticated air defence network and anti-ship missile systems.

It has the capacity to hold 30 fighter jets and helicopters.

At the commissioning ceremony of the vessel, Prime Minister Modi called it a "floating city" and that it is a reflection of India becoming self-reliant in defence. The night landing of the MiG-29K aircraft came as part of flight trials onboard the aircraft carrier.

The INS Vikrant has over 2,300 compartments, designed for a crew of around 1700 people, including specialised cabins to accommodate women officers.

It has a top speed of around 28 knots and a cruising speed of 18 knots with an endurance of about 7,500 nautical miles.

The ship is 262 metres long, 62 metres wide and it has a height of 59 metres.

***

AUKUS Moving from Nuke Subs to AI Drone Swarms

Gabriel Honrada | 15 Apr 2023

Source: Asia Times | https://asiatimes.com/2023/05/aukus-moving-from-nuke-subs-to-ai-drone-swarms/

Artist's concept of a drone swarm. Credit: C4ISRNET

From nuclear submarines to hypersonic weapons, AUKUS is now developing AI-powered drone swarms and target identification capabilities that may prove decisive in a Taiwan Strait conflict.

Breaking Defense reported that the UK Ministry of Defense (MOD) announced the first-of-its-kind AI and autonomy trial for aerial and ground vehicles occurred last month, with several claimed "world firsts" at the event showcasing AUKUS Pillar 2's capabilities.

AUKUS' advanced technology-sharing follows a two-pillar framework. Pillar 1 is a trilateral effort focused on supporting Australia to build a nuclear attack submarine (SSN) fleet.

In contrast, Pillar 2 focuses on accelerating cooperation in several high-tech fields such as cyber capabilities, artificial intelligence, quantum computing, hypersonics and counter-hypersonics.

Breaking Defense notes that the event was spearheaded by the UK's Defense Science and Technology Laboratory (DSTL), which included "live retraining of models in flight and the interchange of AI models between AUKUS nations."

The same report mentions that AUKUS teams developed AI models and directed each other's air and ground systems tasked with target identification.

These assets, the Breaking Defense notes, include UK Blue Bear Ghost and Australian Insitu CT220 drones, UK Challenger 2 tanks, Warrior armored vehicles and Viking uncrewed ground vehicles, alongside an FV433 Abbot self-propelled gun and a BMP OT-90 infantry fighting vehicle.

Intelligent drone swarms may be a game-changing capability in a Taiwan scenario. Asia Times reported in May 2022 that drone swarms linked together by a distributed laser "mesh" data-sharing network were essential in securing a US victory in the Taiwan Strait during 2020 simulations conducted by the RAND think tank.

The drones used line-of-sight lasers to transmit data among each other, sharing targeting and flight data instantaneously between individual drones and effectively making the swarm autonomous.

Such intelligent drone swarms can work with manned stealth aircraft, extending the latter's sensor range while maintaining electronic silence, thus drastically increasing the latter's target acquisition capabilities.

They could also flood enemy radars with multiple targets, forcing the enemy to use limited air defense missiles and ammunition on expendable targets while manned stealth aircraft move in for the kill.

Machine learning and AI also enable drone swarms to look at targets from multiple angles, cross-check various targeting data streams and suggest the best attack.

For example, such capability may allow drone swarms to attack specific points on a warship, such as missile launchers, radars and engine compartments.

In line with the 2020 RAND simulation, Asia Times reported on February 2023 that the US is moving to accelerate the development of autonomous drone swarm technology that has already proved its worth in the Ukraine war and may prove decisive in a Taiwan contingency.

The US Department of Defense (DOD) has launched a low-profile program called "Autonomous Multi-Domain Adaptive Swarms-of-Swarms" (AMASS) to develop drone swarms that can be launched from sea, air and land.

AMASS aims to develop the capability to command autonomous drones working together to destroy enemy air defenses, artillery pieces, missile launchers and command centers.

Although details of the AMASS project are classified, pre-solicitation documents show that it is likely to focus on defeating or deterring a Chinese invasion of Taiwan.

Australia may already be deeply involved in US drone swarm projects. For example, Australia's 2023 Defense Strategic Review mentions that collaboration with the US on the MQ-28A Ghost Bat should be a priority, with the drone capable of flying autonomously or with manned aircraft while being an expendable asset.

Drone-based target acquisition capabilities may also benefit AUKUS land-based precision fires in the Pacific. Asia Times reported in December 2022 that the US plans to build a "missile wall" in the Pacific, built around US Army and Marine Corps land-based missile launchers.

The US Army is testing its Typhon land-based missile launcher for its mid-range capability (MRC) program to provide long-range precision fires in the Pacific. It is designed to fire the Standard SM-6 or Tomahawk Block V missiles between 500 to 1,800 kilometers.

In the same direction, the US Marine Corps pursues a similar project with its Long-Range Fires program, using the same Tomahawk Block V missiles and other subsystems as the US Army's Typhon.

Not to be left behind, Australia is also acquiring land-based missile launchers. The Strategist reported in April 2023 that the Australian Defense Force is seeking "land-based maritime strike" capability for a future conflict in coastal areas.

The Strategist report notes that a leading contender for this project is the Bushmaster troop carrier equipped with a pair of Naval Strike Missiles and advanced anti-ship weapons with a 250-kilometer range, the type of which are in service with the US Navy and US Marine Corps.

Such a level of advanced technology-sharing only happens in the tightest of alliances, with ingrained trust, shared culture and common language. The deep institutionalization of defense ties gives AUKUS an advantage over other Pacific security arrangements where those factors are lacking.

However, the high-tech AUKUS alliance may also have profound pitfalls. In a November 2022 Hudson Institute article, Koichiro Takagi notes that AI may outpace humans in decision-making speed, citing the risk of a flash war wherein opposing AI systems start an uncontrollable chain reaction that starts a conflict or even launches nuclear missiles.

He notes the tendency of humans to trust AI in the heat of battle, even if evidence shows that the AI's decisions are incorrect. Takagi mentions that throughout history, it has not been superior technology and science that has won wars but the human intelligence that uses those tools.

He notes that future wars may not be determined by who has the better AI but by the innovativeness of the concepts that use it alongside human intelligence and creativity.

***

Iran Claims to Successfully Test-Launched Ballistic Missile with Potential 2,000-Km Range

Saumya joshi | 26 May 2023

Source: Republic World | https://www.republicworld.com/world-news/uk-news/iran-claims-to-successfully-test-launched-ballistic-missile-with-potential-2000-km-range-articleshow.html

Iran launched its ballistic missile. (Image: AP)

Iran has successfully launched a 2,000km-range (1,243m) ballistic missile, according to the country's state media - two days after the chief of Israel's armed forces raised the prospect of "action" against Tehran over its nuclear programme. "One of the prominent characteristics of this missile is its ability to evade radar detection and penetrate enemy air defence systems, thanks to its low radar signature," said Defense Minister Gen. Mohammad Reza Ashtiani, reported AP. Further, he added, "This missile has the capability to utilize various warheads for different missions.".

Iran, which has one of the largest missile programmes in the Middle East, claims that its missiles can reach the regional bases of Israel and the United States, its two main regional adversaries.

The Islamic Republic has stated it will advance its "defensive" missile technology despite criticism from the US and Europe.

Isreal and France are concerned about the missile launch by Iran, why?

While talking about the new ballistic missile that has been unveiled recently, the Tehran officials said that they would be developing its "defensive" missile programme, even after facing opposition from the US and European countries. According to Iran's defence minister, Mohammad Reza Ashtiani.

Isreal, which has not been recognised by the Islamic Republic, has viewed Iran as an 'existential threat'. Whereas, France has shared its concerns over Iran's recent test-firing of a ballistic missile and also cited it as a violation of the UN Security Council resolution that supports the 2015 nuclear deal.

The spokeswoman for the French Foreign Ministry, Anne-Claire Legendre has expressed discomfort during a Paris briefing, citing the "continuing escalation of Iran's nuclear program" as a reason for concern.

Meanwhile, It is to be noted that the footage of an upgraded version of Iran's Khorramshahr 4 ballistic missile has been broadcasted on state TV. "Our message to Iran's enemies is that we will defend the country and its achievements. Our message to our friends is that we want to help regional stability, said Iran's General"

The new ballistic missile has a range of 1,243 miles (2,000km) that can carry a 1,500kg (3,300lb) warhead, as per Iran media reports. According to the IRNA, the missile has been named Kheibar, which is a reference to a Jewish castle overrun by Muslim warriors in the early days of Islam.

Further, Iranian officials have claimed that this ballistic missile would be an important deterrent as well as a retaliatory force against the US, Israel and other potential regional adversaries. Meanwhile, Isreal and France have shared their concerns regarding the new military development in Iran.

***

The Air Force used Microwave Energy to Take Down a Drone Swarm

Kelsey D. Atherton | 23 May 2023

Source: Popsci | https://www.popsci.com/technology/thor-weapon-drone-swarm-test/

THOR stands for Tactical High-power Operational Responder. Adrian Lucero / US Air Force

In the desert plain south of Albuquerque, New Mexico, and just north of the Isleta Pueblo reservation, the Air Force defeated a swarm of drones with THOR, a powerful microwave weapon. THOR, or the Tactical High-power Operational Responder, is designed to defend against drone swarms, frying electronics at scale in a way that could protect against many flying robots at once.

THOR has been in the works for years, with a successful demonstration in February 2021 at Kirtland Air Force Base, south of Albuquerque. From 2021 to 2022, THOR was also tested overseas.

This latest demonstration, which took place on April 5, saw the microwave face off against a swarm of multiple flying uncrewed aerial vehicles. The event took place at the Chestnut Range, short for "Conventional High Explosives & Simulation Test," which has long been used by the Air Force Research Lab for testing.

"The THOR team flew numerous drones at the THOR system to simulate a real-world swarm attack," said Adrian Lucero, THOR program manager at AFRL's Directed Energy Directorate, in a release earlier this month. "THOR has never been tested against these types of drones before, but this did not stop the system from dropping the targets out of the sky with its non-kinetic, speed-of-light High-Power Microwave, or HPM pulses," he said.

Crucial to THOR's concept and operation is that the weapon disables and defeats drones without employing explosive or concussive power, the kind derived from rockets, missiles, bombs, and bullets. The military lumps these technologies together as "kinetics," and they make up the bread and butter of how the military uses force. Against drones, which can cost mere hundreds or even thousands of dollars per vehicle, missiles represent an expensive form of ammunition. While the bullets used in existing counter-rocket weapons are much cheaper than missiles, they still create the problem of dangerous debris everywhere they don't hit. Using microwaves means that only the damaged drone itself becomes a falling danger, without an added risk from the tools used to shoot it down.

"THOR was extremely efficient with a near

continuous firing of the system during the swarm engagement," Capt. Tylar Hanson, THOR deputy program manager, said in a release. "It is an early demonstrator, and we are confident we can take this same technology and make it more effective to protect our personnel around the world."

The THOR system fits into a broader package of directed energy countermeasures being used to take on small, cheap, and effective drones. Another directed energy weapon explored for this purpose is lasers, which can burn through a drone's hull and circuitry, but that approach takes time to hold focus on and melt a target.

The Russian foreign minister has alleged that Ukraine is attempting to interfere with Russian communication satellites with the help of foreign experts.

"The system uses high power microwaves to cause a counter electronic effect. A target is identified, the silent weapon discharges in a nanosecond and the impact is instantaneous," reads an Air Force fact sheet about the weapon. In a video from AFRL, THOR is described as a "low cost per shot, speed of light solution," which uses "a focused beam of energy to defeat drones at a large target area."

An April 2023 report from the Government Accountability Office is much more straightforward: A High Power Microwave uses "energy to affect electronics by overwhelming critical components intended to carry electrical currents such as circuit boards, power systems, or sensors. HPM systems engage targets over an area within its wider beam and can penetrate solid objects."

Against commercial or cheaply produced drones, the kind most likely to see use on the battlefield in great numbers today, microwaves may prove to be especially effective. While THOR is still a ways from development into a fieldable weapon, the use of low-cost drones on the battlefield has expanded tremendously since the system started development. A report from RUSI, a British think tank, found that in its fight against Russia's invasion, "Ukrainian UAV losses remain at approximately 10,000 per month."

While that illustrates the limits of existing drone models, it also highlights the scale of drones seeing use in regular warfare. As drone technology improves, and militaries move from adapting commercial drones to dedicated military models made close to commercial cost and scale, countering those drones en masse will likely be a greater priority for militaries. In that, weapons like THOR offer an alternative to existing countermeasures, one that promises greater effects at scale.

Watch a video about THOR, which also garnered a Best of What's New award from PopSci in 2021, from the Air Force Research Laboratory, below:

https://youtu.be/QjHGxKb6W1c

***

Space

India Needs Space-Based 'Offensive' Weapons in Future, Says IAF Chief

Rajat Pandit | 30 Apr2023

Source: Times of India | https://timesofindia.indiatimes.com/india/india-needs-space-based-offensive-weapons-in-future-says-iaf-chief/articleshow/99878896.cms?from=mdr

NEW DELHI: India needs to have space-based offensive weapons in the future IAF chief Air Chief Marshal V R Chaudhari said on Saturday, even as he also called for the country to have a full-fledged military space doctrine amid the increasing weaponization and contestation of the final frontier.

The IAF chief's emphasis on effectively exploiting the entire space domain, rather than restricting it largely to ISR (intelligence, surveillance and reconnaissance) and communication purposes as is the case now, comes in the wake of China's rapid advances in developing deadly space and counter-space capabilities that has even the US alarmed.

Both Chief of Defence Staff General Anil Chauhan and the IAF chief have in recent days stressed the need for India to develop both defensive and offensive capabilities in the space domain.

On Saturday, speaking at a conclave here, ACM Chaudhari said India should build on the success of "Mission Shakti", under which an anti-satellite (A-Sat) interceptor missile was used to destroy the 740-kg Microsat-R satellite at an altitude of 283-km in the low earth orbit (LEO) in March 2019.

"In the future, instead of having purely land-based offensive systems, we should also have space-based offensive systems. It will reduce the response time…The future lies in having space-based offensive platforms," he said.

"The space domain will percolate and have its effects across all other domains of warfare," ACM Chaudhari said, dwelling upon how the Indian armed forces transitioned from depending on the high-altitude MiG-25 "Foxbat" aircraft for "strategic reconnaissance" in the 1980s and 1990s to spacebased assets like satellites now.

Similarly, citing the examples of the US and France air forces, the IAF will also have to transform from "air-power" to "aerospace power" in the years ahead. "In the future, the IAF will be called upon to take part in space situational awareness, space denial exercises or space control exercises," he said.

China, after testing its first A-Sat missile in January 2007, has set a scorching pace in building and deploying anti-satellite weapons from direct ascent missiles and co-orbital killers to directed-energy lasers, electromagnetic pulse weapons, jammers and cyberweapons.

The People's Liberation Army Strategic Support Force, which is a theatre command-level organization, focuses on degrading or destroying satellites of adversaries that are vital for ISR, communications, missile early-warning, precisiontargeting and other such purposes. China has also doubled the number of its satellites in just the last three-four years to have over 700 operational ones now.

The US, too, has a full-fledged Space Force as a distinct branch of its armed forces. In contrast, India still does not have an Aerospace Command, having created just a small tri-service Defence Space Agency in 2019 after much dithering.

***

China's 'Satellite Killer' Spacecraft Threatens to Puncture US Military in Space by Crippling its Recon, Navigation & EW Satellites

13 May 2023

Source: Eurasian Times | https://eurasiantimes.com/china-could-soon-become-the-global-leader-in-space/

Representational Image

A highly maneuverable spacecraft like this could be used to "surveil, disrupt and outright attack an opponent's space-based assets" or conversely can "retrieve or otherwise interact with friendly ones."

Private space services company LeoLabs revealed on its Twitter handle that the Chinese reusable space vehicle "docked with or captured a separate object on multiple occasions" during the orbit.

The Chinese state-run China Aerospace Science and Technology Corporation has not provided many details about its time in orbit.

Highly maneuverable reusable space vehicles that can manipulate other objects in orbit could be used for research and development. But they can also act as a weapon and become "satellite killers" that can attack other objects in space.

The ability of the Chinese spaceplane to capture other objects indicates the presence of "robotic arms" that could be used to damage or destroy an enemy satellite. The other means that can be used to disrupt the enemy space-based platforms are electronic warfare jamming or a high-powered microwave beam.

The "satellite killer" can also smash itself into the target or lob projectiles at the target space objects, a capability Russia has been actively testing.

The less dangerous objective of these satellites could be to shadow and gather intelligence on other space objects. The other innocuous application of this technology is to inspect, refuel, and service other space assets.

Space: Battleground of Future Conflict Between US & China

Space will be an important battleground in case of a conflict between the US and China or Russia. With the US military heavily relying on its satellites for intelligence gathering, navigation and weapon guidance, and communication and data sharing, damage to their satellite can have a blinding effect.

The US Space Force chief of space operations, General B Chance Saltzman, in congressional testimony on March 14, 2023, said that China is the "most immediate threat" as it continues to weaponize its space technology.

The most threatening Chinese technologies, he said, are ground-based lasers designed to disrupt and degrade satellite sensors, electronic warfare jammers targeting GPS and communications satellites, and anti-satellite missiles.

In his testimony to the Senate Armed Services Committee's strategic forces subcommittee, Saltzman said: "China is likely pursuing anti-satellite systems able to destroy satellites in

geosynchronous orbit." The geosynchronous orbit is a special position high above the Earth that allows an object to keep pace with its rotation.

It is useful for satellites tasked with monitoring missions, tracking the weather, and other remote sensing tasks and for communication satellites.

"They (Chinese) are testing on-orbit satellite systems which could be weaponized as they have already shown the capability to physically control and move other satellites," Saltzman added.

When asked to elaborate on the scenarios that can play out during a space conflict with a rival power, Saltzman said: "If they can blind us, if they can interfere with those capabilities, or God forbid, destroy them completely. They know that will diminish our advantages." He added, "I can see interfering, I can see blinding, I can see some of those gray area kinds of attacks on our capabilities to try and put us behind the eight ball."

He said that China has "grappling satellites" that could pull a US spacecraft out of orbit. This is because the US relies on "less than maneuverable older legacy satellites." That is why the recently constituted US Space Force plan to transition from its current geostationary satellites to a "proliferated network of smaller satellites."

The genesis of the anti-satellite arms race was in 2007 when China struck one of its own weather satellites with a missile. Fast forward to 2022, a Chinese Shijian-21 spacecraft docked with a defunct Beidou-2 navigation satellite and towed it into a graveyard orbit above the geostationary orbit.

In 2023, China is well on the path to becoming a global leader in space technology. The credit for its success goes to the blurring of lines between the military and civil endeavors of the Chinese government.

Space is at the center of the Chinese Military Doctrine and Strategy. The Commander of the US Space Command, General James Dickinson, told the Senate Armed Services Committee in 2022 that the goal of the Chinese military is to "blind and deafen" the enemy by crippling reconnaissance, communications, navigation, and early warning satellites. General Dickinson said the Chinese spaceplane "could carry a payload designed to disable or capture a satellite while in orbit."

The US Space Force has been contending that the US satellites are at the receiving end of the Chinese and Russian attacks through non-kinetic means, including lasers, radio-frequency jammers, and cyber-attacks, almost daily. While the Chinese reusable Space Plane is shrouded in secrecy, its sketchy details confirm the growing Chinese anti-satellite capabilities.

The US also has two X-37B mini space shuttles, presented as broad analogs to their Chinese counterpart.

***

US Space Force Sends Two Space Domain Awareness sensors to Japan

17 May 2023

Source: Dvids Hub | https://www.dvidshub.net/news/444975/us-space-force-sends-two-space-domain-awareness-sensors-japan

Photo By Tech. Sgt. Hailey Haux

U.S. Forces Japan and U.S. Space Forces Indo-Pacific continue to make significant strides in Japan since activating the new service component in November 2022. This week, the U.S. Space Force announced the delivery the second of two Space Domain Awareness sensors to Japan that will be hosted on Japanese satellites to build SDA capacity and resiliency, in support of a US-Japan cooperative effort called Quasi-Zenith Satellite System Hosted Payload.

"The U.S. Space Force and Japan are pathfinding how we extend our alliance into space through QZSS-HP," remarked Brig. Gen. Anthony Mastalir, USSPACEFOR-INDOPAC commander. "We are dedicated to enabling a cadre of space experts who can work with Allies and partners to integrate space activities into shared operations, activities, and investments. By bringing in the right Guardians at the right time with our Allies, we can maximize opportunities to exercise and train together as well as cooperatively field capabilities such as QZSS-HP." Mastalir emphasized, "this milestone is significant for both nations."

The first QZSS-HP payload was successfully delivered via a combination of C-17 and ground movements from Massachusetts Institute of Technology Lincoln Laboratory in Lexington, Massachusetts, to Japan in January 2023. Guardians and Airman from U.S. Indo-Pacific Command, USSPACEFOR-INDOPAC, USFJ, and the 374th Air Wing at Yokota Air Base, Japan worked in close coordination with the program office at Space Systems Command. The National Space Policy Secretariat leads the effort on Japan's side.

"This important system is a beneficial space cooperation pacesetter for both nations, and it paves the way for future initiatives," said Lt. Gen. Ricky Rupp, USFJ commander. "US-Japan dialogue and collaboration across all domains is imperative to set conditions with our Japanese counterparts to ensure U.S. service components maintain a lethal posture and readiness to support theater-wide operations," said Rupp. "This includes the Space Force and I'm excited to see such amazing progress on this particular effort."

The second delivery comes on the heels of a myriad of Congressional Testimonies by senior USINDOPACOM, SPACECOM, and USSF leaders bolstering the importance of space cooperation initiatives with Allies and partners.

China remains the pacing threat in the space domain. "In 2022, the People's Republic of China completed 64 successful space launches that placed at least 160 satellites into orbit," Adm. John Aquilino, USINDOPACOM commander, highlighted in his April testimony. "The PRC is delivering capabilities that seek to deny use of our own space architecture."

In his statement to Congress, Gen. B. Chance Saltzman, USSF's Chief of Space Operations,

explained, "the Space Force has two fundamental missions: to provide essential services to the joint force and to protect the joint force from adversary hostile uses of space systems. The ability to perform these missions is at risk today and that risk is increasing over time," said Saltzman. "Our space systems are threatened by a variety of growing anti-satellite capabilities, and the joint force is threatened by increasingly sophisticated adversary space-based systems intended to target the joint force."

The QZSS-HP will augment the Space Force's ability to conduct persistent, time dominant volume search at geosynchronous orbit.

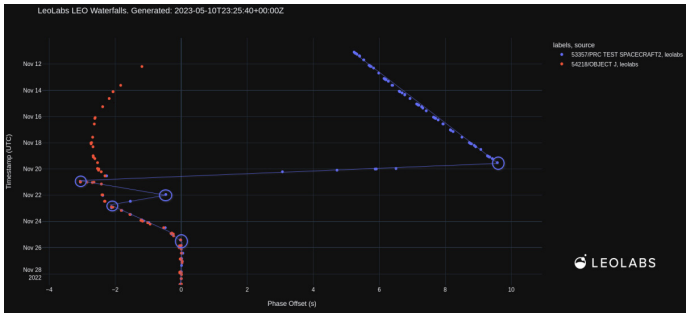
The effort seeks to demonstrate the ability of the US-Japan alliance to extend to space, contribute toward the Department of Defense's broader integrated deterrence posture against our shared concerns in the Indo-Pacific and contribute to the USSF's Space Domain Awareness. Ultimately, this effort provides a basis for future international cooperative space partnerships and initiatives.

***

China's Spaceplane Conducted Proximity and Capture Maneuvers with Subsatellite, Data Suggests

Andrew Jones | 11 May 2023

Source: Space News | https://spacenews.com/chinas-spaceplane-conducted-proximity-and-capture-maneuvers-with-subsatellite-data-suggests/



Maneuvers of China's spaceplane and companion subsatellite in November 2022, tracked by Leolabs. Credit: Leolabs

HELSINKI — China's secretive spaceplane may have performed multiple recaptures of an object it released into orbit during its recently completed second flight as part of on-orbit testing.

Private firm Leolabs, which provides space situational awareness data through its global network of radars for tracking objects in low Earth orbit, said its analysis found evidence of what appeared to be at least two and possibly three capture/docking operations with a co-orbiting object.

China's clandestine spaceplane launched Aug. 4, 2022, embarking on its second flight, two years after its first, four-day-long mission. The second flight ended with a horizontal landing May 10, after 276 days in orbit.

China has released very little information about the project, but clues indicate the spacecraft is somewhat similar to the Boeing X-37B.

U.S. Space Force's 18th Space Defense Squadron tracking data revealed an object in a closely-matching orbit to the spaceplane Oct. 31, 2022 (NORAD ID 54218 (2022-093J COSPAR ID)).

This companion subsatellite was then used in a series of rendezvous and proximity operations (RPO) with the spacecraft, according to Leolabs.

"Analyzing data from our global radar network, we've determined that the Test Spacecraft2 has propulsive capability and engaged in proximity operations with Object J, including what appeared to be at least two and possibly three capture/docking operations," a Leolabs statement said.

Leolabs' assessment of on-orbit activities highlights three periods of RPO. One period, between Nov. 25 and Dec. 24 last year, shows that the two spacecraft were either docked or spaced very closely, with a possible docking performed on Nov. 25 or 26. A second docking was noted as taking place Jan. 10, 2023, in a second phase of operations.

A later phase, between Feb. 20 and March 29, was similar to the previous and "featured what appeared to be apparent forced separation, followed by rendezvous and formation flying. 54218 [companion satellite] was once again observed to maneuver independently of the parent craft."

Leolabs notes that, on a minimum of five occasions, the companion satellite demonstrated what appeared to be independent propulsive capabilities.

The spaceplane's operations will likely gain attention outside of China, particularly with regards to docking and capture operations and the possible uses of such capabilities.

"Based on what we do know, it seems like the Chinese and American spaceplane programs are being used in very similar fashions – primarily as testbeds for new technologies and capability demonstrations. It's hard to tell for sure what technologies or capabilities exactly, as both governments are pretty secretive about the details," Brian Weeden, director of program planning for the Secure World Foundation, told SpaceNews via email.

"What I find fascinating is the perceptions surrounding each program. When the X-37B started flying, it generated a lot of concern from the Chinese about the potential for it to be used as a weapon, a concern they've mentioned in recent multilateral discussions on space security.

"Likewise, I expect that these latest reports on the Chinese spaceplane are likely to cause a lot of concern in the US, despite it being pretty similar to capabilities the U.S. is also developing."

A statement from the spaceplane's maker, CASC, released after the May 10 landing claimed that the project "will provide a more convenient and inexpensive way to access space for the peaceful use of space in the future."

"We know the X-37B has also deployed several subsatellites on previous missions, but there isn't the public tracking data to be able to tell if it did RPOs or not," Weeden wrote.

The spacecraft landed at Lop Nur military base in Xinjiang May 8. Leolabs states that their observation data indicated the landing window to be likely between 0018 and 0020 UTC.

CASC's reusable spaceplane project last year acquired national level funding from the Natural Science Foundation of China.

Leolabs previously highlighted that the spaceplane made a large change to its orbit in April, likely in preparation for the spacecraft to land. The mission was used by the company to test its capabilities.

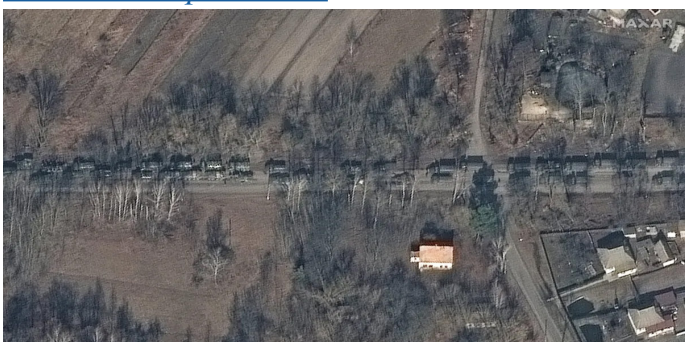
"This event tested LeoLabs object tracking and maneuver detection and characterization capabilities, proving that we can provide critical intelligence on the behaviors and activities of HIOs thanks to our continuous, real-time operations," Leolabs said in a statement.

***

Drawing lessons from the first 'commercial space war'

Sandra Erwin | 20 May 2023

Source: Space News | https://spacenews.com/on-national-security-drawing-lessons-from-the-first-commercial-space-war/



Maxar satellite images show a 3.25-mile convoy of Russian ground forces with 100s of military vehicles NE of Ivankiv, Ukraine and moving toward Kyiv (40 miles away). Contains fuel, logistics, armored vehicles (tanks, infantry fighting vehicles, self-propelled artillery).

Throughout Russia's invasion and offensive in Ukraine, some of the most compelling images of the war have come from satellites in space operated by private companies.

"For many of us who have been tirelessly watching this conflict from our TVs or smartphones, some of the most iconic scenes which come to mind are those of a huge Russian military convoy, stretching more than 60 kilometers northwest of Kyiv," commented tech industry consultant Chetan Woodun.

The convoy image, taken by one of Maxar's WorldView satellites, was one of many taken by Maxar and other commercial operators like BlackSky and Planet. Commercial radar imagery from the likes of Capella Space, Umbra and Iceye also have been in high demand, as only radar can penetrate the heavy cloud coverage over Ukraine.

Earth observation companies have shared visuals that previously would only come from government sources. Most recently, Maxar identified the location of a mass grave outside Mariupol in eastern Ukraine. The company tracked the gradual expansion of the grave over several weeks as Russian forces escalated the fight to take over the city.

In addition to helping track Russian movements, imagery is supporting humanitarian efforts as organizations try to identify safe passages to evacuate civilians and locate perpetrators of war crimes.

The way commercial spy satellites have shaped the narrative of this war has elicited comparisons to the Persian Gulf War more than 30 years ago, when 24-hour news coverage — much of it live via satellite — showcased the dramatic effects of GPS technology on military operations.

"If Desert Storm was the first space war, I see Ukraine as the first commercial imagery conflict," said Michael Moran, a retired U.S. Air Force officer and now senior vice president of defense and intelligence systems at Terran Orbital. The company is building a constellation of radar imaging satellites aimed at military and

government users.

For years, U.S. intelligence agencies have been skeptical of commercial systems, but he said this conflict settles the debate. "Commercial systems can really augment national capabilities for the United States."

Moran said that there had been a lot of talk about the idea of a "hybrid architecture" and how interesting that could be. Now, "we're seeing the hybrid architecture being validated in this conflict."

A realization of the value of commercial space systems also could have long-term implications for military strategy.

"This is changing the way we fight, the way that the world is able to see the fight," said Todd Harrison, defense analyst and senior fellow at the Center for Strategic and International Studies.

The impact of satellite imagery in the Ukraine war could change China's calculus about a future invasion of Taiwan, Harrison said.

"If you're China and you're watching the situation, one of the lessons they may learn is, 'I don't want commercial space to be used against me the way it was used against Russia,'" he said.

"A country like China would have a strong incentive to go after commercial companies in the very early phases of a conflict, maybe pre-conflict, in order to kind of shut off the world's view of what's happening," Harrison said. "It's something we have to expect and prepare for."

The good news on that front is that reliance on commercial satellites makes the entire U.S. government-industry architecture more resilient and more difficult for an enemy to defeat.

Another lesson from Ukraine is that Russia's preferred antisatellite weapons are non-kinetic — jammers and cyberattacks — which have temporary and reversible effects, said Brain Weeden, space policy expert at the Secure World Foundation.

"They are not blowing up satellites. They're going after the interference and denial of service," he added.

Russia, of course, showed in November that it is capable of taking down a satellite in orbit with a missile "but the fact of the matter is that kinetic capability is not all that useful when you're talking about dozens to hundreds of satellites you might have to target."

***

Global Aerospace Industry

Egypt in Advanced Talks to Purchase 12 Chinese J-10 Vigorous Dragon Fighter Jets

26 May 2023

Source: North Africa Post | https://northafricapost.com/68046-egypt-in-advanced-talks-to-purchase-12-chinese-j-10-vigorous-dragon-fighter-jets.html

Egypt is in advanced talks with China for the purchase of around 12 of the latest version of the J-10 Vigorous Dragon multirole combat fighter jet, The New Arab reports.

Talks between the two sides started last year and the North African country is expected to send representatives of its Air force to the Chinese state-owned Chengdu Aircraft Industry Group at the International Maritime and Aeronautical Exhibition in Malaysia later this week, the London-based media stressed. J-10 Vigorous Dragon, multirole fighter aircraft, is China's latest fourth generation combat aircraft capable of flying at a maximum speed of 2,327km/h at high altitudes.

Cairo's turning to Beijing for arms deal is likely to anger Washington which is a traditional security partner and provider of $1.3 billion in military aid annually to the Arab country. Egyptian authorities, whose human rights records are slammed in Washington, view the U.S. administration very political.

Egypt has also ignored western sanctions against Russia amid its ongoing campaign in neighboring Ukraine. Early this month, leaked US secret documents revealed that President Abdel Fattah al-Sisi secretly planned in February to produce rockets for Russia.

The Washington Post which saw the documents reported that the Egyptian leader intended to produce 40,000 rockets for the heavily-sanctioned country and instructed officials to keep it a secret to "avoid problems with the West. Egyptian authorities denied the report and brushed aside any alleged involvement in the crisis between Russia and Ukraine.

"Egypts position from the beginning is based on non-involvement in this crisis and committing to maintain equal distance with both sides," the Washington Post quoted Foreign ministry spokesperson, Ahmed Abu Zeid as saying.

***

New Chinese Passenger Plane C919 Set to Make First Revenue flight on Sunday

Ricardo Meier | 26 May 2023

Source: Airdata News | https://www.airdatanews.com/new-chinese-passenger-plane-c919-set-to-make-first-revenue-flight-on-sunday/

After nearly 15 years in development, COMAC C919 jetliner is expected to make its first commercial flight this Sunday, May 28, with China Eastern Airlines, the only airline to have it in the fleet for now.

With capacity for 164 passengers, the aircraft is the most advanced ever developed in China for the civilian market and designed to be a competitor to the widely popular Airbus A320 and Boeing 737.

The debut flight will be MU9191, which will depart Shanghai at 10:45 am and land in Beijing at 1:10 pm. The return flight (MU9192) will take place in late afternoon on Sunday, according to China Eastern's app.

So far, only the C919 with registration B-919A has been delivered by COMAC, in December last year. Weeks after that, China Eastern began a schedule of evaluation flights to complete 100 hours of testing with no passengers on board.

The flights continued until February, but then the C919 remained on the ground for long periods until on May 17 it took off again and since then it has been used almost uninterruptedly, an indication that the Chinese carrier is finalizing the tests.

Chinese Jet, Foreign Components

The C919 was launched by COMAC in 2008 with an ambitious mission to compete with western aircraft in the higher production volume category.

The aircraft follows the classic configuration of a single-aisle jet, with rows of six seats, low wings that carry the engines and a conventional tail.

Although developed in China, the C919 relies on a wide range of western suppliers. Companies such as CFM (Leap-1C engines), Honeywell, Rockwell, Eaton, Parker and Michelin are part of the list.

Foreign content, however, has been a potential issue as the Chinese government's relations with the United States have deteriorated.

COMAC is working on the nationalization of several of these components, including turbofans, but development is quite behind schedule.

Although it has more than 1,200 purchase intentions, the C919 officially has five aircraft on order from China Eastern and, more recently, 60 firm orders from the HNA group.

***

Saudi Arabia and Egypt Reportedly Want to Buy Chinese Weapons

25 May 2023

Source: Ruetir.com | https://www.ruetir.com/2023/05/saudi-arabia-and-egypt-reportedly-want-to-buy-chinese-weapons/

Chengdu J-10C, the fighter jet that forms the backbone of the Chinese Air Force. Photo/Flickr/AereiMilitari.org

By RIYADH – China is reportedly in talks with Saudi Arabia and Egypt to sell the two Arab countries various new weapons.

The arms sale includes the Chengdu J-10C, a fighter jet that forms the backbone of China's People's Liberation Army Air Force (PLAAF).

A report published Monday by Tactical Reports, a Beirut-based intelligence service, has claimed Saudi Arabia's Military Industries (SAMI) is currently in talks with China North Industries Group Corporation (Norinco) to purchase fighter jets, reconnaissance drones and air defense systems.

The agency also said negotiations had continued between the Egyptian Air Force and the Chengdu Aircraft Industry Group, with the two sides meeting on the sidelines of the Langkawi International Maritime and Aerospace Exhibition in Malaysia on Tuesday.

Cairo is seeking a dozen Chengdu J-10C fighter jets, which so far have only been sold overseas to Pakistan.

Cairo is seeking a dozen Chengdu J-10C fighter jets, which so far have only been sold overseas to Pakistan.

The aircraft has an advanced radar, fly-by-wire control system, a top speed of Mach 1.8, and can perform ground attack missions in addition to interceptor duties, which is its primary purpose.

Riyadh is reportedly seeking to acquire the Sky Saker FX80, a truck-launched unmanned aerial vehicle (UAV); CR500 vertical takeoff and landing (VTOL) UAV; Cruise Dragon 5 and 10 ammo roaming; and the HQ-17AE short-range air defense system, which is derived from the Russian SHORAD Tor-M1 system.

Both Egypt and Saudi Arabia are among the world's major arms importers, and both are increasingly looking to Russia and China as partners in various fields to reduce their dependence on the United States.

Beijing has expanded its cooperation with Riyadh in recent years on a variety of fronts, including economic, military and diplomatic, recently helping negotiate a revival of ties with Iran.

Saudi Arabia's appetite for arms has also been fueled by Yemen's eight-year war against the Houthi movement, which is currently in peace talks.

Egypt has historically enjoyed a closer relationship with Russia than Saudi Arabia, and its military equipment is testament to this: where the Saudis fly US-made F-15s, Egypt flies Russian-made MiG-29s. Both countries also use US-made F-16s.

***

United States Approves $285 Million Sale of NASAMS Air Defense System, Equipment to Ukraine

25 May 2023

Source: First Post | https://www.firstpost.com/world/united-states-approves-285-million-sale-of-nasams-air-defense-system-equipment-to-ukraine-12644242.html

An apartment block on fire in the city of Bakhmut, Donetsk region, amid the Russian invasion of Ukraine. AFP

The United States approved a $285 million sale of a NASAMS air defence system and accompanying equipment to Ukraine on Wednesday, as Kyiv looks to strengthen its defences against Russian strikes.

The US Defence Security Cooperation Agency issued a statement saying that Ukraine urgently needs to improve its ability to fight against missile and aircraft attacks from Russia. "Acquiring and effectively deploying this capability will enhance Ukraine's ability to defend its people and protect critical national infrastructure."

The agency also stated that the sale will help the US achieve its foreign policy and national security goals by "improving the security of a partner country that is a force for political stability and economic progress in Europe."

The sale would not require any additional US government employees or contractors to be assigned to Ukraine, the statement added.

The State Department approved the sale, and the DSCA on Wednesday provided the required notification to Congress, which still needs to sign off on the transaction.

Countries including the United States that are supporting Ukraine in its battle against invading Russian forces have donated tens of billions of dollars of military equipment to Kyiv, but this transfer would be a sale.

Ukraine's air defences have played a key role in protecting the country from strikes and preventing Moscow's forces from gaining control of the skies.

When Russia invaded in February 2022, Ukraine's air defences largely consisted of Soviet-era planes and batteries.

They have since been significantly augmented by Kyiv's international supporters, who have donated a series of systems including NASAMS.

***

Indian Aerospace Industry

Govt Bans 928 More Items from Import List; Includes Parts for LCH and Sukhoi, Jaguar Jets

Anish Kumar | 14 May 2023

Source: News Able | https://newsable.asianetnews.com/india-defence/govt-bans-928-more-items-from-import-list-includes-parts-for-lch-and-sukhoi-jaguar-jets-ajr-rumui5

The Giving a further push to the government's ambitious initiative 'Aatmanirbharta' in defence to minimise imports, Defence Minister Rajnath Singh has approved the 4th Positive Indigenisation List (PIL) of 928 strategically-important line replacement units, sub-systems, spares and components, with import substitution value worth Rs 715 crore.

The defence ministry had in December 2021 issued positive indigenization lists of 351 items, 107 items in March 2022 and 780 items in August 2022.

Army Launching Anuman App for Troops Deployed Along China Border on May 19

The ministry has banned import of spares and components used in helicopters like HTT-40 trainer aircraft, light combat helicopter, Sukhoi-30 MKI, Jaguar, and other defence platforms.

The items which have been banned from importing, will only be procured from the Indian Industry, starting December 2024.

Prior to this, a total of 2,500 items were already indigenised and 1,238 (351+107+780) items will be indigenised within the given timelines.

Of 1,238, 310 items have been indigenized with 262 items from the first positive indigenization list, 11 from second one and 37 from the third list.

6 Projects Aimed at Making Indian Army Future-Ready, more Lethal

"The DPSUs will undertake indigenisation of these items through different routes under 'Make' category and in-house development through the capabilities of MSMEs and private Indian industry, thereby providing impetus to the growth in economy, enhanced investment in defence and reduction in import dependence of DPSUs," the ministry said.

***

IAF Chief Chaudhari Underlines Need to Reduce Dependence on Imports

26 May 2023

Source: Business Standard | https://www.business-standard.com/india-news/iaf-chief-chaudhari-underlines-need-to-reduce-dependence-on-imports-123052601013_1.html

The IAF Chief Air Chief Marshal V R Chaudhari on Friday said the key to success lies in increased spending on research and development, coupled with indigenous manufacture of defence equipment.

Addressing a conclave here, he also impressed upon the need to reduce dependence on imports.

The IAF on Friday shared a tweet highlighting some of the key points made in Air Chief Marshal Chaudhari's speech.

"Speaking on the topic of 'Propelling Self Reliance in the Aerospace & Defence Sector' at the 'India Defence Conclave' organised by the @EconomicTimes, #CAS Air Chief Marshal VR Chaudhari impressed upon the need to reduce dependence on imports," it tweeted.

It was followed by more tweets in one thread along with some photographs.

The IAF chief advocated an "ABCD approach for achieving strategic autonomy in defence equipment," it tweeted.

"Such a methodology would entail acquisition of Indigenous technology, boosting capability with upgrades, conserving capacity through maintenance & developing potential for the future through R&D," he said.

He also highlighted the importance of new and niche technologies that would power defence technologies of the future, "stressing that the key to success lay in increased spending on R&D, coupled with indigenous manufacture #AtmaNirbharBharat".

***

Parallel Flight Technologies Inks with India's UAV Systems

26 May 2023

Source: Geospatical World | https://www.geospatialworld.net/news/parallel-flight-technologies-inks-with-indias-uav-systems/

Parallel Flight Technologies, a developer of autonomous heavy-lift drone technology and hybrid propulsion, announced a purchase agreement for 50 aircraft, with paid deposits, from UAV Systems Private Limited (UAVS), a drone and robotics solution provider based in India. In addition, Parallel Flight will provide ongoing maintenance, repair and overhaul support to UAV Systems and its end-user base for increased efficiency and uptime of all platforms. Deliveries are slated to begin in 2024.

This landmark agreement is the next chapter for Parallel Flight's global expansion and will bolster the company's leadership role for full-stack UAV solutions in India. The two companies will work together to differentiate and amplify the customer experience by providing comprehensive solutions that merge

innovative technology, safety, high efficiency and low-cost solutions across the industrial sector.

UAV Systems Private Limited specializes in the field of UAV's and is backed by a diversified group of major Indian conglomerates, spanning auto, ev, battery manufacturing, fortified fencing and hospitality. The UAV Systems team has extensive experience penetrating emerging markets and has a keen focus on integrating turnkey solutions for its customers. The country's adoption of drone technology is widespread across various sectors, including energy, agriculture, renewables, mining, conservation/reforestation, defense, law enforcement, and numerous other industrial logistic applications.

"After extensive global research, we decided to strike a partnership with Parallel Flight because of their differentiated technology, divergent thinking, ability to understand customer behavior and the excellent backgrounds, from the likes of Tesla, that their team brings to the table," says Arab Khan, CEO of UAV Systems. He continues, "The extensive knowledge of their scientists and engineers speaks for itself, as they have developed superior heavy-lift drone technology which can help address a UAV technology gap throughout India. Our team is looking forward to joining hands – we see this as just the beginning and we see the demand for Parallel's units to grow to 500+ over the next few years."

Parallel Flight's USA built, flagship aircraft, the 122 kg MTOW Firefly, has been widely praised as a 'heavy-lift workhorse' and is well suited for numerous industrial applications. Backed by USDA, NASA and NSF. The company's proprietary Parallel Hybrid Electric Multirotor (PHEM) drone technology enables the Firefly to carry an impressive 45kg payload (not including fuel) for up to 1.6 hours. The proprietary IP built into Parallel Flight's flagship aircraft allows for 10x longer endurance and range, making it an exponential gain over all-electric drones. Parallel Flight's technology recently resulted in a signed USSOCOM CRADA and partnership with global NGO, Island Conservation, for critical biodiversity initiatives on remote islands.

"This purchase agreement with UAV Systems solidifies a commitment that reflects the growing demand for heavy-lift drone technology in India and around the world. By deploying and scaling our autonomous aircraft and combining Parallel's customer-centric focus with UAVS' expertise in solution integration, we are confident that we will provide customers a premium turnkey experience, at low costs, for their critical applications," says Joshua Resnick, CEO of Parallel Flight Technologies. "Our vision is to continue driving innovation in the industry, which could not be done without our partners. We look forward to successful market penetration in India and for the day when we can expand manufacturing of this technology in the region."

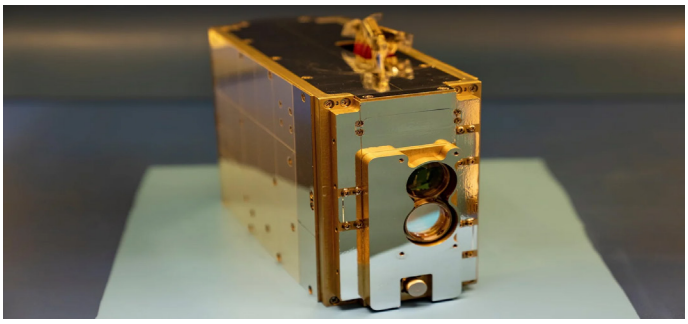
***

Technology Development

A Tiny NASA CubeSat Just Set a Big Data Speed Record with Lasers

Andrew Paul | 16 May 2023

Source: Popci | https://www.popsci.com/technology/nasa-tbird-laser/



The TBIRD CubeSat is about the size of a box of tissues, but could change space communications. NASA

A golden, tissue box-sized satellite has set a new record for the fastest data transfer rate ever achieved by orbital laser light communications—breaking its own previous milestone set less than a year ago. According to a recent announcement from NASA, the agency's TeraByte InfraRed Delivery (TBIRD) system achieved a 200 gigabit per second (Gbps) space-to-ground optical link speed on April 28 during a six-minute pass high above its corresponding ground station.

Within that time frame, NASA estimates TBIRD can transmit multiple terabytes of test data back to Earth. That's equivalent to thousands of hours of HD video data. "This capability will change the way we communicate in space," said Beth Keer, TBIRD's mission manager at the Goddard Space Flight Center in Maryland.

Since 1958, radio waves have transmitted the majority of all space communications via the Deep Space Network, a global antenna array capable of sending and receiving information for satellites and astronaut crews. As NASA explains, switching to "ultra-high-speed" optical communications crams more data into each lasers' infrared light waves that are invisible to the naked eye. This alternative—as showcased in TBIRD's recent record breaking demonstrations—will prove vital to future space research and exploration, particularly as humans look to return to the moon, and eventually attempt to make their way to Mars.

The TBIRD system was first delivered into space last year via NASA's Pathfinder Technology Demonstrator 3 (PTD-3) as a tiny satellite (also known as a CubeSat) roughly the size of two stacked cereal boxes. CubeSats are popular for both their relative simplicity and cost-effectiveness. After launching aboard SpaceX's Transporter-5 rideshare mission in May 2022, PTD-3 synchronized with the Earth's solar orbit so that the CubeSat entered a "fixed" position relative to the sun. Once established, the TBIRD satellite could begin transmitting data twice a day as it passed over its space-to-ground command center link. Within less than a year, its capabilities have broken records twice over.

"Just imagine the power of space science instruments when they can be designed to fully take advantage of the advancements in detector speeds and sensitivities, furthering what artificial intelligence can do with huge amounts of data," Kerr added. "Laser communications is the missing link that will enable the science discoveries of the future."

***

Momentus Tug Raises Orbit with Water-Fueled Thruster

Jeff Foust | 08 May 2023

Source: Space News | https://spacenews.com/momentus-tug-raises-orbit-with-water-fueled-thruster/

The Vigoride tugs developed by Momentus change orbits using the company's Microwave Electrothermal Thruster. Credit: Momentus

The United States approved a $285 million sale of a NASAMS air defence system and accompanying equipment to Ukraine on Wednesday, as Kyiv looks to strengthen its defences against Russian strikes.

The US Defence Security Cooperation Agency issued a statement saying that Ukraine urgently needs to improve its ability to fight against missile and aircraft attacks from Russia. "Acquiring and effectively deploying this capability will enhance Ukraine's ability to defend its people and protect critical national infrastructure."

The agency also stated that the sale will help the US achieve its foreign policy and national security goals by "improving the security of a partner country that is a force for political stability and economic progress in Europe."

The sale would not require any additional US government employees or contractors to be assigned to Ukraine, the statement added.

The State Department approved the sale, and the DSCA on Wednesday provided the required notification to Congress, which still needs to sign off on the transaction.

Countries including the United States that are supporting Ukraine in its battle against invading Russian forces have donated tens of billions of dollars of military equipment to Kyiv, but this transfer would be a sale.

Ukraine's air defences have played a key role in protecting the country from strikes and preventing Moscow's forces from gaining control of the skies.

When Russia invaded in February 2022, Ukraine's air defences largely consisted of Soviet-era planes and batteries.

They have since been significantly augmented by Kyiv's international supporters, who have donated a series of systems including NASAMS.

***

Commentary

1. Five sustainability trends driving change in aerospace industry - https://www.aerospacemanufacturinganddesign.com/news/five-sustainability-trends-driving-change-in-aerospace-industry/

Further Reading

1. Space war: India must improve its military space programme to beat China - https://www-financialexpress-com.cdn.ampproject.org/c/s/www.financialexpress.com/business/defence-space-war-india-must-improve-its-military-space-programme-to-beat-china-3097660/lite/

2. Life and death weigh on Ukraine air defence teams. - https://www.france24.com/en/live-news/20230526-life-and-death-weigh-on-ukraine-air-defence-teams

3. Taliban Effort To Resurrect Afghan Air Force Runs Into Turbulence - https://www.rferl.org/a/afghanistan-taliban-air-force-aircraft-helicopters-training/32427528.html

"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).

Centre for Air Power Studies
P-284 Arjan Path, Subroto Park, New Delhi - 110010
Tel.: +91 - 11 - 25699131/32 Fax: +91 - 11 - 25682533
Email: capsnetdroff@gmail.com
Website: www.capsindia.org

Supervised by : AVM Anil Golani (Retd)
Editor & Content : Gp Capt T H Anand Rao

Composed by Mr Rohit Singh
Tel.: +91 9716511091
Email: rohit_singh.1990@hotmail.com