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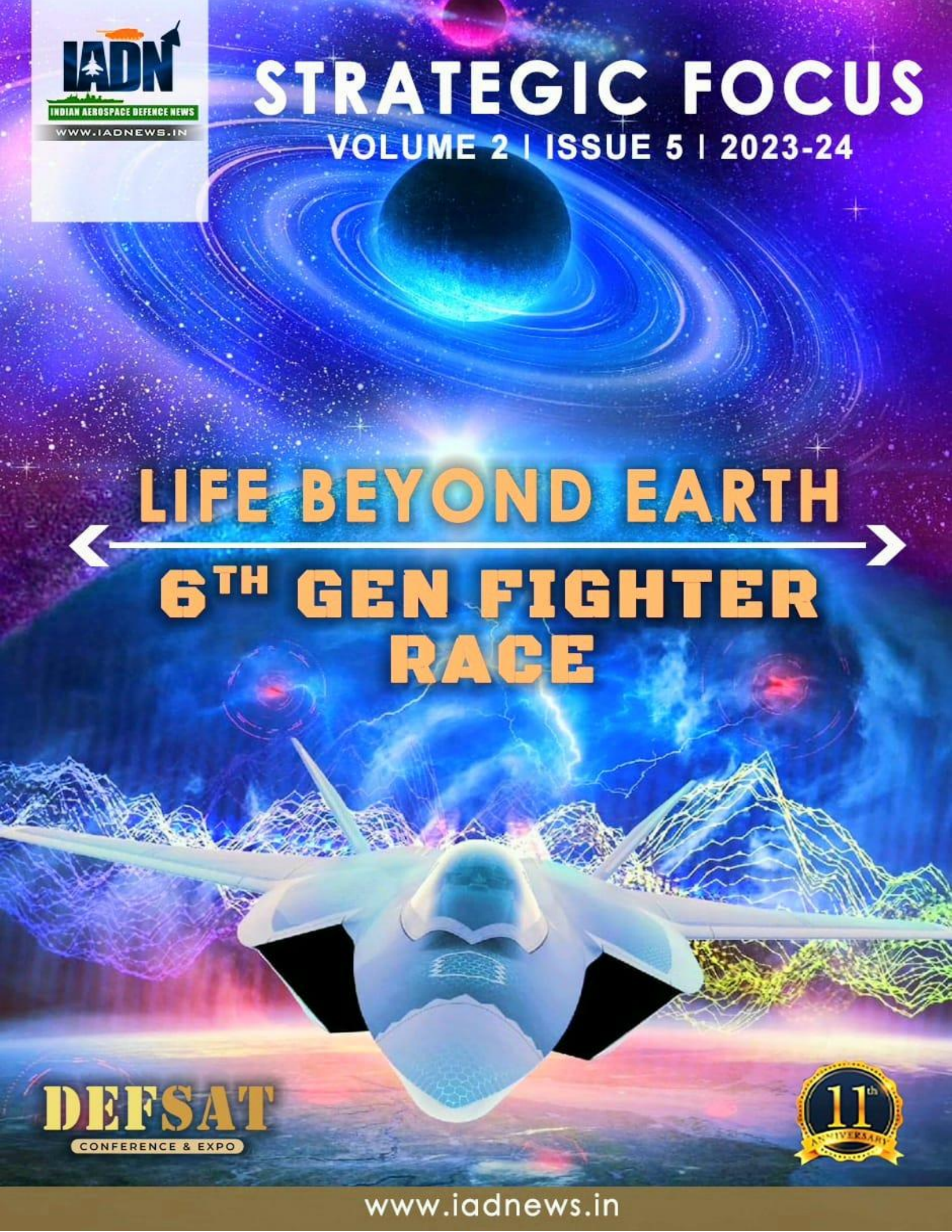
LIFE BEYOND EARTH

6TH GEN FIGHTER RACE



DEFSAT
CONFERENCE & EXPO

11th ANNIVERSARY

WE ENTER 11TH YEAR IN SERVICE

The IADN is a leading Independent Defence and Strategic news and information-providing website. It is a 'Not-for-profit' 'self-sustaining' 'non-partisan' 'knowledge building' website providing exclusive, non-partisan in-depth news and analysis on leading defence strategic and security-related issues about India.

The IADN was founded in March 2012 by Mr Shantanu K. Bansal. It can be called a unique venture that has played an instrumental role in presenting defence and strategic issues to a wider audience. Before IADN, the issues related to defence and security were limited to the interest of some scholars and government, the IADN took the initiative to enlighten the public about the prevailing security situation of the country hence assisting the much-needed 'strategic culture.' Having been inspired by IADN many such news and analysis platforms mushroomed across the open domain.

With extreme efforts, the IADN was able to transform itself into an open information & knowledge sharing platform. Time and again through its unique way of reporting, it has touched upon minds worldwide, providing a way for better policy orientation in the sector it serves. Today IADN is backed by a strong, ever-growing community of more than 5 lakh followers hence having a prominent say on the leading issues of National Interest.

The IADN has a spotless record, it has the intact quality of reporting as it should be. The team of editors, content writers and graphic designers from various backgrounds, represents every region of India- North, South, West and East reflecting the true spirit of India. Our serving/veteran team members have got the opportunity to associate with leading companies, institutions and government organisations.

CONTENT

WEAPON TRIALS

A Series of Newly Tested Platforms

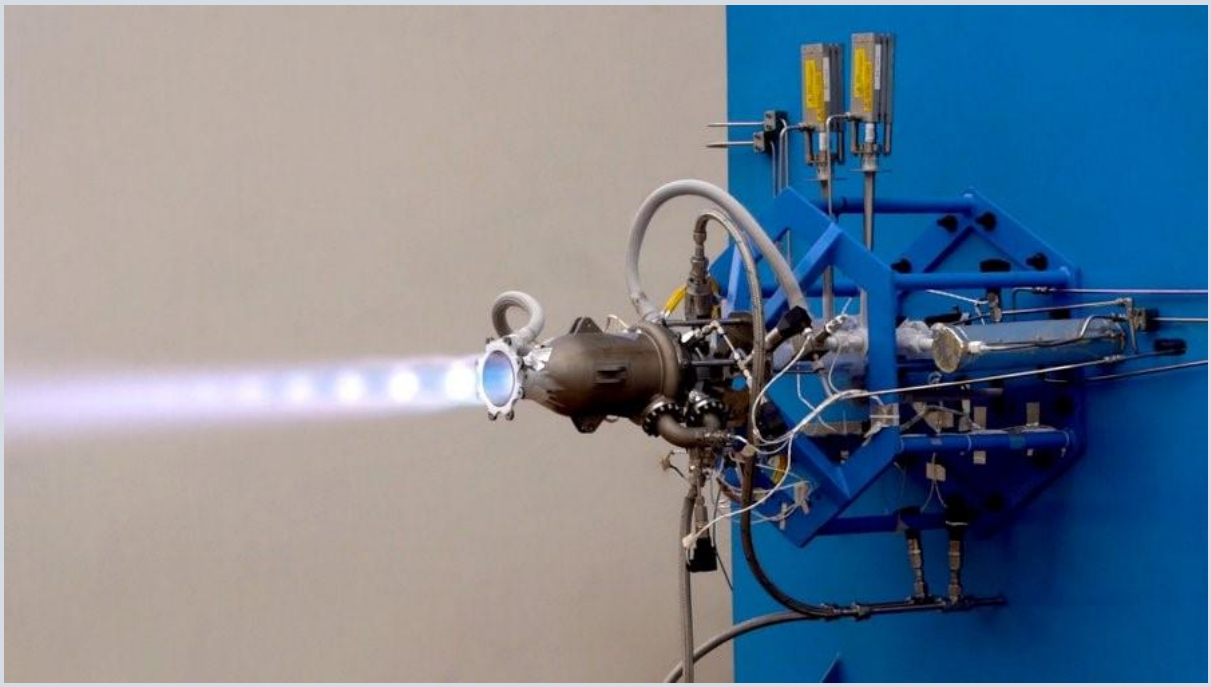
NAVAL BMD INTERCEPTOR TESTFIRED BY DRDO

The Defence Research and Development Organisation (DRDO) and Indian Navy successfully conducted a maiden flight trial of sea-based endo-atmospheric interceptor missile off the coast of Odisha in the Bay of Bengal on April 21st, 2023.

The purpose of the trial was to engage and neutralise a hostile ballistic missile threat thereby elevating India into the elite club of Nations having Naval BMD capability. The interceptor missile looks derived from AAD Ashwin Endo-Atmospheric Interceptor of Phase 1 of BMD.

This missile has maximum engagement altitude of 40km. This can intercept ballistic missiles with a range of up to 1500 km. The interceptor was fired from INS Anvesh (A41) of Indian Navy.

SKYROOT TESTS 3D PRINTED CRYOGENIC ENGINE



In a test Skyroot Aerospace, a startup based in Hyderabad, India, has successfully test-fired an advanced, fully 3D-printed cryogenic engine, marking a significant milestone in the India's indigenous space technology development. The test, which took place at the Satish Dhawan Space Centre in Sriharikota, saw the rocket engine operate for a duration of 75 seconds, demonstrating its ability to withstand the extreme temperatures and pressures of spaceflight. The engine, named Dhruvastra, was designed and manufactured by Skyroot Aerospace entirely in-house, using advanced metal 3D printing techniques. The use of 3D printing technology allowed for greater precision in the engine's design and fabrication, resulting in a highly efficient and powerful rocket engine.

ISRO RLV AUTONOMOUS LANDING

Defence Research and Development Organisation, Indian Air Force and Indian Space Research Organisation (ISRO) jointly conducted successful autonomous landing of a scaled prototype of RLV from a Chinook Heavy Lift helicopter of IAF on 2nd April. The RLV took off at 7:10 AM IST by IAF Chinook Helicopter as an underslung load and flew to a height of 4.5 km (above MSL). RLV then performed approach and landing manoeuvres using its own guidance system in autonomous mode, landing successfully on the air strip at 7:40 AM IST.

ZEN TECHNOLOGIES STEALS THE SHOW AT AFINDEX 2023

The Zen Technologies Limited, the leading provider of Military Training and Counter Drone solutions in India, recently participated in AFINDEX 2023. During the event, Zen showcased its range of Live and Virtual Training Simulators designed, developed and manufactured in India for the Infantry and Armoured Corps, Anti-Drone System, Operational Equipment, and Live Firing Ranges.

AFINDEX 2023 was a significant platform that provided an opportunity for the Indian defence industry to display its equipment to decision-makers from various African nations who were previously unreachable. This event is expected to boost the export of indigenous products from the Indian defence industry.

NEW ACQUISITION AND PROCUREMENT

Acquisition of New Weapons, Parts and Collaborative Developments

US GE IS OPEN TO THE TRANSFER OF TURBOFAN ENGINE TECH TO INDIA FOR THE INDIGENOUS MANUFACTURE OF ENGINES

The US based GE is open to the transfer of technology to India for the indigenous manufacture of engines for light combat aircraft TEJAS MK-2 by 2028 as it does not want to lose a big market o Europe. American Congressman Ro Khanna said, "Let's make sure the GE Engines deal gets

completed with India so we don't lose out to Europe." He stated that India and US need to be stronger on defence. He said that India wants jet engines and the first thing is to make sure that deal gets done before Prime Minister Narendra Modi's visit to the US.

MINISTRY OF DEFENCE ISSUES RFI FOR PROCUREMENT OF 439 LIGHT VEHICLES (ELECTRIC)

MoD has released a RFP for the procurement of 439 (Indian Army-415 and Indian Air Force-24) Light Vehicles (Electric) along with 35 x Fast Chargers (Indian Army-29 & Indian Air Force - 06) under Buy (Indian-IDDM) category. Light Vehicles are authorised to formations/units of the Indian Army and Indian Air Force to provide requisite mobility in terrains as prevalent in the country. The present fleet of Light Vehicles of IA and IAF are based on the Internal Combustion Engine (ICE) tech which is dependent on fossil fuels and leads to carbon emissions and resultant pollution. To keep up with futuristic trends and in support of initiatives of government to achieve net zero carbon emission, there is need for

introduction of electric vehicle with fast charging facility in the vehicle fleet of Army and Air Force.

L&T GETS ORDER TO BUILD PROTOTYPE OF LIGHT TANK FOR SINO-INDIA BORDER: REPORT

Defence Acquisition Council (DAC) — the Ministry of Defence's (MoD's) apex body for capital purchases — has granted an Acceptance of Necessity (AoN), or in-principle agreement, for seven light tank regiments, each equipped with 45 tanks. The AoN requires L&T — the MoD's development partner — to build one regiment of light tanks, while the MoD acquires the other six regiments under the "Make" procedure reports Business Standard.

NAVY MAY ORDER SMALL NUMBER OF NAVAL-TEJAS FIGHTERS AS A TRAINER: REPORT

The Indian Navy may order a small number of the Naval variant of TEJAS, the N-TEJAS fighter jet as a trainer for frontline naval aviators, reported Livefist. According to the report, the Navy is currently engaged in internal discussions regarding the potential purchase of 12-15 Naval-TEJAS (N-TEJAS) from Hindustan Aeronautics Limited (HAL).

INDIA MOVING TOWARDS CREATING ROCKET FORCE, DEFENCE SERVICES TO ACQUIRE AROUND 250 MORE 'PRALAY' BALLISTIC MISSILES

In a giant leap towards creating a strong rocket force to tackle the threat from the northern borders, Indian defence forces are set to place orders for two more units of the Pralay ballistic missiles at the cost of over Rs 7,500 crore. The move comes after the Defence Ministry in December last year cleared one unit of these missiles for the Indian Air Force.

INDIAN ARMY-SOLAR INDUSTRIES SIGN DEAL FOR OVER 450 'MADE-IN-INDIA' NAGASTRA-1 ATTACK DRONES

In a major success for 'Make-in-India' in defence, the Indian Army has signed a deal for acquiring over 450 fully indigenous loitering munitions, Nagastra-1, which can strike enemy targets with precision. The deal has been signed under the emergency provisions under which the drones will have to be supplied to the Army within one year. The emergency procurement deals can be worth up to Rs 300 crores.

INDIAN NAVY TO GET HELLFIRE MISSILE THAT KILLED AL-QAEDA CHIEF AS PART OF $300 MILLION DEAL

From offshore patrol vessel to missile vessels and BrahMos missiles, orders by the Ministry of Defence had a lot of firepower in store for the Indian Navy. A part of defence deals worth Rs 37,600 crore with local manufacturers, the contracts are also expected to boost Make in India. At the same time, the Indian defence ministry is close to sealing a deal worth $300 million, to equip Indian Navy's choppers with American weapons.

GERMANY EXPECTED TO PRESENT GOVERNMENT-TO-GOVERNMENT PROPOSAL FOR SALE OF SUBMARINES TO INDIA

Germany is soon expected to present a proposal to India for the sale of advanced conventional submarines through the government-to-government route, it is learnt. The Navy, which is staring at a dwindling sub-surface fleet, is looking to procure six advanced diesel-electric submarines under Project-75I estimated to cost over ₹45,000 crore. The project has been stuck for a while over technical issue.

INDIAN NAVY TO ACQUIRE ₹1,700-CRORE WORTH GUN FIRE CONTROL SYSTEMS FROM BEL

The Ministry of Defence on Thursday signed a contract with Bharat Electronics Limited (BEL) for procuring 13 indigenously designed and developed Gun Fire Control Systems for Indian Navy warships at a cost of ₹1,700 crore. According to the ministry, the upgraded 13 Lynx-U2 Fire Control Systems is capable of accurately tracking and engaging targets amidst sea clutter as well as air and surface targets.

THE COCHIN SHIPYARD WILL BUILD NEXT-GENERATION MISSILE VESSELS FOR INDIAN NAVY

Six Next Generation Missile Vessels (NGMV) will be built by the Cochin Shipyard Limited for the Indian Navy at the cost of 9,805 crores, with ship deliveries expected to start in 2027. According to the state-run shipyard, the contract signals its debut into platforms with advanced weapons.

INDIAN NAVY TO ACQUIRE US HARPOON AND RUSSIAN KALIBR MISSILES

According to information published on April 25, 2023, a proposal is under consideration by the government and is expected to be cleared soon for the acquisition of US Harpoon and Kalibr Missiles. The Harpoon missile and the Kalibr missile have similarities in their capabilities and differences in their specifications.

INS IMPHAL STEALTH GUIDED MISSILE DESTROYER UNDER PROJECT 15B SAILS FOR MAIDEN SEA TRAILS

INS Imphal, Indian Navy's third indigenous stealth destroyer of the Project 15B class, planned to be commissioned later this year, undertook her maiden sea sortie today. The ship incorporates several niche technologies and high indigenous content and is designed in-house by the Navy's Warship Design Bureau and constructed by Mazagon Dock Ltd. (MDL) stands proud testimony to the Indian Navy's thrust on the national vision of 'Aatmanirbhar Bharat' and 'Make in India' initiative. Imphal will have the unique distinction of being the largest and most advanced destroyer to be ever named after a city from the North-East. Imphal would thus be a befitting symbol of the growing importance and contribution of the North-Eastern region and the state of Manipur towards national security and development.

SAGAR DEFENCE ENGINEERING TO SUPPLY DRONE CAMERAS TO UP STATE POLICE

Sagar Defence Engineering (SDE), a Pune-based robotics start-up, will deliver 84 drone cameras to the Uttar Pradesh State Police Department. The new drones will assist in defining their plan of action before the deployment of forces, with a pre-survey of the situation and on-demand surveillance with advanced drone technology. SDE has already supplied similar drones to the UP Police Special Task Force and provided drone technology to the Mumbai Police.

TO BOOST IAF'S CAPABILITIES, DEFENCE MINISTRY SIGNS CONTRACTS WORTH RS 3,700 CR WITH BEL FOR RADARS, RECEIVERS

The defence ministry on Thursday signed two contracts worth over Rs 3,700 crore with Bharat Electronics Limited (BEL) for radars and receivers, which will enhance the operational capabilities of the Indian Air Force. The first contract worth over Rs 2,800 crore pertains to the supply of Medium Power Radars (MPR) 'Arudhra' for the IAF, and the second, at an overall cost of around Rs 950 crore, relates to 129 DR-118 Radar Warning Receivers (RWR).

SPECIAL REPORT

DEFSAT INDIA 2023

27-29 APRIL 2023, MANEKSHAW CENTRE, DELHI CANTT, NEW DELHI

The DefSAT 2023 conference and expo was India's first ever-dedicated international defence and space conference and expo as described by Satcom India Association (SIA-India). It was conducted from 27th to 29th April 2023, at the Manekshaw Centre, Delhi Cantt, New Delhi, India. The event and expo were organised by SIA-India along with its knowledge partners like Centre for Joint Warfare Studies (CENJOWS), Centre for Air Power Studies (CAPS), Centre for Land Warfare Studies (CLAWS), and National Maritime Foundation (NMF).

The event's primary focus revolved around the convergence of strategy and industrialisation concerning space applications within the realm of national security. The aim to explore and enhance the synergy between strategic planning and the process of industrialisation to effectively address the requirements and challenges of space-based initiatives related to national security was the emphasis.

The SIA-India is an esteemed non-profit organisation that advocates for the welfare of India's space industry. Comprising a diverse membership, SIA-India encompasses satellite operators, manufacturers, suppliers, startups, academic institutions, and law firms, all united in their shared commitment to advancing the interests of the Indian space sector.

The event was open to a wide range of attendees, which included government departments, regulators, policymakers, the Indian Army, Indian Navy, Indian Air Force, paramilitary forces, satellite operators, service providers, satellite system integrators, launch vehicle experts, ground and terminal equipment manufacturers and suppliers, software and application developers, deep tech startups, incubators, innovation hubs, space parks and more. Additionally, academic and R&D institutions, standards bodies, law firms, and representatives of various users of Space segments like agriculture, oil and gas, railways, healthcare, banking, and fintech were present at the event, VSAT manufacturers and distributors, telecom service providers, venture capital firms, Etc. also attended the event.

MANEKSHAW CENTRE, DELHI

VISION BEHIND THE EVENT

NATIONAL MARITIME FOUNDATION, DELHI

The significance of space has grown exponentially, encompassing commercial and military realms, resulting in substantial geopolitical transformations as nations compete for influence. The need for space-related resources and technologies, such as satellites, launch vehicles, and ground control systems, has witnessed a notable surge. Furthermore, there is an amplified emphasis on research and development. To sustain a competitive advantage in this swiftly progressing domain, it becomes imperative to synergise state-of-the-art technologies from the civil, commercial, and military space sectors. This integration is crucial for the effective utilisation, operationalisation, and safeguarding of military space capabilities in India.

The DefSat 2023, organised by SIA-India, is set to become an annual flagship event. It seeks to delve into India's aspirations in the realm of space, with a primary objective of aligning national security needs with industrialised solutions, disruptive innovations, and technological breakthroughs. This conference will serve as a platform where government

officials, military commanders, think tanks, industry experts, academia, and pioneers in disruptive technologies, both domestic and international, can converge, exchange ideas, and foster collaboration.

The main goal of the event will be to establish a comprehensive "One Stop Shop" catering to defence space requirements, serving as a platform for Government-to-Business (G2B) engagements. It will also serve as a knowledge pool to address future needs of India, while featuring exclusive Defence SpaceTech Sessions to showcase exceptional and distinctive solutions.

INDIA'S FIRST SPACE WARGAME AS A PART OF DEFSAT 2023

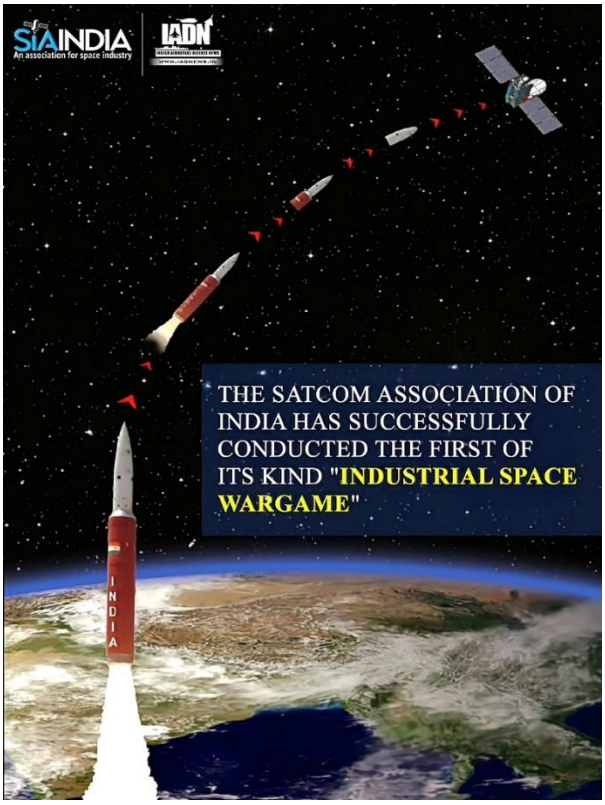
INDUSTRIAL SPACE WARGAME, MANEKSHAW CENTRE

The Satcom Association of India (SIA-India) organised India's first "Industrial Space Wargame," during the DefSAT Expo which saw active participation from representatives across diverse sectors. Esteemed government organisations such as the Indian Space Research Organisation (ISRO), the Indian National Space Promotion and Authorisation Centre (IN-SPACe), the Defence Research and Development Organisation (DRDO), and the National Institution for Transforming India (NITI) Aayog contributed

their expertise. The event also welcomed representatives from the tri-services.

Furthermore, prominent think tanks like the Centre for Joint Warfare Studies (CENJOWS), Centre for Land Warfare Studies (CLAWS), Centre for Air Power Studies (CAPS), and National Maritime Foundation (NMF) lent their support to the wargame. The objective was to simulate realistic space warfare scenarios, putting the capabilities of the Indian space industry and organisations to the test in responding to contingencies or crises. The close-door tabletop exercise was conducted under the leadership of Lt Gen V.G. Khandare, principal advisor, Ministry of Defence and the convenor of the exercise was Lt Gen PJS Pannu, former Deputy Chief IDS HQ (operations).

A simulated, scenario-based, interactive tabletop exercise that tested the capability of the space industry and organisation to come together and respond to contingency or crisis situations. Factors such as resources, logistics, sequence of action, and how long each phase of the plan will take was also tested. The defence practitioners and industry stakeholders put their heads together to assess the requisite industrialised solution, disruptive innovations and technology discovery in space and counter-space capabilities that are needed by India to protect its national security interests in simulated scenarios.



Defence practitioners and industry stakeholders collaborated to evaluate the necessary industrialised solutions, disruptive innovations, and technological discoveries in the space and counter-space capabilities domain. These evaluations were aimed at safeguarding India's national security interests in simulated scenarios. This is the first in a series of many such exercises to be unfolded periodically.

HIGHLIGHTS FROM THE EVENT

During the thematic address on the second day, Lieutenant General PJS Pannu (Retd.) emphasised the significant potential of private space players in delivering rapid and effective solutions. He underscored the crucial role that space capabilities play in shaping the future of warfare and promoting peaceful economic growth. Lieutenant General Pannu emphasised the need for India to establish a clear space philosophy, doctrine, and strategy to chart a well-defined roadmap for the industry.

"Full potential of space for strategic purposes was not recognised earlier, as it was primarily utilised for public good and civilian use," Dr S Somanath, Secretary, Department of Space, and ISRO's Chairman was quoted as saying during the event. According to him, India possesses the capability to launch payloads in a reasonably efficient manner. However, there is a need to scale up operations and generate increased demand, as space investments

entail substantial capital requirements. The objective is to reduce the cost of space access, making it more affordable and accessible.

Dr G Satheesh Reddy, who serves as the Scientific Adviser to the Minister of Defence, highlighted the noteworthy advancements in space technology for defence applications worldwide. He emphasised the substantial progress in areas such as image intelligence, electronic intelligence, signal intelligence, and communication intelligence. Of particular significance to the Indian defence, especially in border regions, are Synthetic Aperture Radar (SAR) and hyper spectral technology, as they play a critical role in enhancing capabilities.

Establishing self-reliance in the space sector necessitates enduring efforts over the course of several years. India must proactively prepare to meet future technological demands and allocate resources for their development and operation. Dr. G Satheesh Reddy, emphasised the importance of clarity in determining which capabilities should be developed domestically and which should be sourced externally. To accomplish this, collaboration with existing institutes and the establishment of new ones are crucial steps towards nurturing a skilled and capable workforce that is prepared for future requirements.

Air Marshal Surat Singh, the Director General Air (Operations), acknowledged that the newly unveiled space policy would provide a substantial impetus to the Indian space industry. He emphasised the need for the Indian Air Force to evolve into an Indian airspace force, capitalising on space-based capabilities for intelligence, surveillance, and reconnaissance (ISR), navigation, targeting, space situational awareness (SSA), and meteorological operations. According to Air Marshal Surat Singh, this transformation would be facilitated by the advancements and opportunities presented by the space policy.

Air Vice Marshal DV Khot, the Director-General of the Defence Space Agency (DSA), put forward the idea that the fusion of Space and ground-based assets could greatly enhance military capabilities, granting a distinct advantage in any conflict. In order to accomplish this, it is imperative for

industry partners to establish close collaboration, effectively identifying novel technologies and capabilities tailored to address the specific requirements of the military. Furthermore, it is crucial to engage in partnerships with international counterparts, harnessing their expertise and knowledge for optimal outcomes.

Lt. Gen Sunil Srivastava, AVSM, VSM** (Retd) DG CENJOWS discussed the growing concern over space-based weapons, which have the potential to cause catastrophic damage to both military and civilian infrastructure. As the use of space-based weapons continues to evolve, it's critical for the international community to work together to establish norms and regulations governing their use. He further emphasis as our reliance on space-based assets continues to grow, protecting those assets will become even more crucial to ensuring the safety and security of our nation.

Brigadier Anshuman Narang, an esteemed author and expert in the field of Intelligence, Surveillance, and Reconnaissance (ISR), emphasised the unparalleled potential of Space in facilitating Intelligence Preparation of the Battlefield (IPB), serving as the cutting-edge Common Operating Picture (COP), and serving as the foundation of the Indian Comprehensive National Power (CNP) across Diplomatic, Informational, Military, and Economic (DIME) domains at the Defence Satellite (DefSat) event. He underscored the significance of data and the inseparable connection between interoperability and policy considerations for the ultimate beneficiary of the data.

Dr. PK Jain, the Director of Program Management and Authorisation (PMAD) at IN-SPACe, delved into the realm of space diplomacy, highlighting its ability to unlock access to global technology and funding resources. Dr. Jain underscored the importance of active industry involvement to propel the work of the Indian Space Research Organisation (ISRO) to new heights and achieve significant advancements in the field.

Day two witnessed a remarkable highlight with a keen focus on "Space security - Philosophy, Doctrines & Strategies; connecting requirements & industrial capabilities." The session, chaired and moderated by Lieutenant

General VG Khandare (retd.), principal advisor, MoD emphasised the crucial necessity for the tri-services to remain at the forefront, leaving no room for second place in times of war.

Dr Subbarao Pavuluri, President, SIA-India emphasised on the fact that India is ushering into the commercial Space and Satellite communication era where the opportunities are humongous, enhancing its global digital footprint. The emergence of the commercial space sector and startups throw up some attractive possibilities for the country's defence requirements. While, Mr Anil Prakash, DG SIA-India quoted that space is a final frontier of warfare and a critical component of next-generation National offense and defence. The space-based capabilities are critical for adding a strategic depth to India's defence preparedness, both in times of peace and conflict. A modern and future-ready space, aerospace, and Defence sector which addresses the realities of 21st century India is the need of the hour.

The ensuing round-table conference brought together exceptional minds from the Armed Forces, particularly emphasising civil-military integration. Esteemed think tanks such as CENJOWS (Tri-Services), CLAWS (Army), NMF (Navy), CAPS (IAF), and made significant contributions to the panel, offering a wealth of wisdom to the esteemed stakeholders present at the event. Their collective insights fostered valuable synergy and enriched the ongoing conversation.

A special address by Dr. Subbarao Pavuluri, Dr. Ranjana N, and Dr. Anupam Sharma from DRDO and ISRO added another pivotal moment to this grand occasion. Other noteworthy highlights included discussions on Civil-Military Fusion, focused on catalysing the industrial base and overcoming supply chain challenges.

Lt Gen Tarun Kumar Aich, VCOAS (Strategy) said that the military utilisation of space has been on the rise since the Gulf War, with operations such as Desert Storm and Iraqi Freedom employing satellite-based communication, reconnaissance, and GPS technology. Space is being exploited by both the private and public sectors, with China rapidly

developing its own capabilities in the field. Military applications include satellite-based surveillance, precise positioning, and quantum technology for un-hackable communication. It is essential to establish a space policy that ensures national control and denies access to other countries.

Another event on the last day of the DefSAT 2023 had a conversation on "Closing capability gaps and retaining the high ground by integrating drones, HAPS and satellites" including narrow discussions on how these technologies together can provide the security landscape and help to identify and mitigate potential threats more quickly and effectively.

The session also includes a discussion on integrating drones, HAPS, and satellite coordination and a well-planned approach that considers each technology's unique capabilities and requirements. The event was Chaired and Moderated by Lt Gen PJS Pannu, PVSM, AVSM, VSM (Retd) Former Deputy Chief Indian Integrated Defence Staff (Operations) and Chair of the Aerospace and Defence Committee at SIA-India. The Keynote was addressed by Lt Gen (Dr) V. K. Saxena, PVSM, AVSM, VSM (Retd) former Director General of the Corps of Army Air Defence.

LT. GEN. VG KHANDARE (RETD.), PRINCIPAL ADVISOR, MOD

LT. GEN. SUNIL SRIVASTAVA, DG CENJOWS

MR. ANIL PRAKASH, DG SIA-INDIA

CONCLUSION

DR SUBBARAO PAVULURI, PRESIDENT, SIA-INDIA AND LT. GEN, VG KHANDARE (RETD.), PRINCIPAL ADVISOR, MOD

The conference brought together distinguished representatives from high-level government, key industry players, and academia to engage in discussions, deliberations, and knowledge exchange on the space domain, with an emphasis on innovation, thought leadership, and disruptive technologies. The conference provided an ideal platform for organisations with a vested interest in advancing India's military space capability and plans.

The event prioritised enhancing military operations by delivering space domain awareness and satellite communications, addressing funding concerns for new space capabilities, expanding international partnerships, and developing a defence space strategy that aligns with the national space strategy.

The event saw active participation from over 50 industry representatives, including companies and organisations, along with the presence of over 15 prominent think tanks. All three services and the leading space-related organisations of the country, ranging from ISRO to IN-SPACe, enthusiastically participated in the event.

FINDING EARTH LIKE PLANETS AND THE POSSIBILITY OF LIFE BEYOND EARTH

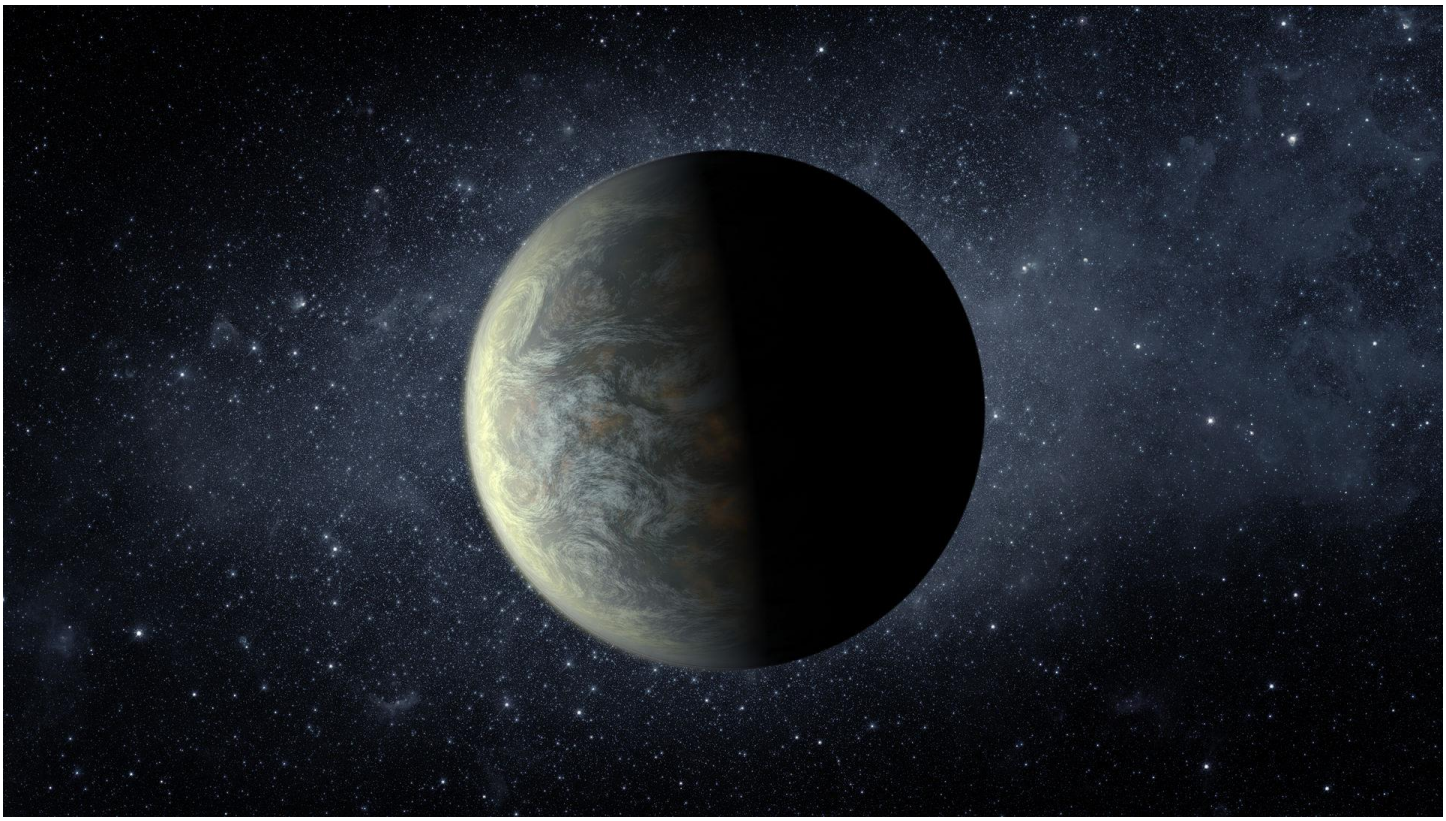
YASHWANTH NAIDU TIKKISETTY

He is currently pursuing MSc in Embedded Systems and has previously worked as an Embedded Software Engineer. He is exploring various areas in science such as the cosmos, universe, black holes, stars, and more. He regularly writes on his blog: cthecosmos.com

The discovery of thousands of exoplanets in recent years has provided strong evidence that planets are common in our galaxy. Many of these exoplanets are located in the "habitable zone," where conditions may be suitable for liquid water and potentially life as we know it.

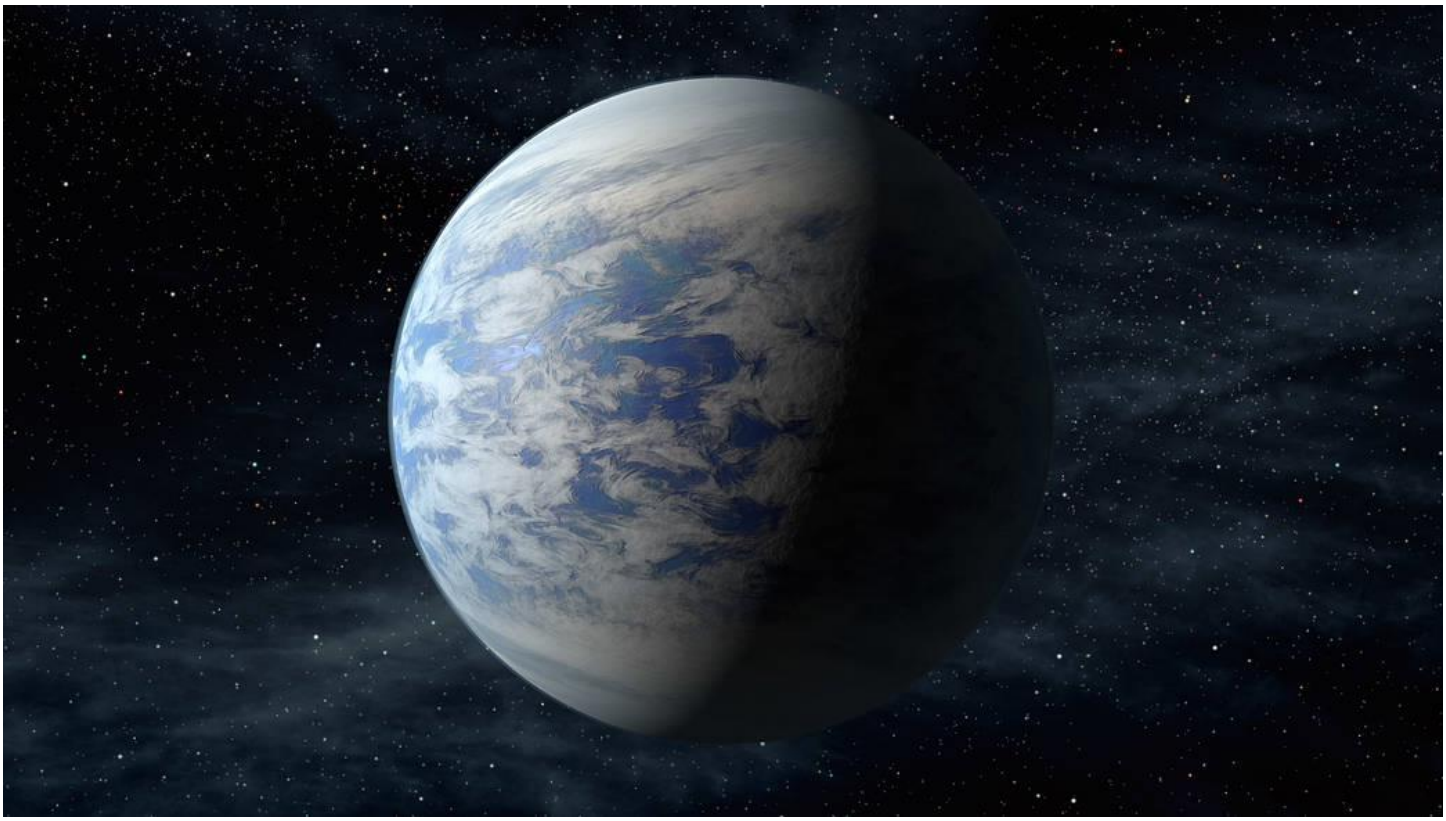
Beyond Earth, there are several celestial bodies that scientists believe could harbour conditions suitable for life, such as Jupiter's moon Europa and Saturn's moon Enceladus, both of which have subsurface oceans. Mars, despite its harsh surface conditions, also holds potential for microbial life or the possibility of past life.

While the existence of extra-terrestrial life is still a matter of speculation, ongoing scientific research and technological advancements continue to shed light on this intriguing question. The discovery of even microbial life beyond Earth would have profound implications for our understanding of the universe. Overall, while we do not yet have definitive evidence of life beyond Earth, the growing body of evidence suggests that the possibility of finding extra-terrestrial life is becoming increasingly likely. The range of planets listed as habitable is huge but an important one is listed here, what do you think, will we ever find any intelligent life beyond Earth and what shall be the geopolitical scenario of Earth if we ever come across one?



KEPLER-20F

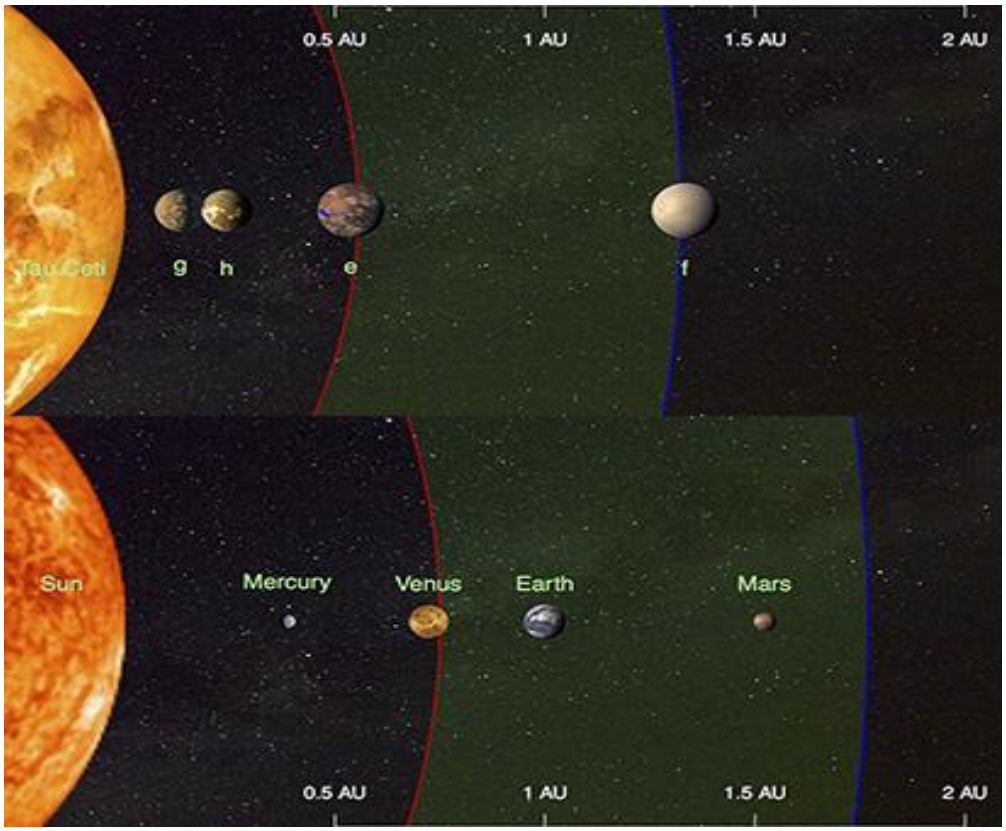
NASA's Kepler mission has discovered the first Earth-size planets orbiting a sun-like star outside our solar system. The planets, called Kepler-20e and Kepler-20f, are too close to their star to be in the so-called habitable zone where liquid water could exist on a planet's surface, but they are the smallest exoplanets ever confirmed around a star like our sun. Kepler-20f is the closest object to the Earth in terms of size ever discovered. With an orbital period of 20 days and a surface temperature of 800 degrees Fahrenheit, it is too hot to host life. It is an exoplanet which orbits its host star Kepler-20 which is about 921.4 light-years (285.4 pc) from the solar system. Kepler-20 is 0.9 times more massive compared with our sun. The surface temperature of this star is 5502 degrees which has a few spectral types of G8 stars. Kepler-20f orbits its star every 19.6 days with as distance of 0.14 AU (20,883,862.7km).



KEPLER-69C

Kepler-69c can be also considered as Super-Earth /Super-Venus. This is a debatable planet among scientists as they still are researching whether it's an Earth-like planet or a Venus-like planet. It revolves around its host star namely Kepler-69 at a distance which is 0.64 times that of Earth every 242 days (close to Venus's orbital period). Kepler-69 is a G-type star which is orbited by two planets.

The surface temperature of this star is around 5368 K with an estimated age of around 400 million years. Kepler-69c is a confirmed super-earth extra-solar planet, which is a rocky planet. It is located 2,430 light-years (746 parsecs) from Earth. This planet is present in a habitable zone, and by considering its distance from its host star, there is a chance that Kepler-69c might have water in it or even a global ocean on its surface.



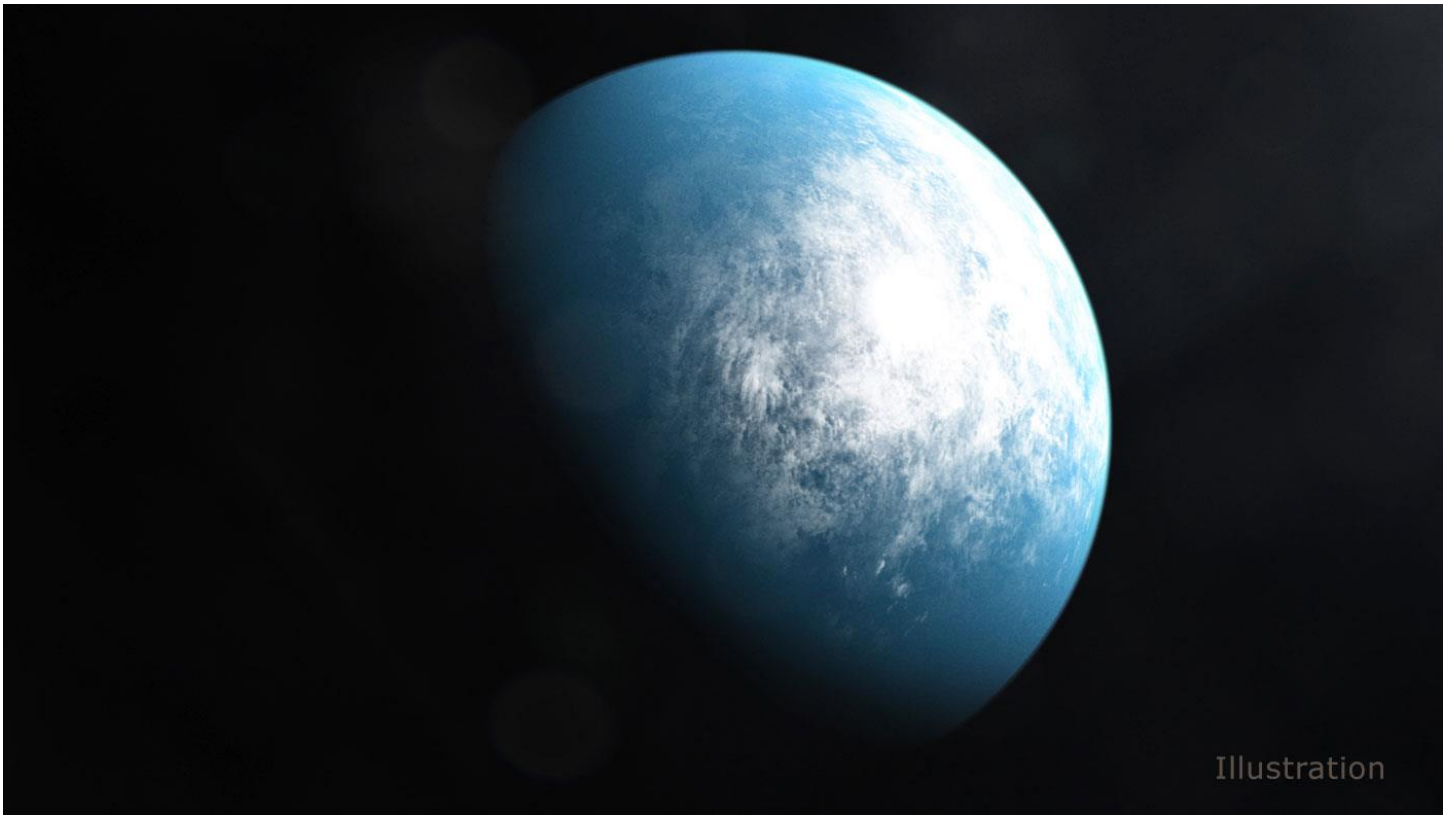
TAU CETI STAR

This is not a planet but a star very similar to our sun which is at a distance of 12 light-years (3.7 parsecs) from Earth. It has five possible planets orbiting this star, two of which are potentially in the habitable zone, because of the debris dust around this start, any planet in this system would face far more impact events than Earth did. Tau Ceti is consistently listed as a target for the Search for Extra-Terrestrial Intelligence (SETI) and appears in some science fiction literature.

The principal factor which puts Tau Ceti in a potential search for intelligent life beyond Earth is that the star's proximity to planets. After a few observations, the results on what kind of planet might exist in that system were declared. This result excludes the presence of Hot Jupiters and probably excludes any planet with minimal mass greater than or equal to Jupiter's mass and with orbital periods less than 15 years. However, as of 2019, analysis of the star has detected the signature of a possible planet of a few Jovian masses, with a tangential velocity of around 11.3 m/s.

Taue Ceti is in the habitable zone only if we make generous assumptions. Tau Ceti f has likely resided in the habitable zone for much less than 1 billion years as per some researchers. The other three Tau Ceti planet candidates (b, c and d) all orbit considerably closer to the star than do e and f, making them likely too hot to harbour life-like conditions.

All five Tau Ceti worlds are likely larger than planet Earth. Planets e and f are estimated to be 4.3 and 6.6 times bigger than Earth, respectively; the other three planets appear to harbour the size of 2 and 4 Earth masses.



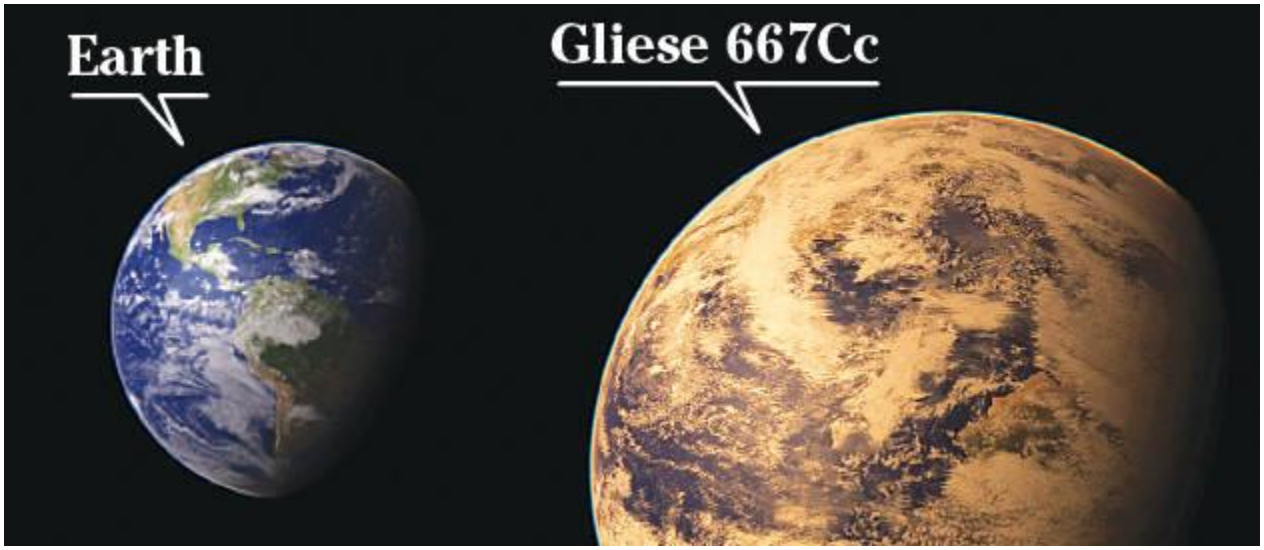
TOI 700 D

TOI 700d orbits its M-type dwarf star 16% the distance of the earth orbits the sun. It is considered the first Earth-Sized planet to be discovered. TOI 700d is one of the only few Earth-size planets discovered in a star's habitable zone as of now, the others might also include several planets in the TRAPPIST-1 system. The TOI 700 is a cool M dwarf star located just over 100 light years from the southern constellation Dorado.

It is roughly 40% of our sun's mass and size and about half its surface temperature. The innermost planet, called TOI 700b, is almost exactly Earth-size, is probably rocky and completes an orbit every 10 days. The middle planet, TOI 700c, is 2.6 times larger than Earth- between the sizes of Earth and Neptune-orbits every 16 days and is likely a a-dominated world. TOI 700d, the outermost known planet in the system and the only one in the habitable zone, measures 20% larger than Earth, orbits every 37 days and receives from its star 86% of the energy that the Sun provides to Earth.

The climate models examined a variety of surface types and atmospheric compositions typically associated with what scientists regard to be potentially habitable worlds. Because TOI 700d is tidally locked to its star, the planer's cloud formations and wind patterns may be strikingly different from Earth's.

One simulation included an ocean-covered TOI 700 d with a dense, carbon-dioxide-dominated atmosphere similar to what scientists suspect surrounded Mars when it was young. The model atmosphere contains a deep layer of clouds on the star-facing side. Another model depicts TOI 700 d as a cloudless, all-land version of modern Earth, where winds flow away from the night side of the planet and converge on the point directly facing the star.

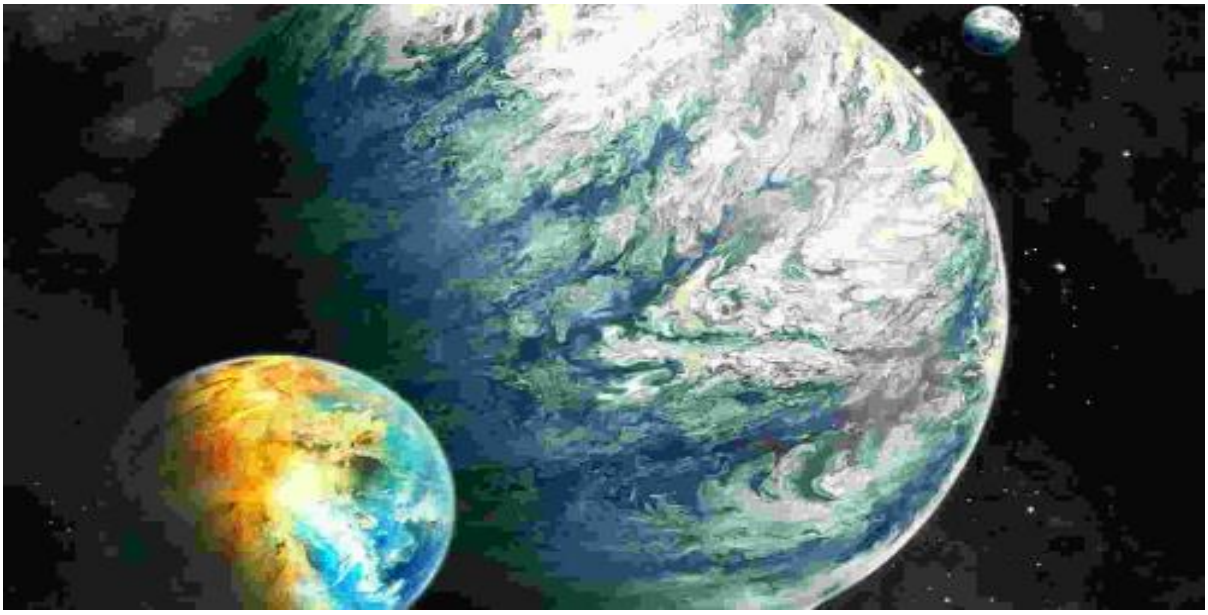


GLIESE 667CC

Gliese 667C, also known as GJ 667C, is a red dwarf star located in the Gliese 667 triple star system. It is the smallest and dimmest star in the system, with about one-third the mass of our Sun. Gliese 667C gained significant attention because it was found to host several exoplanets, including potentially habitable ones. In 2013, a team of astronomers discovered three super-Earth planets orbiting Gliese 667C within the star's habitable zone—the region where conditions might be suitable for liquid water to exist on the surface.

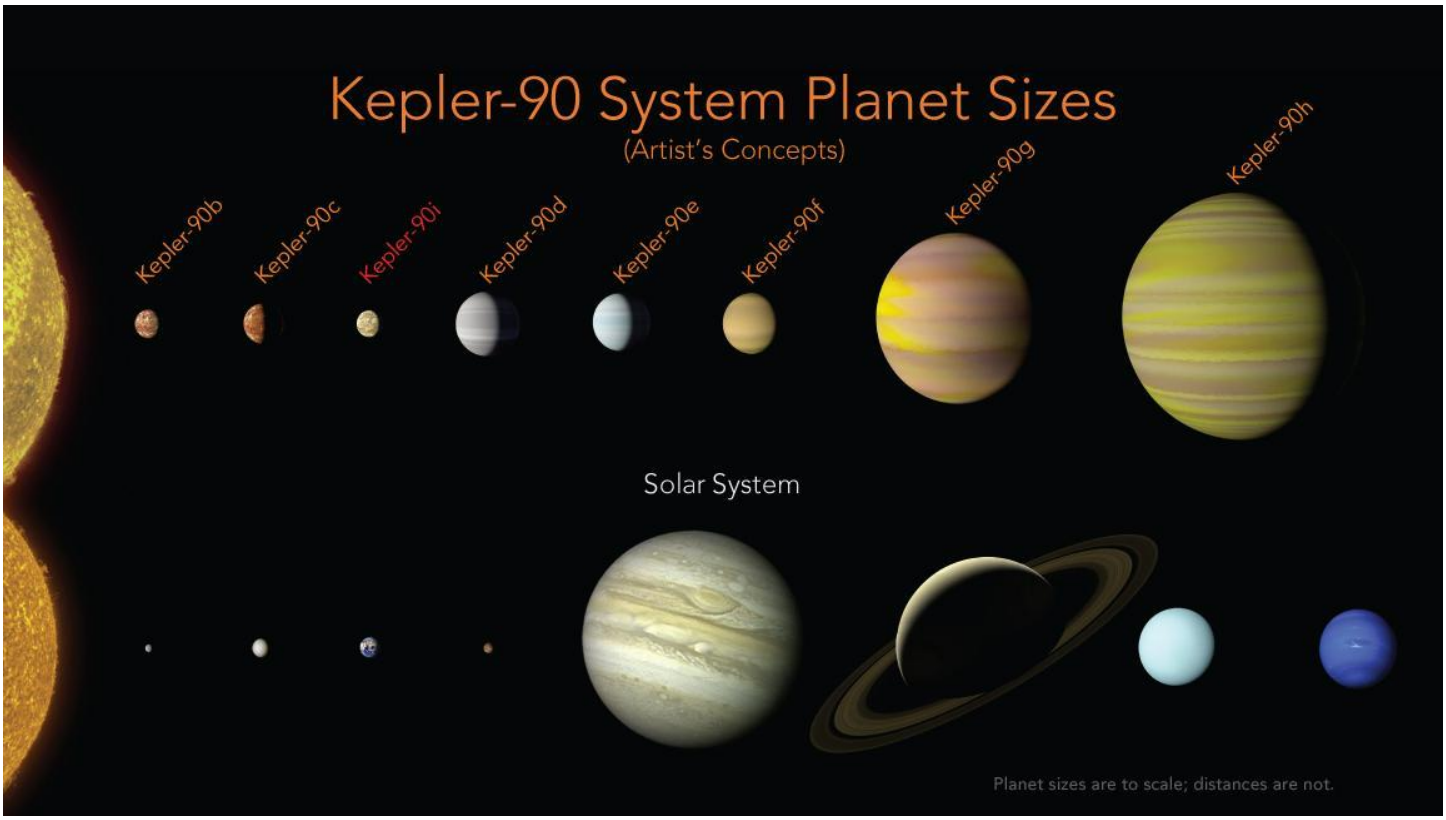
The three planets are named Gliese 667Cc, Gliese 667Ce, and Gliese 667Cf. Gliese 667Cc, the second planet in the system, has received the most attention due to its potential for habitability. It is estimated to be about 4.5 times the mass of Earth and orbits its star at a distance of about 0.12 AU, completing an orbit in roughly 28 Earth days.

The GJ667Cc receives a radiation flux which is about 90% of what we receive from our Sun on Earth. Although most of this radiation is emitted in the Infrared (IR), it is most likely enough to allow for liquid water on the planetary surface. The temperature could be a pleasant 30 degree C if we assume a planetary atmosphere that is similar to the Earth's. Further observations are needed to answer if GJ 667Cc truly supports liquid water and if the conditions on this planet are appropriate for the hosting life.



KIC-7340288 B

Officially named KIC-7340288 b, the planet discovered by young researcher Michelle Kunimoto is among 17 planets discovered by her while doing her PhD at University of British Colombia (UBC), Canada. The KIC-7340288 b is just 1 ½ times the size of Earth – small enough to be considered rocky, instead of gaseous like the giant planets of the Solar System – and in the habitable zone of its star. The planet has a year that is 142 ½ days long, orbiting its star at 0.444 Astronomical Units (AU) – just bigger than Mercury's orbit in our Solar System, and gets about a third of the light Earth gets from the Sun.

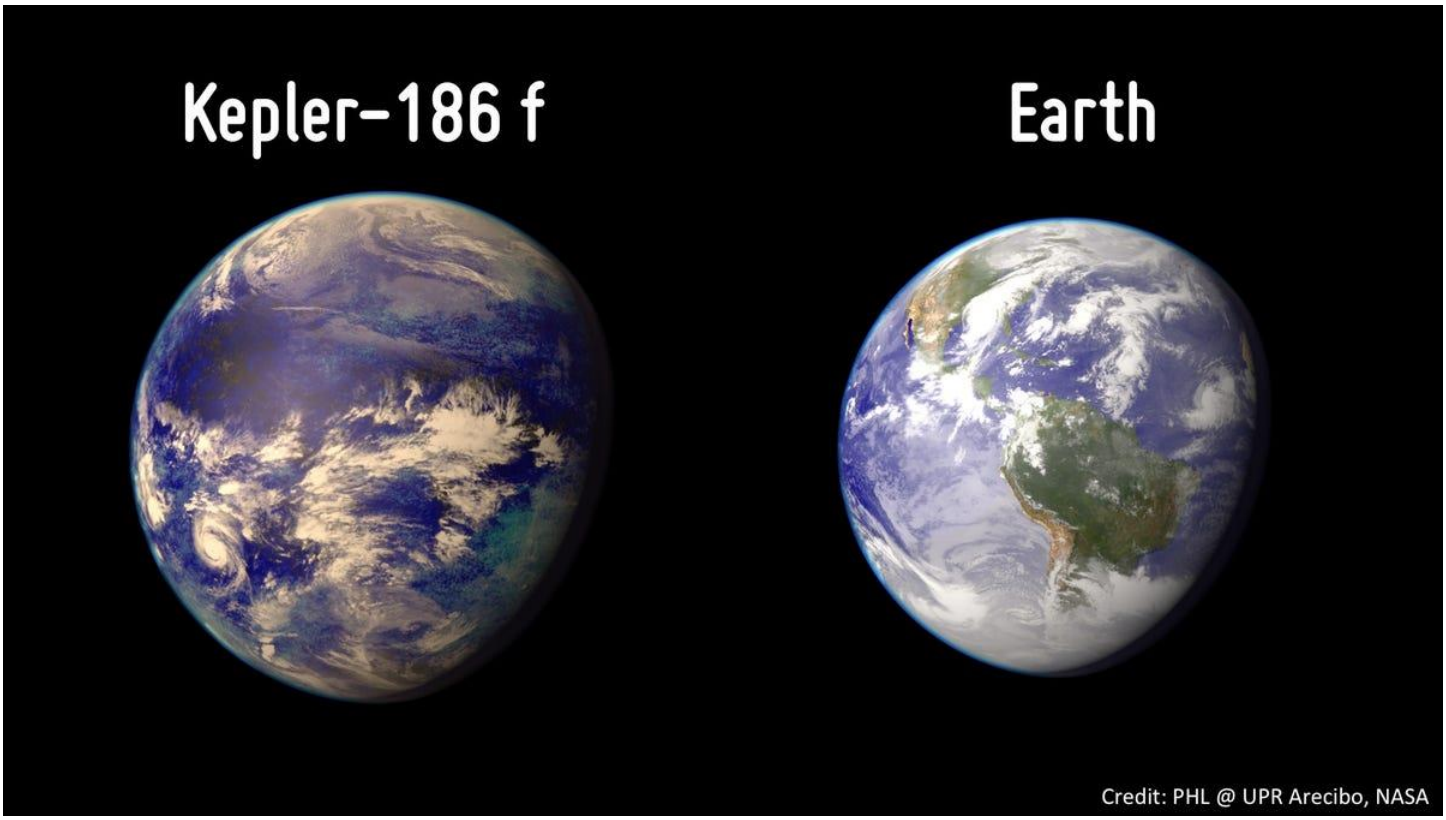


KEPLER-9D

Kepler-9d, formerly known as KOI-377.03, is a planet in orbit around the sun-like star Kepler-9. Initially discovered by Kepler spacecraft, a terrestrial planet-searching satellite built and operated by NASA, Kepler-9d is most likely a Super-Earth, with an estimated radius approximately 60% larger

than that of Earth's, although its exact mass cannot be determined.

The Kepler-9d orbits Kepler-9 every 1.56 days at a distance of .0273 AU from its star, an extremely close distance. Although Kepler-9d is the closest planet to its star in its system, it is named Kepler-9d instead of Kepler-9b because two gas giants, Kepler-9b and Kepler-9c, were confirmed first.



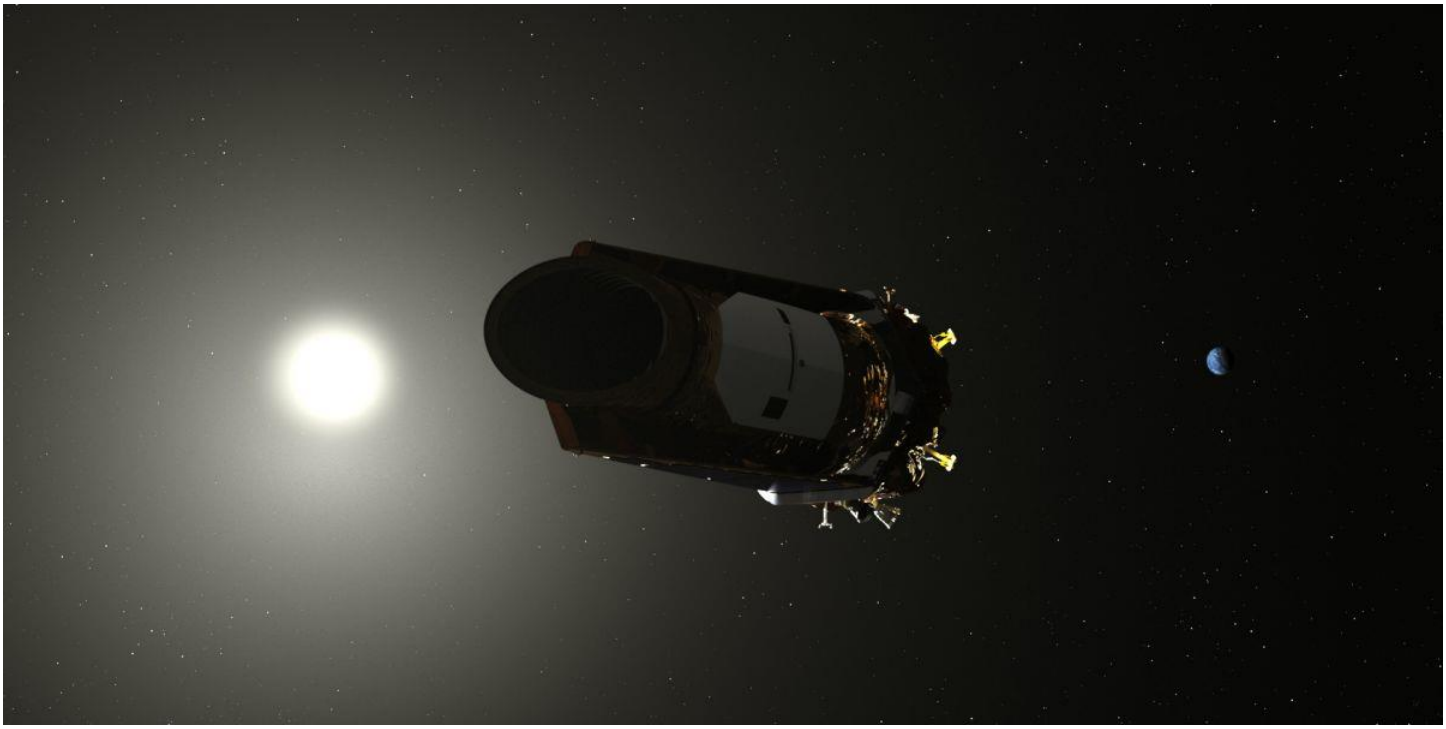
KEPLER-186F

NASA's **Kepler Space Telescope**, astronomers have discovered the first Earth-size planet orbiting a star in the "habitable zone" – the range of distance from a star where liquid water might pool on the surface of an orbiting planet. The discovery of Kepler-186f confirms that planets the size of Earth exists in the habitable zone of stars other than our sun.

While planets have previously been found in the habitable zone, they are all at least 40% larger in size than Earth and understanding their makeup is challenging. Kepler-186f is more reminiscent of Earth.

Kepler-186f resides in the Kepler-186 system, about 500 light-years from Earth in the constellation Cygnus. The system is also home to four companion planets, which orbit a star half the size and mass of our sun. The star is classified as an M dwarf, or red dwarf, a class of stars that makes up 70% of the stars in the Milky Way galaxy. "M dwarfs are the most numerous stars," said Quintana. "The first signs of other life in the galaxy may well come from planets orbiting an M dwarf."

Kepler-186f orbits its star once every 130-days and receives one-third the energy from its star that Earth gets from the sun, placing it nearer the outer edge of the habitable zone. On the surface of Kepler-186f, the brightness of its star at high noon is only as bright as our sun appears to us about an hour before sunset.



KEPLER SPACE TELESCOPE

Being in the habitable zone does not mean we know this planet is habitable. The temperature on the planet is strongly dependent on what kind of atmosphere the planet has. Kepler-186f can be thought of as an Earth cousin rather than an Earth twin. Experts believe that the planet has many properties that resemble Earth.

The four companion planets, Kepler-186b, Kepler-186c, Kepler-186d, and Kepler-186e, whiz around their sun every four, seven, 13, and 22 days, respectively, making them too hot for life as we know it. These four inner planets all measure less than 1.5 times the size of Earth.

The next steps in the search for distant life include looking for true Earth-twins – Earth-size planets orbiting within the habitable zone of a sun-like star – and measuring their chemical compositions. The Kepler Space Telescope, which simultaneously and continuously measured the brightness of more than 150,000 stars, is NASA's first mission capable of detecting Earth-size planets around stars like our sun.

TRAPPIST-1E

Some 40 light-years from Earth, a planet called TRAPPIST-1e offers a heart-stopping view: brilliant objects in a red sky, looming like larger and smaller versions of our own moon but these are no moons. They are other Earth-sized planets in a spectacular planetary system outside our own. These

seven rocky worlds huddle around their small, dim, red star, like a family around a campfire.

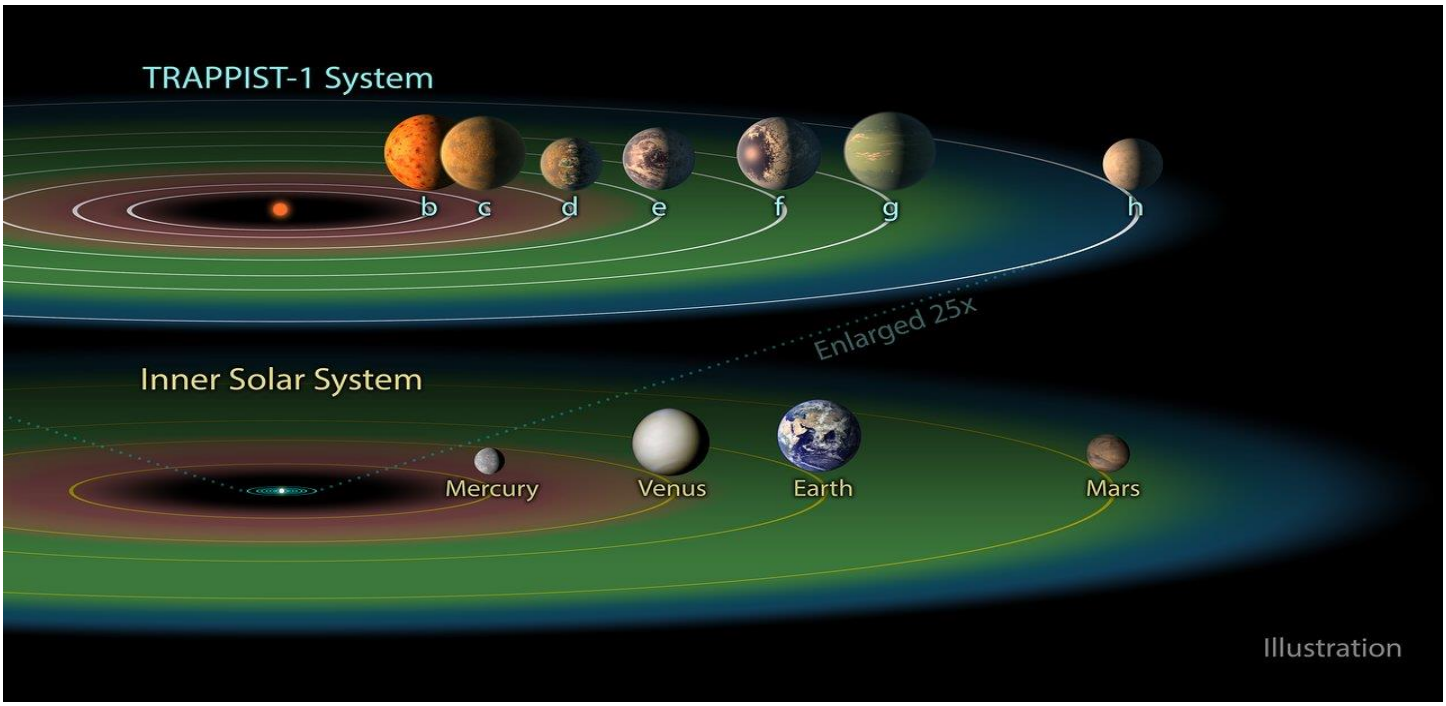
Any of them could harbour liquid water, but the planet shown here, fourth from the TRAPPIST-1 star, is in the habitable zone, the area around the star where liquid water is most likely to be detected. This system was revealed by the TRAnsiting Planets and PlanetIsmals Small Telescope (TRAPPIST) and NASA's Spitzer Space Telescope. The planets are also excellent targets for NASA's **James Webb Space Telescope**.

One of seven planets orbiting a small star, TRAPPIST-1, may be capable of supporting life as we know it on Earth, new climate models suggest. Located 39 light-years away from Earth, TRAPPIST-1 is a relatively cool M-dwarf star with about 9 % the mass of Earth's sun and about 12 % its radius. This ultra-cool star is believed to host at least seven rocky planets that are about the size of Earth or smaller.

Using terrestrial climate and photochemistry models, researchers from the University of Washington (UW) simulated environmental states for each planet of the TRAPPIST-1 system. The models show that all seven exoplanets likely evolved like Venus, meaning that any water or oceans would have evaporated early on in the system's formation, the research team said in a statement.

According to these models, the seven planets of TRAPPIST-1 would have dense, uninhabitable atmospheres. However, one of the worlds, called TRAPPIST-1e, may host liquid water on its surface and, as a result, be able to support Earth-like life, according to the statement.

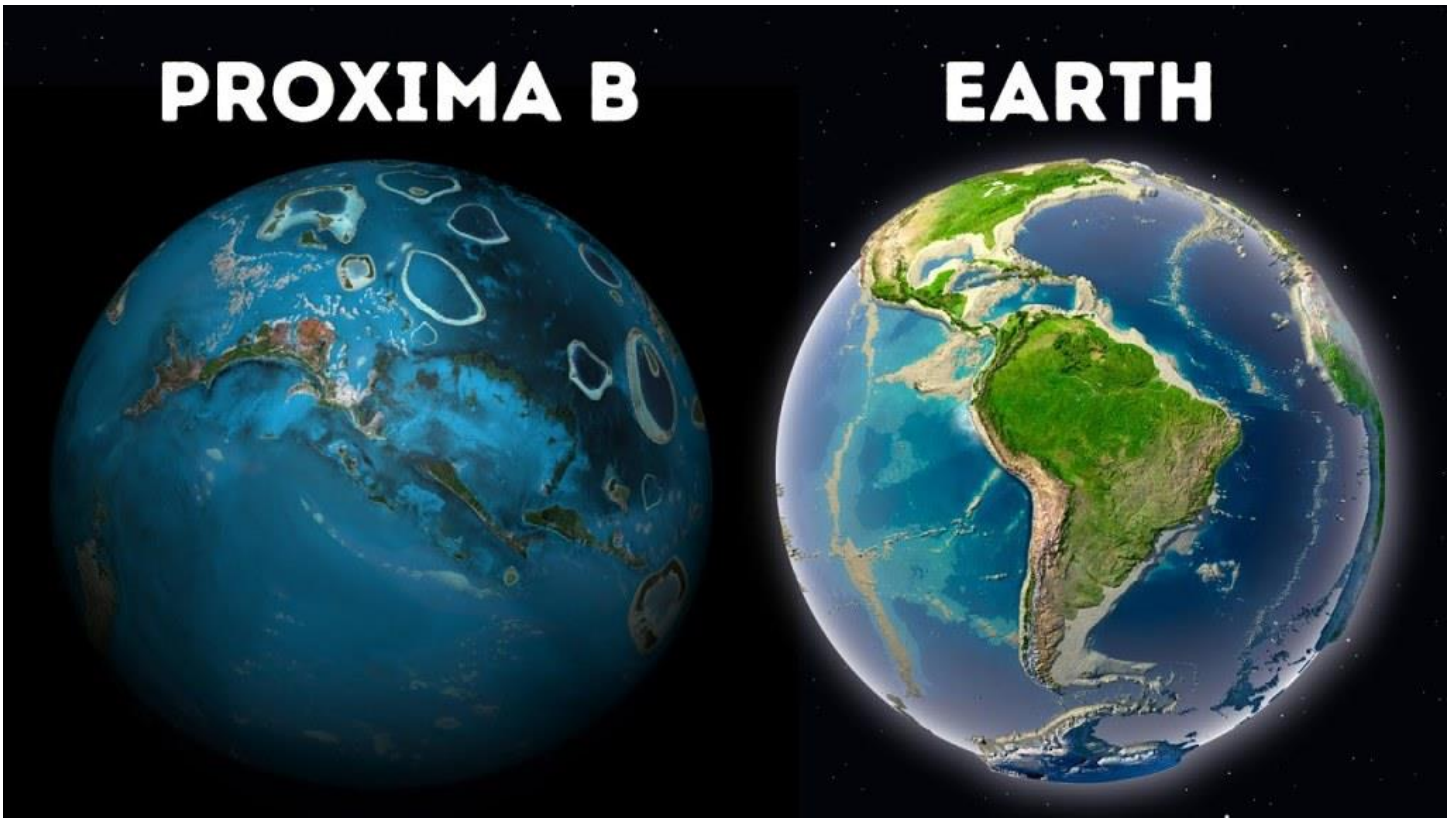
It was one of seven new exoplanets to be discovered orbiting the star using observations from the **Spitzer Space Telescope**. The exoplanet is within the star's habitable zone. Since its initial announcement, the physical characteristics have become better defined, allowing scientists to better understand its nature. TRAPPIST-1e is very similar to Earth, with just about the same mass, radius, density, gravity, temperature, and stellar flux. It is also confirmed to have a compact atmosphere like the terrestrial planets in our solar system.



More detailed studies of TRAPPIST-1e and the other TRAPPIST-1 planets released in 2018 determined that the planet is one of the most Earth-sized worlds found, with 91% the radius, 77% the mass, 102.4% the density (5.65 g/cm3), and 93% the surface gravity. TRAPPIST-1e is confirmed to be a terrestrial planet with a solid, rocky surface. It is cool enough for liquid water to pool on the surface, but not too cold for it to freeze like on TRAPPIST-1f, g, and h.

The planet receives a stellar flux 0.604 times that of Earth, about a third lower than that of Earth but significantly more than that of Mars. Its equilibrium temperature ranges from 225 K (−48 °C; −55 °F)to 246.1 K (−27.1 °C; −16.7 °F), depending on how much light the planet reflects into space. Both of these are between those of Earth and Mars as well.

TRAPPIST-1e is confirmed to have a compact, hydrogen-free atmosphere like those of our Solar System's rocky planets, further raising the chances of habitability. Hydrogen is a powerful greenhouse gas, so if there was enough to be easily detected, it would mean that the surface of TRAPPIST-1e would be inhospitable. Since such an atmosphere is not present, it raises the chances for the planet to have a more Earth-like atmosphere instead. The TRAPPIST-1e could be an early target of the James Webb Space Telescope.



PROXIMA B

Proxima Centauri b is a super Earth exoplanet that orbits an M-type star called Proxima Centauri. Its mass is 1.27 of Earths', it takes 11.2 days to complete one orbit of its star, and is 0.0485 AU from its star. Its discovery was announced in 2016. The discovery of a roughly Earth-size planet around Proxima Centauri, the nearest star to Earth, has generated a lot of buzz, and even speculation that a robotic probe may visit the world in the coming decades.

But "Earth-size" is a very different thing than "Earth-like." Even though the newfound planet, known as Proxima b, appears to orbit in its star's habitable zone – the range of distances where water could exist in liquid form – nobody knows if it's actually capable of supporting life.

Rory Barnes, a professor of astronomy at the University of Washington, stressed this point in an essay posted on palereddot.org, the website dedicated to the discovery team's search for a planet around Proxima Centauri. If Proxima b formed relatively far away from the star (and later migrated inward to its present position), then it has a better chance of being

ice-rich, ensuring a plentiful supply of water. But if the world formed closer in, much or all of its water may have been heated to vapor and lost. Or the planet could have formed with lots of water, lost it, and then had more delivered to it by comets and/or asteroids, as the Earth did.

Proxima b may be the closest of the thousands of exoplanets – which are planets orbiting stars outside our solar system – discovered to date, but at 4.2 light years away the prospect of a quick visit to find any Proximese aliens is still remote. Based on spacecraft today, a probe launched now would take around 70,000 years to reach the new planet. The James Webb Space Telescope, may provide more insights into the planet's atmosphere and composition, which would be crucial in assessing its habitability. **[End]**

THE 6TH GENERATION FIGHTER RACE THE WAY FORWARD FOR INDIA

SHANTANU K. BANSAL

Founder of IADN. He has more than 10 years of experience in research and analysis. An award-winning researcher, he writes for the leading defence and security journals, think tanks and in-service publications. He has been a senior consultant to the Army Training Command (ARTRAC), Shimla and Helicopter Training School (HTS), Hyderabad.

In December 2007, the Lockheed Martin F-22 Raptor of the United States Air Force (USAF) got fully operationalised and so far, only three countries have managed to develop and successfully induct fifth-generation fighter aircraft: US, Russia and China yet only one country has so far been able to operationally deploy fifth-generation fighter which is U.S. leading with not one but two successful fifth-generation fighter programmes, the Lockheed Martin F-22 Raptor and F-35 Lightning II. Yet, at least a dozen of countries are now working towards developing 6th generation fighters, a quantum generational leap to say the least.

There are five universally accepted features that characterise a fifth-generation fighter aircraft: stealth, manoeuvrability, advanced avionics, multi-role capabilities, and advanced sensors. The F-22 had long reigned as the undisputed 5th-generation fighter, much ahead of its Russian and Chinese counterparts. The F-22 success is being followed by the F-35 Lightening II the first advanced fighter aircraft ever produced on such a large scale. A sixth-generation fighter will include basic features of a fifth-generation fighter with real-time network-centric capabilities, manned-unmanned teaming, greater sensory awareness, a better weapon package with advanced automation, sensor fusion, on-board computing and more.

POLICY BRIEF NO. 115/2023-24

The technological know-how achieved in developing the fifth-generation fighter will be used in developing a sixth-generation fighter in addition to technologies that are still not employed yet as they exist or are being worked upon at different levels. Some other key features that a fifth-generation fighter like F-22 and F-35 include are stealth, integrated sensors, super-cruise capability and a helmet-mounted display system that means intelligence and target information displayed on the pilot's helmet visor. While F-35 cannot super-cruise, it is designed as an ambush predator that uses its stealth, it employs advanced sensors and networking capabilities to shoot down opponents before they enter visual—or dogfighting—range at least as per the concept.

Combining the capabilities of the existing fifth-generation fighter aircraft in addition to the new emerging technologies like automated take-off, landing, and air-to-air refuelling using advanced algorithms through AI and ML, with sixth-generation fighters also may have the ability to fire lasers/DEWs and hypersonic missiles, displaying true multirole capabilities with enhanced mission flexibility for all-around mission excellence is what will make a true sixth-generation fighter.

*At least a **dozen of countries** are now working towards developing **6th generation fighters**, a **quantum generational leap** to say the least*

DEFINING SIX KEY FEATURES OF THE 6TH-GENERATION FIGHTER

There is no standardised definition for a sixth-generation fighter aircraft as the concept is still in development and there is no fixed set of requirements or characteristics, yet a sixth-generation fighter can be defined as an aircraft that will bridge the shortcomings posed by the existing stealth fighters to provide all-round mission success. Automated take-off and landing, automated missions and auto air-to-air refuelling, low-probability-of-intercept radar, advanced avionics, agile airframes with supercruise, super manoeuvrability, net-centric computers, are some of the key features that are often discussed in relation to a sixth-generation fighter aircraft.

Increased Stealth

The sixth-generation fighters are expected to have improved stealth technology that will make them harder to detect and track by radar and other sensor systems, the stealth characteristics of the fighter is going beyond just reducing the Radar Cross Section (RCS) of the fighter but also reducing infrared and acoustic signatures to counter advancement in radar technologies such as the introduction of Low-Frequency Radars (LFRs), Over the Horizon (OTH) radars, Multi-static/Bi-static radars, and quantum radars.

Network-Centric Warfare

These fighters are expected to provide a complete picture of the battlefield environment through advanced sensors providing real-time situational awareness on the pilot's virtual cockpit or HUD enabling net-centric computing capabilities onboard. For E.g., the 5th generation F-35 fighter provides 360-degree situation awareness through its advanced sensors and information fusion, similarly, the Su-57 of Russia is armed with 06 radars, with a higher detection range – these technologies can further be matured and integrated on a 6th-generation fighter. Therefore, 6th generation fighters are expected to be part of a larger network-centric

system, allowing them to share data with not only nearby aircraft but also ground-based systems in real time with the help of advanced satellite communications.

Autonomous

The 6th-generation fighters are expected to use artificial intelligence (AI) to help pilots make better decisions and to enhance their situational awareness with the help of advanced analytical tools enabling next-generation human-machine interfacing. Better use of software relied on systems can also enable better, more frequent and flexible mission upgrades, enhancing the fighter's durability, and keeping it in the air for a long-time. The design is expected to include open architecture to adapt and enhance capabilities in future. The DARPA is already testing how human pilots interact with AI to examine how well they trust machines to automatically conduct dogfights. Some key features to further the concept of autonomous fighters with the help of AI/ML applications could be automated take-off and landing, automated missions, auto air-to-air refuelling combined with intelligent adaptive engines for better fuel efficiency, advanced computing for data fusion onboard, automatic mission profiling with cyber-hardened secured communications.

WHEN DATA MEETS STEALTH

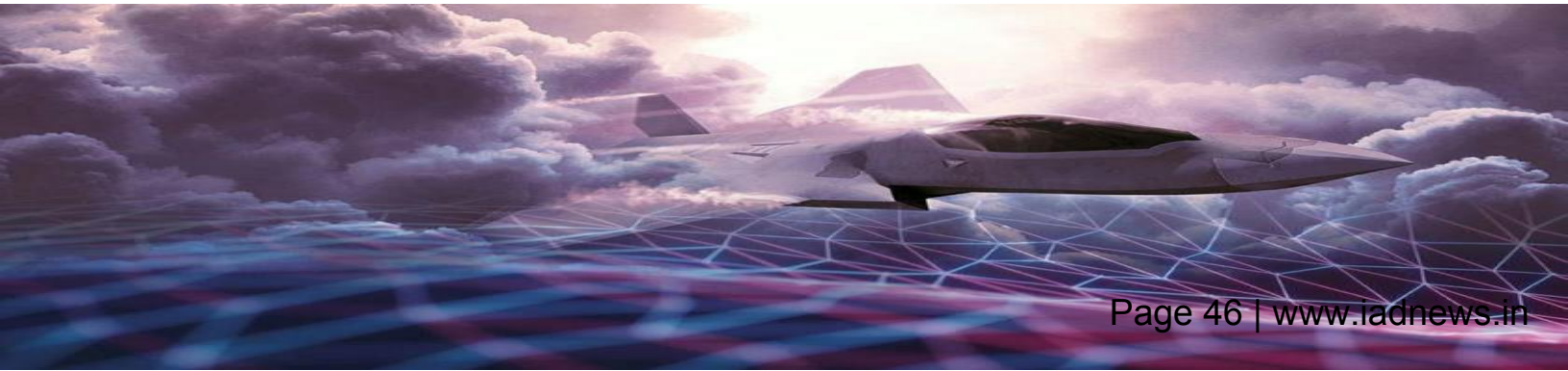
- **PILOT ASSISTANCE:** modern data science technologies could further assist pilots in making critical decisions by analysing data from sensors and other sources, and presenting the information clearly and concisely, enabling various missions to be automated, be it landing, take-ff or air-to-air refuelling and more.
- **IMPROVED SITUATIONAL AWARENESS:** processing vast amounts of data from sensors and other sources to provide pilots with a complete picture of the battlefield, allowing them to make more informed decisions.
- **AUTONOMOUS DECISION-MAKING:** AI and ML algorithms could be used to analyse vast amounts of data from sensors and other sources to help the aircraft make the best possible decisions in real-time.
- **PREDICTIVE MAINTENANCE:** Through Knowledge Engineering the systems could automatically be used to predict when components of the aircraft are likely to fail, allowing for proactive maintenance that could reduce downtime and improve operational efficiency and life-cycle needs. The F-35 already employs an Autonomic Logistics Information System (ALIS) for scheduling maintenance, ordering parts, flight-readiness information and more.
- **CYBER HARDENED:** predictive technologies could further be used to detect and respond to cyber threats in real-time, improving the overall cybersecurity infrastructure of the aircraft.

High-Performance Fighter

Combat range, payload, speed, stealth, manoeuvrability, avionics, sensors and weapons systems are some of the basic characteristics that define the advancement of a fighter aircraft by generation. Each of these factors plays a role in determining the overall combat capability of a fighter and a 6th-generation fighter would showcase an increase in capabilities in all these parameters, especially with regards to combat range and payload capacity, in general, the present fifth-generation fighters tend to have comparatively lower combat range and payload capacities like the F-22 and F-35 have a shorter range and carrying capacity than their 4th-generation predecessors.

This is due to the fact that these aircraft are designed to engage the targets from beyond visual range, using advanced sensor suites and long-range weapons. In this regard, a 6th-generation fighter can deliver results while not only operating from far-off distances but also engaging opponents in line-of-sight with its better fuel efficiency, higher speed, advanced sensors, greater weapon payload, with higher energy generation onboard to fire DEWs while the super-manoeuvrability characteristics providing a better chance of survival in intense A2/AD environment/contested airspace.

*The 6th-generation fighters are expected to use **Artificial Intelligence (AI)** to help pilots make better decisions and to enhance their **situational awareness** with the help of advanced analytical tools enabling next-generation **Human-Machine Interfacing***



Directed Energy Weapons (DEWs)

The 6th-generation fighters may use DEWs, such as lasers, or high-powered microwaves for both defensive and offensive roles including missile defence, anti-satellite operations, and even ground-based anti-personnel weapons. However, the development and deployment of DEWs are still limited by technological and logistical challenges, including power requirements, targeting accuracy, and cost-effectiveness. The US Navy has been testing the Laser Weapons System (LaWS) installed on the USS Ponce and the US Air Force is also working on such a platform for air-to-air and air-to-ground operations. China has also been developing such a system and there have been reports that PLA has deployed such DEWs on its naval ships and has developed land-mobile HEL-based DEW.

Manned Unmanned Teaming (MUM-T)

Traditional air combat introduced the concept of a wingman as the pilot of a second aircraft providing support or protection to a primary aircraft. Now the next generation of fighters will come with multiple wingmen of unmanned aircraft or drones that are controlled by the pilot of the manned aircraft, unmanned wingmen and remote carriers will form the primary feature of a 6th-generation fighter with the system of systems approach.

ADVANTAGE OF MUM-T IN TOMORROW'S CONFLICT

- **FORCE MULTIPLIERS**: Wingmen can serve as force multipliers, allowing a single manned aircraft to control multiple unmanned wingmen, effectively expanding the capabilities of the pilot. The wingmen and remote carriers with 6th-generation fighters are expected to provide increased autonomy in air combat missions, by flying in formation with a manned aircraft, a wingman can enhance the capability of the manned aircraft by providing additional sensors, weapons, or communication capabilities allowing them to operate independently of the manned aircraft and carry out missions on their own. This will allow the manned aircraft to focus on more complex tasks, such as air-to-air combat.

- **IMPROVED SITUATIONAL AWARENESS**: By combining the sensors and capabilities of manned and unmanned aircraft, the wingmen and remote carriers can provide a more comprehensive view of the battlefield, improving situational awareness for the pilot hence enabling informed decision-making. The unmanned platforms can perform extended ISR missions, Electronic Warfare, and other combat support missions beyond the reach of a fighter aircraft hence by using wingmen for high-risk missions, 6th-generation fighters can reduce the risk to the manned aircraft and the pilot(s)

- **DISTRIBUTED LETHALITY**: Wingmen in 6th-generation fighters could be able to carry a range of weapons, this will enable the wingman to engage targets independently, effectively multiplying the firepower of the manned aircraft, the arsenal may also include directed energy weapons and hypersonic missiles. The distributed lethality gives the effective option for swarming over the targeted and overwhelming the AD environment.

- **COMBAT TRAINING**: Wingmen can be used for training purposes, allowing pilots to practice and develop new tactics and strategies without risking the safety of a manned aircraft., and they can be used to simulate various scenarios, such as enemy aircraft or ground targets, without the risks associated with live combat

THE 6TH - GENERATION FIGHTERS UNDER DEVELOPMENT

Global Combat Air Program (GCAP), Aka Tempest

Participating countries: UK, Japan, Italy

Announced in December 2022, the Global Combat Air Programme (GCAP), Aka. Tempest GCAP aircraft is a part of the UK's Combat Air Strategy launched in July 2018. In The year 2021, the U.K. announced a £2 billion investment in the GCAP programme for up to 2025, the project formerly known as FCAS. The main partners in Team Tempest are UK MoD, BAE Systems, MBDA UK, Rolls-Royce, and the RAF while the JV include IHI Corporation, Mitsubishi Electric and Mitsubishi Heavy Industries in Japan

which were previously working on F-X stealth fighter programme now merged with the Tempest and Avio Aero, Elettronica, Leonardo and MBDA in Italy with almost 600 other organisations on contract, including SMEs and academic institutions. According to BAE Systems, the Tempest consortium is working on over 60 technology demonstrations in the fields of sensing, data management, and autonomy, and is using new collaborative methods that have brought down the cost of developing the new radar technology by 25 per cent.

Since 2003, the Eurofighter Typhoon has been at the forefront of RAF operations, therefore the Tempest is designed to complement current combat aircraft like the F-35 Lightning II and the Typhoon fighters starting in the mid-2030s until the older warplanes are retired in the 2040s. The stealth fighter will be capable of carrying hypersonic missiles and controlling drone swarms, as well as producing large amounts of electricity, allowing it to power laser weapons. The first flight demonstration of the Tempest 6th-generation fighter is expected by 2035 and is expected to be unveiled by 2027. The Tempest GCAP aircraft is expected to be in service with the British RAF by 2035.

The twin-engine, supersonic, delta-wing Tempest will have reconfigurable artificial intelligence and cyber-hardened communications that allow it to act as a flying command and control centre, where the pilot acts more as an executive officer than a dogfighter, flanked by smaller, less costly, less capable planes known at this stage as Lightweight Affordable Novel Combat Aircraft (LANCA), which could act as decoys. The Tempest designs are examining the use of a software reconfigurable wearable cockpit, employing the use of a hi-tech 'Striker II' helmet – without a single physical dial or screen in the cockpit.

Tempest will be modular, both to be easily role-adapted to fit the particular mission as well as have easily upgradeable components during its lifetime. The aircraft's two generators are able to provide 10 times more electrical power than the Eurofighter Typhoon. The pilot's helmet will monitor brain signals and other medical data, amassing a unique biometric and psychometric information database for each pilot, that will grow the more the pilot flies. The aircraft's AI will work in conjunction with the database to assist the pilot.

*The **Tempest** designs are examining the use of a **software** reconfigurable **wearable cockpit**, employing the use of a hi-tech **'Striker II' helmet** – without a single physical dial or screen in the cockpit*

Future Combat Air System (FCAS), Aka NGF

Participating countries: France, Germany, Spain

The Future Combat Air System FCAS is a sixth-gen jet project announced by France and Germany in 2017 and joined by Spain in 2019. The FCAS program of France is an ambitious collaborative effort between France, Germany, and Spain it intends to develop a family of systems for air dominance, with a sixth-generation fighter known as the Next Generation Fighter (NGF) at its centre. The NGF will have a new engine, new weapon systems, advanced sensors and stealth technology, and the ability to link with unmanned aircraft and connect to an air-combat cloud network.

With an estimated cost of about $106 billion, the first NGF flight was expected in 2027-2029, with manufacturing starting in 2030 and full introduction in 2040. The jet is meant to replace France's Rafales and the Eurofighter Typhoons flown by Germany and Spain. There are also plans for a carrier-based variant for use on France's future aircraft carrier. It is said that the FCAS will also utilise remote carrier drones for a variety of purposes, such as long-range reconnaissance, electronic warfare, and combat support. Thales also is working to improve the multi-ship data link capability of the Rafale as part of the upgrade with the aim of maturing connectivity technologies for FCAS.

Airbus, Dassault and other partners were applying a digital design, manufacturing and services approach. At least Eighteen partners including start-ups, small and medium companies, and research institutes, applied themselves in the pilot phase to work on 14 FCAS projects, including combat cloud, connectivity, the 6TH-generation fighter and remote carriers Etc.

*The FCAS **open system architecture** permits the **integration** of existing systems across other **dimensions** like land, sea, space and cyber*

PROVIDED BY AIRBUS

Dassault, and Airbus, together with their partners MTU Aero Engines, Safran, Indra Systems of Spain, MBDA and Thales now have the contract to demonstrate the initial prortype. The Next Generation Fighter (NGF), with Dassault Aviation as prime contractor and Airbus as the main partner, for Unmanned Systems Remote Carrier (RC) with Airbus as prime contractor and MBDA as the main partner, for Combat Cloud (CC) with Airbus as prime contractor and Thales as the main partner for developing the engine with Safran and MTU Aero Engines as main partner. Spain's Indra Sistemas will lead the avionics pillar of FCAS in partnership with France's Thales and Germany's Future Combat Mission System (FCMS) consortium – consisting of Hensoldt, ESG, Diehl Defence and Rohde & Schwarz.

NGF is expected to be a large, LO design with significant range, internal weapons capacity and networked multi-spectral sensors. The NGF is expected to be compatible with the ASN4G hypersonic air-to-surface nuclear missile currently in development. Various air-to-surface munitions are expected to be added at a later date such as the MBDA Future Cruise/Anti-Ship Weapon (FC/ASW), SmartGlider and SmartCruiser munitions which are under development. The program aims to incorporate renewable energy technologies such as hybrid engines, fuel cells, and electric power systems. Safran will explore variable cycle engine

technology with the goal of maintaining high thrust at supersonic speeds and reducing fuel consumption when cruising at low altitudes.

The FCAS is referred to as a system of systems because of its complex digital network. A combat cloud ensures that all information within the corresponding network is available in real-time to all units involved in a mission. The FACS includes a protected IT system that serves as a digital backbone connecting the combat aircraft and the unmanned components for the exchange of information. The FCAS open system architecture permits the integration of existing systems across other dimensions like land, sea, space and cyber.

Next Generation Air Dominance (NGAD) Fighter, Aka F/A-XX

Country of Origin: US

The US is working on two next-generation fighter aircraft, one for the U.S. Air Force (USAF) and another for the Navy. Both are officially referred to as Next Generation Air Dominance or NGAD, but the Navy's aircraft is often referred to as the F/A-XX, it is intended to complement the smaller Lockheed Martin F-35C Lightning II and replace its existing aircraft such as the Boeing F/A-18E/F Super Hornet fighters. U.S. top companies like Lockheed Martin, Northrup Grumman, and Boeing are believed to be

competing to build the jets, and all have released illustrations of sixth-gen aircraft.

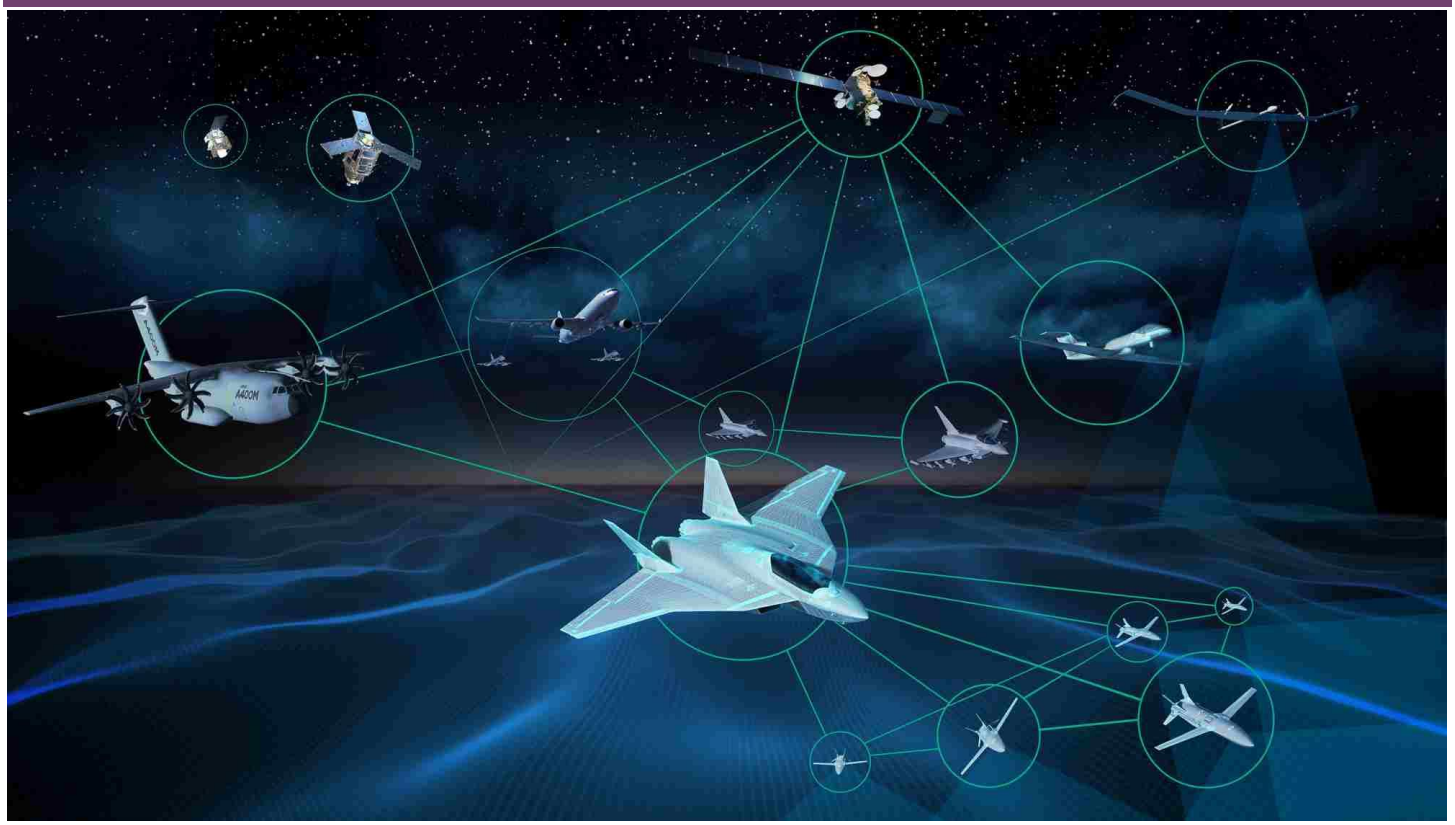
NGAD also includes unmanned aircraft being designed to complement the sixth-gen fighter. Dubbed Collaborative Combat Aircraft, the drones will be networked to the fighter and can be assigned missions, allowing the jet to deploy them while it engages other targets using new long-range weapons like the AIM-260. The U.S. Air Force has acknowledged developing four technologies for the program, including variable cycle engines, new composite materials, and a new suite of sensors, including advanced radar, infrared sensors, and improved electro-optical cameras.

The U.S. Navy launched its sixth-generation F/A-XX program for the first time in 2008. The F/A-XX will have similar features, including the ability to network with unmanned systems, which fits into the Navy's goal of having 60% of its future carrier air wings be unmanned aircraft. The NGAD programme is expected to be inducted into service by 2030. On September 14, 2020, the USAF announced that a prototype aircraft component of the Next-Generation Air Dominance (NGAD) program had flown for the first time.

The NGAD is envisioned to get theatre-wide integration of diverse systems beginning with the primary airborne sensory suite and further including real-time data linking of ground-based detection and ranging technology with sensors aboard primary and support aircraft(s), utilising AI for real-time data translation and rendering geared toward optimising pilot situational awareness. With sensors outreach leading to the extension of existing strike/standoff ranges that may also include the use of lasers, seamless cooperation with ground-to-air defence assets and the ability to deploy aircraft in manned, optionally manned, unmanned and stand-in options are some of the highlighted features of the U.S. NGAD programme. The US is also working on the next-generation bomber B-21, Northrop Grumman describes the newly unveiled B-21 as "the world's first sixth-generation aircraft."

*The NGAD is envisioned to get **theatre-wide integration** of diverse **systems***

MAPPING TECHNOLOGICAL BREAKTHROUGHS FOR DEVELOPING 6TH-GENERATION FIGHTER



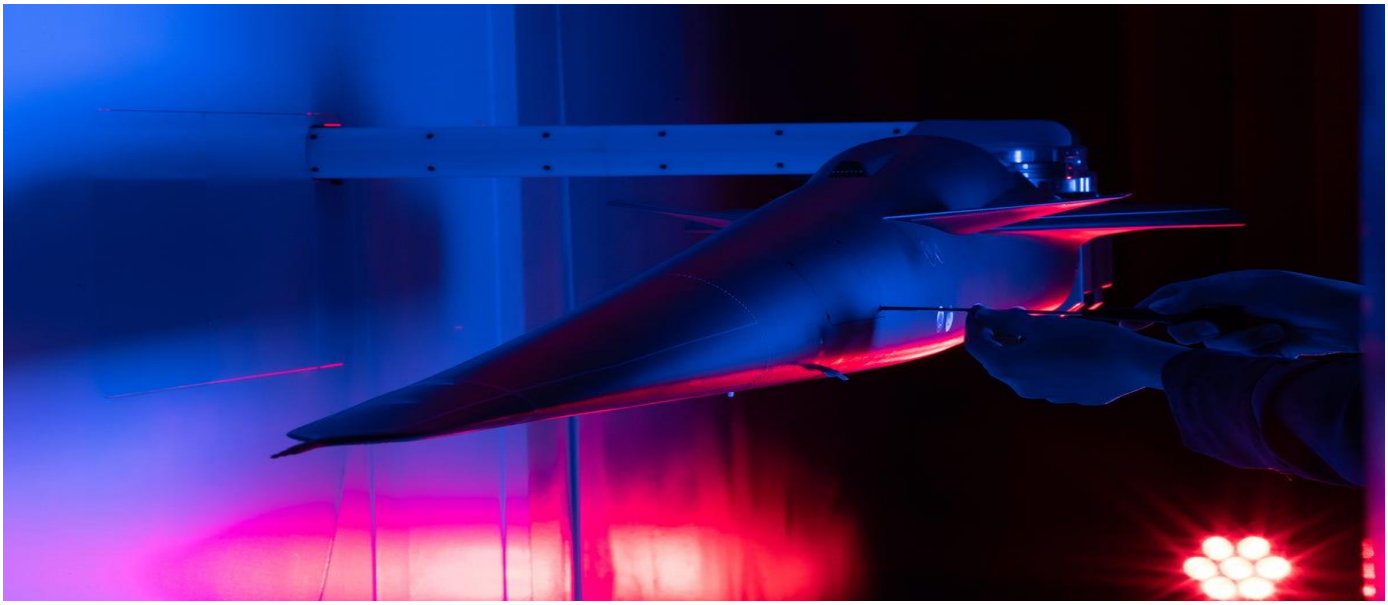
- In December 2019, Leonardo UK demonstrated a next-generation radar warning receiver (RWR) platform it is currently developing for the Tempest, a joint European sixth-generation fighter. RWRs are passive electronic support measures (ESM) systems that enable combat aircraft to recognize as well as identify the source of radar emissions. Leonardo UK's press release says the new RWR technology is "four times as accurate as existing sensors in a package 1/10 the size."

- One of these is a new radar system being developed by Leonardo UK. Called the Multi-Function Radio Frequency System, it is claimed to be able to handle 10,000 times more data than existing systems, processing as much data per second as the entire internet traffic of a city the size of Edinburgh. A number of its subsystems have already been built and it's expected to see airborne testing in a few years.

- Wearable cockpit from BAE Systems replaces most of the physical controls with augmented and virtual reality displays inside the visor of a helmet. Such a cockpit not only reduces the weight and complexity of the pilot area, but it also allows it to be quickly configured to suit a particular mission. When it's fully developed, it may even include a virtual co-pilot that appears as an avatar to interact with the pilot. The gesture-control and eye-tracking feature in the cockpit will enable the measurement of the pilot's workload and the identification of his fatigue and mental stress.

- Leonardo is working on an integrated sensing and non-kinetic effects (ISANKE) and integrated communications system (ICS) for Tempest. It formed a partnership with Mitsubishi Electric to work on the development of JAGUAR sensor technology, which is expected to be used in the development of ISANKE and ICS for the Tempest programme. ISANKE will provide a sensor network across the airframe while ICS will enable the connection of the ISANKE system into the wider system-of-systems within the FCAS. The effectors integrated into the aircraft's sensors will allow the aircraft to engage with a range of non-kinetic effectors such as electronic warfare jamming and directed-energy weapons. The effectors will help in assessing and evaluating incoming threats, and then in managing the deployment of the appropriate method to defeat them.

- Rolls-Royce is working on a new combustion system for the jet engine that will power the Tempest, which will burn hotter than previous designs. This will increase the engine's efficiency and cut down on carbon dioxide emissions. In addition, the company is exploring the use of 3D-printed parts and advanced composite materials that will make the engine lighter, more power-dense, and able to operate at higher temperatures. It will be powered by an efficient power system for increased electrical power generation capability coupled with an intelligent power management system and efficient thermal management to minimise the aircraft's thermal signature.



- The new US jet is an early result of a design, development and production philosophy called digital modelling that greatly expedites the entire process. Digital modelling enables virtually identifying as many potential flaws and limitations as possible prior to choosing the most suitable model and only then building an optimised system. This could eliminate years of repeated prototyping and testing and aims to manufacture a new class of jet fighter in less than five years. If the model succeeds, the US could rapidly build new aircraft using the best technology available and factoring in near-term threats. US-based Collins Aerospace is already providing customised service and sustainment solutions specific to the selected sixth-generation fighters life cycle needs.

- The US Department of Defense's research agency, DARPA, announced on February 13 that a modified F-16 fighter jet had completed an Artificial Intelligence-controlled test flight for the first time in history under the US Air Combat Evolution (ACE) programme. It is believed that the AI will fly the jet and offer real-time flight data, ensuring that the "human pilot focuses on larger battle management tasks in the cockpit." The focus, thus, is still on creating more harmony between human pilots and AI instead of outsourcing combat flight entirely to machines. In 2021 it was reported that an AI agent beat a real US Air Force instructor in a virtual dogfight conducted in flight simulation. In December 2020, the US Air Force tested an AI agent named ARTUμ that controlled and directed radar on a manned reconnaissance plane while carrying out tactical navigation.

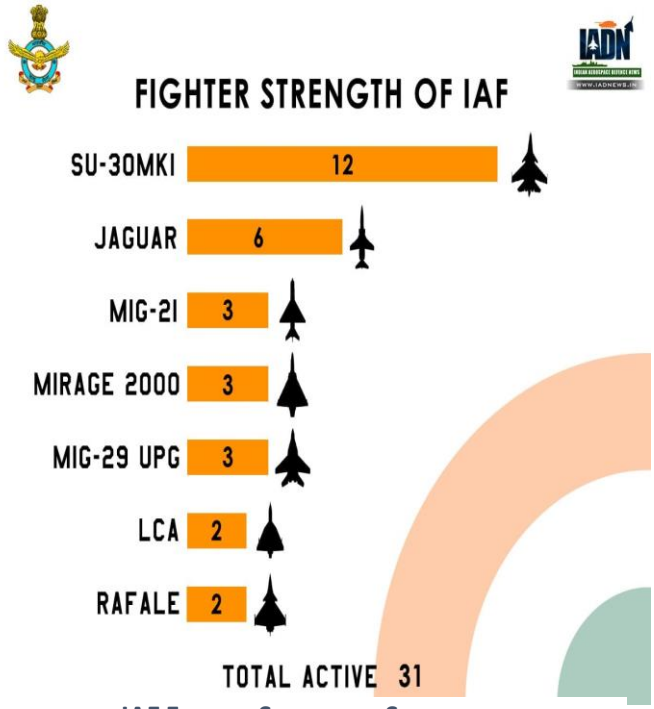
- Airbus demonstrated a successful co-operation of DT-25 target drones and a LearJet aircraft in October 2018, confirming that it had mastered some of the key challenges related to Manned Unmanned Teaming (MUM-T). Airbus subsequently conducted a dual mission group demonstration in 2019. In February 2021, it launched a conceptual loyal wingman (actually a DT-25) UAV from an A400M 'mother ship' aircraft. Last month Airbus showcased automated refuelling of the DT-25 drone.

WAY FORWARD FOR INDIA

Air power is an integral part of the country's defence capabilities and plays an important role in making up a country's deterrence against potential adversaries. However, it is of great concern that India's fighter squadron strength is dropping, primarily due to India's inability to develop a productive aviation industry, which has been reducing India's clout in the domain of air power. Against this backdrop, India is not only experiencing a reduction of combat strength but also seemingly losing on the technological front where countries are fast developing the 6th-generation fighter ecosystem, India is still struggling to introduce 4th-generation fighters in the service.

The Parliamentary Committee on Defence has already recommended the government to go for the off-the-shelf purchase of a 5th gen stealth fighter, as China has not only developed but successfully operationalised its first 5th-generation fighter aircraft J-20. The aircraft entered service in March 2017 with the first J-20 combat unit formed in February 2018, making China the second country in the world and the first in Asia to field an operational stealth aircraft. As per the open source, China is well on track to develop an indigenous 6th-generation fighter. Given the geopolitical scenario which surrounds India with the plethora of threats emerging in the

external security domain, India needs to be at the forefront of fostering excellence in the aerospace sector which is key to national security.



IAF FIGHTER SQUADRON STRENGTH

The IAF Combat strength has reduced to 31 squadrons against the sanctioned 42 combat squadron strength. The already low squadron strength of IAF can fall to dangerous levels by 2030 without MRFA and LCA's timely delivery. The frontline fighters like Mig-29UPG, Jaguars and Mirage 2000s inducted in the 1980s will start retiring by the end of this decade. It is time for India to take a generational leap as the world rapidly moves towards achieving next-generation fighter technologies.

The global security environment is rapidly evolving, and new threats are emerging that require new approaches to defence. There is a global competition among major powers to maintain military superiority, especially in the air domain. Developing a new generation of advanced fighter aircraft is seen as an important way to maintain or gain a competitive edge in this context. Over the past few decades, there have been significant advancements in aerospace technology, including materials, propulsion, sensors, and computing. These advancements have created opportunities to develop new aircraft with improved capabilities that were not possible with earlier aircraft generations.

There are three pathways through which a nation's technological sector can advance—implementing indigenous national-level research and development (R&D) programmes, collaborating with a foreign partner to develop the requisite technology and purchasing foreign technology. It can be done by either one of these or a combination of them all. The case of achieving technologies which make 6th-generation fighter requires

multiple-level engagement, as no one country can provide resource excellence to develop a modern fighter.

India still has the option to participate with France or Britain on respective 6th-generation fighter programmes, however, what could India get on the table while collaborating in these programmes would be nothing more than capital and providing a cost-effective manufacturing base. Given the technological advancement these nations have achieved over the years of investment in developing fighter jet ecosystems, India still has a long road to cover. Even though India may choose to be part of such a programme it would be vital to learn from the leading consortiums about the latest technological advancements as well as modern managerial practices which goes into developing such next-generation platforms.

*It is time for India to take a **generational leap** as the world rapidly **moves towards** achieving **next-generation fighter** technologies*

Participating in a 6th-generation programme may not only give India an insight but also help in order to develop its own 5th-generation AMCA programme, keeping up with the changing time and technological advancements, for India taking a generational leap is not possible while relying only on domestic capabilities as it is highly unlikely that India could master 6th generation technologies at least in the near time when countries would have been flying 6th -generation fighters, India is likely to remain at the stage of developing a 5th- generation fighter.

While the IAF remains a 4th-generation combat force at large, the USAF has already acknowledged that the F-22 will actually begin to sunset in 2030, several decades ahead of earlier projections, there is no possibility in the near future when relying on the domestic aerospace ecosystem that India can produce something which comparable to a fighter like F-22 Raptor, yet alone if India in future decides to buy a 6th-generation fighter off the shelf that will get nothing in terms of technical know-how.

Given the lack of a national aerospace development plan under the aegis of a national security strategy, India's combat readiness is being dwindling over the last decade without any significant foresight towards achieving requisite combat squadron strength and technological benchmarks in the aerospace domain. The US on the other hand has a long-term continuous modernisation development program in place for their F-35 and plans to fly it into the 2070s and beyond that means the fighter may be upgraded to 5.5 to 6th gen fighter given the flexible open architecture which these advanced jets provides allowing them to conduct mid-term upgrades.

The older generation fighter is still going to remain operationally relevant which means India needs to continue its journey of developing 4+ generation fighters and related technologies while also keeping up with the pace of achieving higher-end technologies which goes into the making of a 6th-generation fighter, keeping India ahead of generational race.

It is not necessary to have a large number of advanced stealth fighters in inventory, and they are typically used in limited numbers for specific missions where their unique capabilities are required but the development of 6th generation fighter aircraft is seen as a necessary step in order to address emerging threats, take advantage of new technologies, and maintain a competitive edge in the global security environment.

Some say India will start developing its own 6th-generation fighter after the AMCA programme is completed, sometime in 2030 but that remains a distant dream. Therefore, it is time for the top leadership to come up with effective solutions to stay up with the growing competition of developing next-generation fighters which cannot be done by just relying on our own ecosystem, for which India will require to take a lot of steps in order to get support from the like-minded countries for keeping India ahead of the generational leap. **[End]**

TECHNOLOGY FOCUS

Technologies Which Are Changing the Battlefield In India and Beyond

INDIA'S 'FIRST FULLY DESIGNED AND DEVELOPED' NAVIC CHIP PROMISES TO LOOSEN GPS DEPENDENCE

A chip capable of powering accurate and high-precision navigation, positioning, and timing applications using NavIC, the indigenous satellite-based navigation system, was showcased at the Defence Space Symposium. The Bengaluru-based space technology company Elena Geo Systems' chip functions with NavIC or the Indian Regional Navigation Satellite System

(IRNSS) satellites, indicating progress towards expanding the use of indigenously developed technology in the navigation space.

IIT-I COLLABORATES WITH NASA TO DEVELOP LOW COST CAMERA SETUP

IIT-Indore, in partnership with NASA-Caltech and the University of Gothenburg in Sweden, has designed an inexpensive camera setup that can capture multispectral images of four chemical species in a flame using a single DSLR camera. Previously, capturing such images required a complicated system with four cameras, but this new setup can simultaneously capture multiple spectral three-dimensional images of four chemical species in a flame using only one DSLR camera.

RAKSAKA UGV FROM INDIAN FIRM ASTRA PREMIER

The Unmanned ground vehicle system consists of 4-wheel differential drive, On-board processor, sensors such as Ultrasonic sensors, IR sensors, IMU, GPS, Remote control Unit, Battery and battery management system. It can serve as a robust research platform and has the capability to operate both indoors and outdoors. It has a high-end, compact, computer on-board that allows easy processing of high volume of data gotten from sensors such as 3D LIDARS, GNSS/INS system and Stereo Camera Systems.

CENTRE APPROVES RS 6,003 CRORE NATIONAL QUANTUM MISSION

The Central government approved the National Quantum Mission with a budget provision of Rs 6,003 crores to nurture and scale up scientific and industrial research and development in quantum technology. The mission involves a cost of Rs 6,003.65 crore from 2023-24 to 2030-31.

ELECTRIC AIRPLANES: INDIA, SWEDEN LOOK AT FUTURE AVIATION EVOLUTION

India and Sweden discussed how the two countries can learn from each other and work on the further development of the aviation sector. The discussions were led by Union Minister of State for Civil Aviation General VK Singh and Sweden's Minister for Infrastructure and Housing, Andreas Carlson. Carlson in a meeting with Singh on Friday said: "When India plans investments in infrastructure and aviation, it also needs smaller aeroplanes. They work very hard on it in Sweden."

INDIAN NAVY'S COMBAT CAPABILITIES AUGMENTED WITH SEA-BASED ENDO-ATMOSPHERIC INTERCEPTOR MISSILE TRIAL

The trial of a sea-based endo-atmospheric interceptor missile further augments Indian Navy's combat capabilities aimed at making it a force ready to preserve, protect and promote the country's Maritime interests, said a statement by Indian Navy. This successful firing is a significant milestone towards Aatmanirbhar Bharat, added the Indian Navy. DRDO and Indian Navy on April 21 successfully conducted a maiden flight trial of a sea-based endo-atmospheric interceptor missile off the coast of Odisha in the Bay of Bengal on April 21, 2023.

MIDHANI DEVELOPS CRITICAL COMPONENTS OF TANK IN TITANIUM ALLOYS

To reduce the weight of tanks, MIDHANI has produced Hub: one of the critical components of tank in Titanium alloys using state of art Titanium casting technology. Titanium metal is abundant in the earth's crust and is extracted commercially from the ore minerals rutile (titanium dioxide) and

ilmenite (iron-titanium oxide). Titanium offers properties high strength, stiffness, toughness, low density, and good corrosion resistance. These properties are enabled by a wide variety of titanium alloys ranging from applications at very low to elevated temperatures. This enables weight savings in multiple key aerospace applications and other high-performance applications in the medical, chemical and car industry.

M777 HOWITZERS CAN FIRE UP TO 150KM - GENERAL ATOMICS UNVEILS LRMP HIGH-PRECISION MANOEUVRING AMMUNITION; INDIA MAY BE INTERESTED TO BUY

General Atomics has revealed a new munition for 155mm artillery pieces. It is called the Long-range Manoeuvring Projectile (LRMP). At the Sea Air Space 2023 presentation, a US company representative noted that the 155mm new munition can be used by M777 artillery units, which have a 39 calibre barrel. The maximum range of the LRMP is 150 km. India has

contracted 145 M777 guns from the BAE Systems and over half of them have been inducted.

THE SHAPE OF THINGS TO COME, EMBRAER REVEALS NEW SUSTAINABLE AIRCRAFT CONCEPT

A year on from Embraer's Sustainability in Action in event, which detailed the study of four new aircraft concepts powered by new technologies and renewable energies, the company has been focusing on two 19-30 seater designs for hybrid electric and hydrogen electric propulsion. Guided by the company's 50 year technical expertise, external inputs from airlines, and joint studies with engine OEMs, these two approaches to net-zero offer a technically realistic and economically feasible pathway to net-zero.

INDIA INITIATES DEVELOPMENT OF MASSIVE ARMED XLUUV

India's Ministry of Defence (MoD) has initiated a project to design and develop Extra Large Unmanned Underwater Vehicles (XLUUV). A document released last month by the MoD indicates that the Indian Navy is interested in procuring up to 12 XLUUVs once a prototype is built and clears all trials reported Naval News. According to the document, the XLUUV may have a maximum 'length with payload' of up to 50 meters, width of up to 5 meters, height no more than 10 meters and gross weight without ballast under 300 tons.

DRDO REPORTEDLY COMPLETES TRAILS OF ASTRA MK-2 AIR-TO-AIR MISSILE

According to unconfirmed reports trails of Astra MK-2 almost completed and Limited Series Production started. Integration of Astra MK-1 & MK-2 on Indian Navy MiG-29 K also started reports Next Generation Weapons Technology. Going by the reports, the Astra MK-2 will come with conventional dual pulse rocket motor but with improved grain quality as it is a solid fuel powered missile.

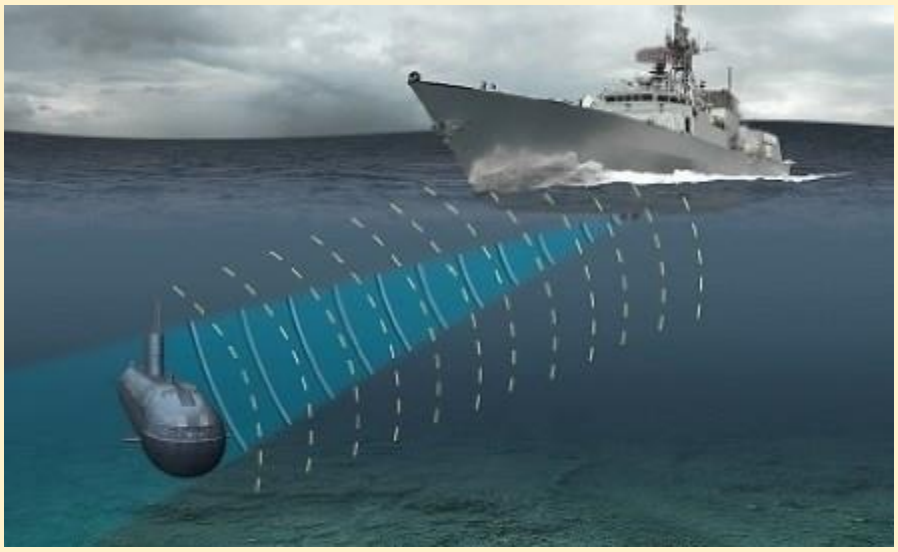
Secondly, the missile will be longer as a result of which more quantity of fuel can be loaded which will result in improved burn time which will correspondingly increase its range. Now combine this with better quality solid propellant the missile should match or even exceed AIM-120D AMRAAM & PL-15. As per some reports in media DRDO is targeting for a range in between 160–180 km.

INS JALASHWA EQUIPPED WITH 30 KW LASER DIRECT ENERGY WEAPON (DEW) UNDERGOING TESTS

In a leap towards building laser weapons capability, India has made a breakthrough in its efforts to develop directed energy weapons, or DEWs, that can potentially end future wars before they begin. India's primary defence research organisation Defence Research and Development

Organisation (DRDO) in 2018, conducted a successful test of a laser system mounted on a truck, and plans are now afoot to create a more powerful laser with a longer range, people familiar with the development told ET. Kalyani Group is also looking to develop or build DEWs in the country.

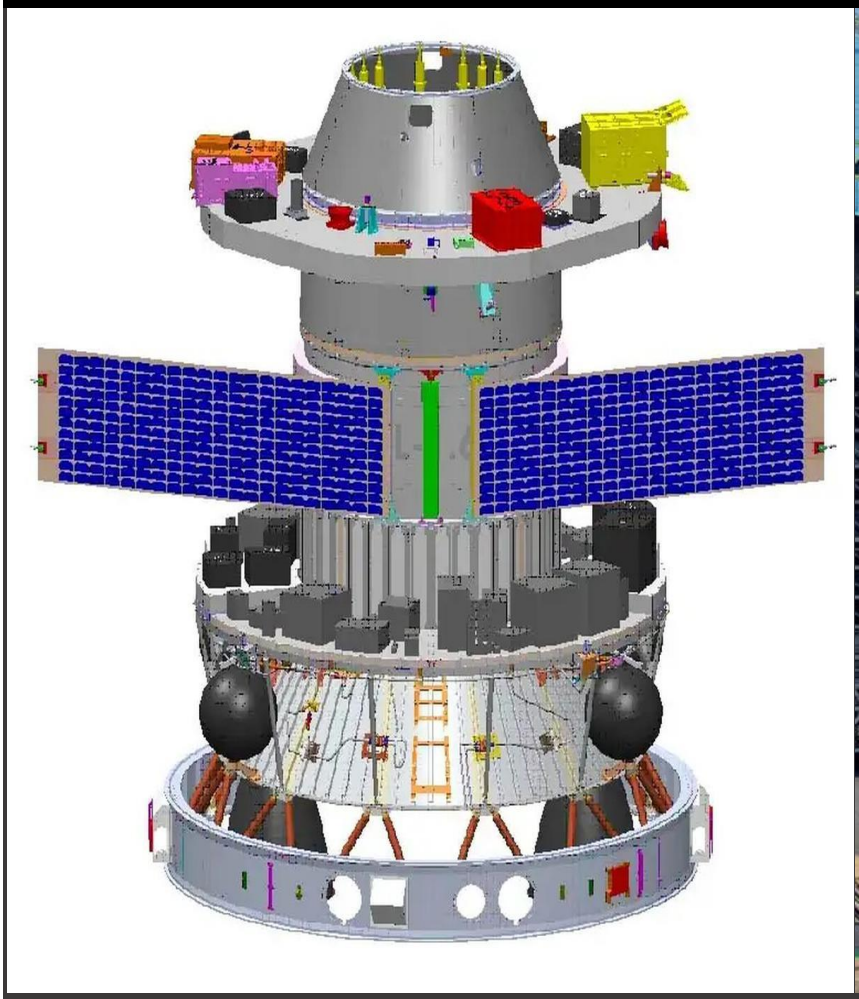
INDIGENOUS HULL-MOUNTED SONAR FOR INDIAN NAVY'S ASW SWC



The 16 Anti-Submarine Shallow Water Craft (ASW SWC) being built for the Indian Navy by the Garden Reach Shipbuilders and Engineers (GRSE) Ltd and Cochin Shipyard Ltd (eight each) will have 'desi' hull-mounted sonar. This fact came to light during the launch of INS Androth, second in the series of the eight ASW SWCs being built by GRSE. This totally indigenous sonar has been specially developed for the ASW SWCs, Commander P.R. Hari (Retd), Chairman and Managing Director, GRSE, said.

SPACE

From The Field of Space And Space Technologies

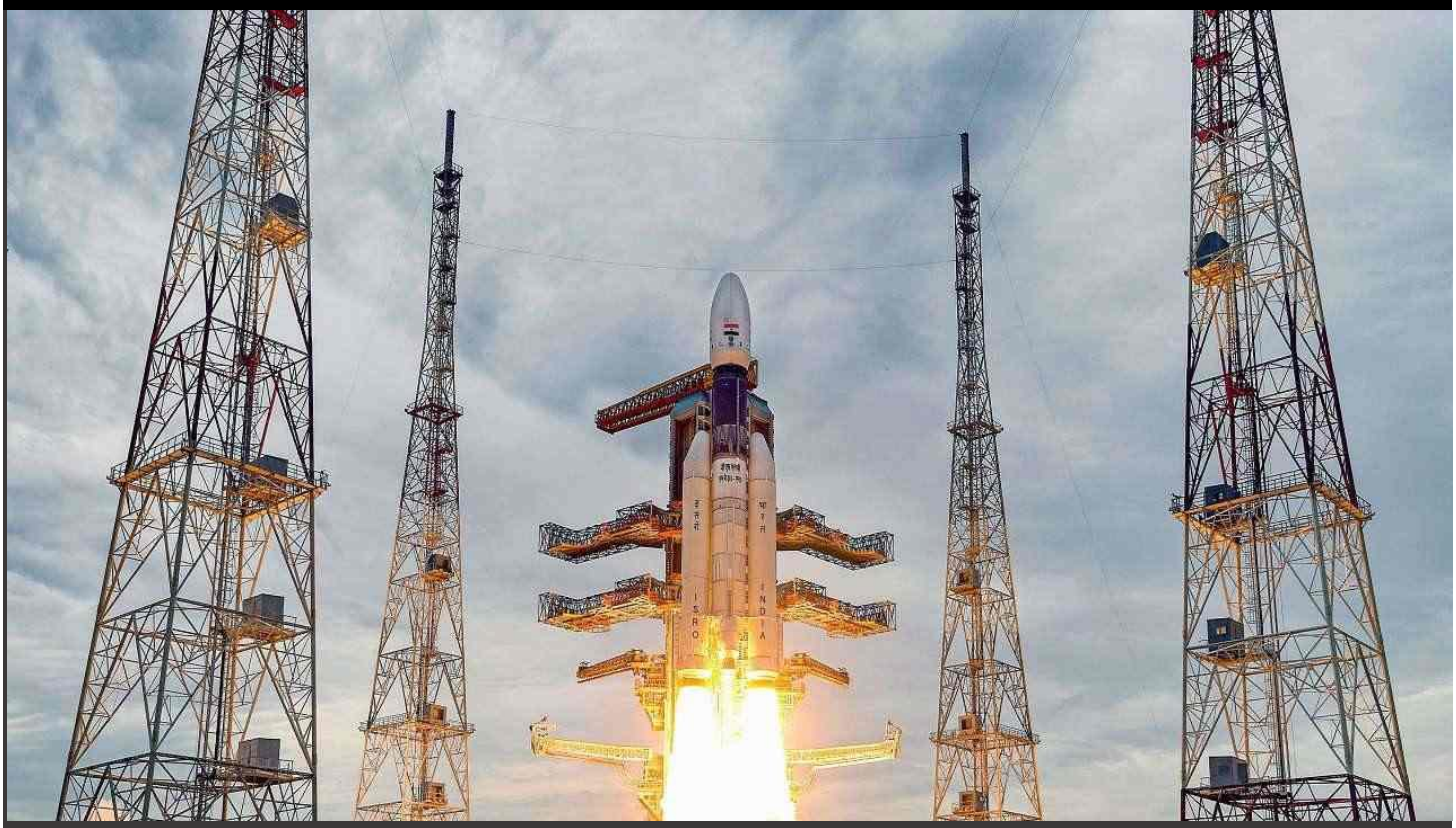


'POEM-2 IS GOING TO WRITE SOME MORE POEMS' SAYS SOMNATH AS ROCKET TURNS INTO A MINI SPACE LAB

ISRO's PSLV Orbital Experiment Module (POEM) 2 has reached space. The PSLV C-55 rocket, which flew into space to launch two Singapore satellites, was converted into a small laboratory after completing the launch

mission. It will float in the sky for a month. It consists of 7 payloads jointly developed by ISRO, the Indian Institute of Astrophysics and start-ups Bellatrix and Dhruva Space. Experiments will be conducted in polar earth orbit with this.

INDIA'S GAGANYAAN MISSION RECEIVES GOVERNMENT APPROVAL



India's Gaganyaan mission has received government approval for a sustained human spaceflight (HSF) program, according to a senior official from the Indian Space Research Organisation (ISRO). Imtiaz Ali Khan, director of ISRO's Directorate of Human Spaceflight Programme, announced the news at the 'Be Inspired: Festival of Ideas' event. The announcement means that the Gaganyaan mission, India's first human spaceflight, is not going to be a one-off event. Khan said that subsequent space missions may include civilians such as doctors and scientists. The first

mission, planned for launch late next year, will involve four Indian Air Force pilots who are currently undergoing extensive training.

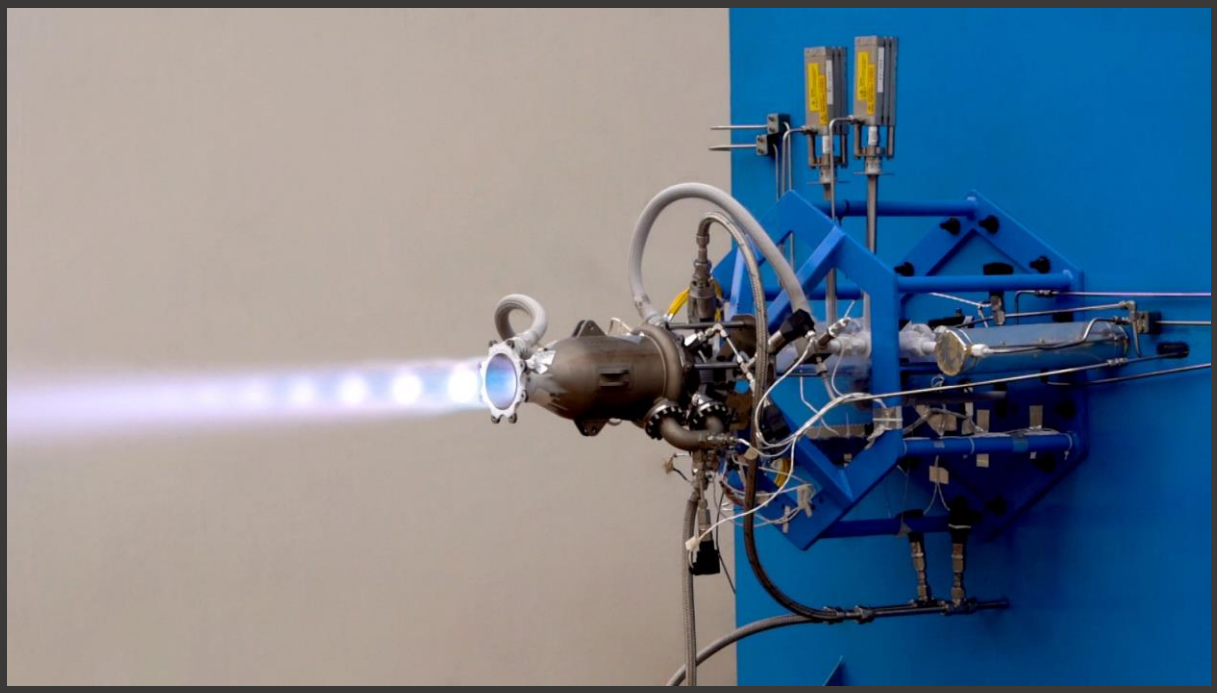
GAGANYAAN NOT ONE-OFF MISSION, GOVT APPROVED SUSTAINED HUMAN SPACEFLIGHT PROGRAM: ISRO OFFICIAL

India's Gaganyaan mission will not be a "one-off" mission as the government has granted approval for a "sustained human space flight program", a senior ISRO official said. Addressing the 'Be Inspired: Festival of Ideas' event here, Imtiaz Ali Khan, director of ISRO's Directorate of Human Spaceflight Program, said the follow-on space missions of Gaganyaan may include civilians such as doctors and scientists.

ISRO WANTS TO SEND CIVILIAN SCIENTISTS, DOCTORS TO SPACE TO RESEARCH MICROGRAVITY

India’s first attempt to send human beings to space – the ambitious Gaganyaan mission – will be the first of many such crewed missions to space. The ISRO is now drawing up a new criteria to recruit astronauts from outside the defence staff for its future missions. Recently, ISRO successfully conducted qualification tests of Cryogenic Engine for the Gaganyaan program for a duration of 720 seconds at ISRO's Liquid Propulsion Systems Centre.

SKYROOT AEROSPACE SUCCESSFULLY TESTS 3D-PRINTED DHAWAN-II ADVANCED INDIGENOUS CRYOGENIC ENGINE



Skyroot Aerospace, India's top private aerospace company, successfully fired an advanced fully 3D-printed cryogenic engine, Dhawan-II. The engine roared to life for 200 seconds as the endurance test demonstrated the agility of the 3D-printed structure est to power the company's Vikram-II rocket.

BOOSTING SPACE DEFENCE: GOVT, PRIVATE SECTOR GET TOGETHER

In order to examine ways and means to boost India's space defence capabilities, the Indian Space Association (ISpA), which represents the private space industry, and the Defence Research and Development Organisation (DRDO) have organised the first edition of DefSpa, a three-day symposium on space defence here from April 11-13.

The idea behind the event is to create a platform for all stakeholders interested in India's military space capability by bringing together experts from multiple domains to discuss the latest trends and challenges in that domain. The focus will be on delivering space domain awareness and satellite communications to enhance military operations, and to address issues related to securing funding for new space capabilities, expanding international partnerships and developing a Space Defence Strategy in line with the National Space Strategy.

ISRO CHAIRMAN SOMANATH CONGRATULATES RLV-TD PROJECT MANAGEMENT TEAM FOR SUCCESSFUL LAUNCH TEST

ISRO chairman Dr S. Somanath on Sunday congratulated Reusable Launch Vehicle (RLV) project management team for successfully conducting the reusable launch vehicle (RLV) autonomous landing mission (RLV-LEX) at the Aeronautical Test Range (ATR) in Karnataka's Chitradurga. ISRO Chairman said that for the first time in the world, with the help of a helicopter, a rocket-like RLV was left in the sky and returned to the ground successfully.

PURSUING SPACE CAPABILITIES SAYS IAF CHIEF

The Indian Air Force (IAF) is pursuing the development of niche technologies in the field of space-based capabilities, data linking and artificial intelligence-based decision support system, said IAF Chief Air Chief Marshall VR Chaudhari. He was speaking at an event, where he also mentioned about the future wars, saying: “We understand the imperative nature of joint planning and execution in future wars and are keen on integrating the efforts of the three services.” This was in reference to pending integration of the three services.

ISRO REVEALS NEW RENDITION OF CHANDRAYAAN-3 MISSION

Chandrayaan-3 is a follow-on mission to Chandrayaan-2 to demonstrate end-to-end capability in safe landing and roving on the lunar surface. It consists of Lander and Rover configuration. It will be launched by LVM3 from SDSC SHAR, Sriharikota. The propulsion module will carry the lander and rover configuration till 100 km lunar orbit. The propulsion module has Spectro-polarimetry of Habitable Planet Earth (SHAPE) payload to study the spectral and Polari metric measurements of Earth from the lunar orbit.

INTERNATIONAL RELATIONS

Covering International and Geopolitical Matters

ASIA AND PACIFIC REGION

WITH 'OPERATION KAVERI', INDIA PUSHES NON-STOP APPROACH FOR RESCUE OPERATION

While the skirmishes in Sudan are becoming violent day by day as the International community has failed to establish a ceasefire, India is actively evacuating its citisens from Sudan with a non-stop approach. Now, the evacuation operation of India does not remain limited to its citisens as India has recently rescued a French staffer and her family from war-torn Sudan.

The French authorities have thanked India for the generous step. In April 15, 2023 when violence started erupting in Khartoum with reporting deaths of more than 3000, India immediately deployed its Air and Naval assets for the rescue of the citizens.

AMMUNITION USED IN 'POONCH TERROR ATTACK' HAS AFGHANISTAN LINK

As per the intelligence report of central agencies, the ammunition that was found been used by terrorists in Poonch terror attack, belong to Afghanistan and had been purposely smuggled to Jammu-Kashmir for terror activities. The local police have also hinted about the US origin of bullets, being in use in Afghanistan. According to an American report published this year, the militants in Kashmir were seen carrying M4, M16 and US-made other ammunition.

PHILIPPINES PATROL VESSEL SURVIVES A NEAR-COLLISION WITH A CHINESE SHIP

According to international sources, a Philippines patrol vessel and a Chinese coast guard ship were about to collide in the South-China Sea after both came in front of each other. The Philippines authorities have claimed that China always attempts to block the ways for Philippines vessels to prevent them from patrolling, this time the Chinese ship came within 45 metres of the Philippines patrolling vessel for deliberately framing an act of collision.

SOUTH KOREA PUSHED UNITED STATES FOR DEFENCE AND NUCLEAR COOPERATION

Amid the fear of North Korea's continuous nuclear tests, South Korea has locked the deal with United States for defence and nuclear cooperation. As per the American reports, it has noted that North Korea has developed tactical weapons to target South Korea and also, it has advanced the capabilities of its weapons to reach American mainland. Under the new deal, the US will make its defence commitments more visible by sending a nuclear-armed submarine to South Korea for the first time in 40 years, along with other strategic assets, including nuclear-capable bombers.

AUSTRALIA ANNOUNCED DEFENCE REFORM

Australia undergoes major defence reforms to strengthen the capabilities of its nuclear-powered submarines as China advances its aggression near the region. The Austalian authorities have announced about the 'key tool' in their new strategy which is the development of stealthy nuclear-powered submarines and long-range missiles (both air and land launched). The Australian Defence Ministry will boost its naval capabilities especially in the country's northern region where China is peaking with its eye.

IRAN AND SAUDI ARAB HOLDS TALK FOR FIRST TIME IN DECADE

Despite being rivals for a long time, Saudi Arabia and Iran holds diplomatic talks for the first time in years signalling out a possible way of friendship between the two countries. As per International sources, China has been named responsible for pushing both Saudi and Iranian regime in the verge of warm diplomatic talks with an attempt of ending years old rivalry. The countries have also discussed for a possible bilateral tie that could happen in a near future.

INDIA AND JAPAN TO HELP SRI LANKA IN RESTRUCTURING

India and Japan have announced for helping out Sri Lanka in restructuring the nation from badly hit economic recession. As per the sources, France is likely to join India and Japan for the assistance. The creditor countries (India, Japan and France) will conduct the discussions for debt-recovery and economic restructuring of Sri Lanka where representatives from World Bank and IMF would also hold the talks. China's participation in the event remains uncertain.

AMERICA (NORTH AND SOUTH)

USA ANNOUNCED NEW $325 MILLION MILITARY PACKAGE FOR UKRAINE

The United States has announced another military aid for Ukraine worth $325 million including anti-armor weapons, HIMARS precision rocket system, anti-tank mines, new artillery rounds and more than nine million of rounds of small arms & ammunition. As per the US Department of Defense, United States has assisted Ukraine with more than $35.4 billion package of aid since the Nation faced Russian invasion.

INDIA AND LATIN AMERICA TO BOOST DIPLOMATIC RELATIONS AND ENERGY TIES

India is set to host a big Latin American conclave in New Delhi in August 2023 for locking important deals with Latin American countries. As per the statements by Janaina Tewaney Mencomo, the Foreign Minister of Panama,

Panama has all set to join the International Solar Alliance (SIA) following ahead the possible visit of Foreign Minister S. Jaishankar in the region. Other Latin American countries are like to join the ties with India in the area of energy this year.

RELATIONS BETWEEN BRAZIL AND USA BECOMES COLD

After Brazilian President Luiz Inacio Lula accuses the USA for encouraging war in Ukraine, the White House has condemned the statements with a bitter response stating that Brazil is 'parroting the Russian and Chinese propaganda. Earlier in the months, Brazil proposed to get Russia and Ukraine on the mediation table, however, the Brazilian leadership made statements against the USA by blaming the country for inciting war.

RUSSIA AND BOLIVIA SET NEW TRADE TIES, DITCH DOLLARS

The Russian Foreign Minister, Sergey Lavrov while on his visit to Bolivia, announced new trade deals and allowed transactions in Russian Rubles and Bolivian Boliviano between two countries by ditching the conventional use of US Dollars. Following the visit of the Russian Foreign Minister, the Russian Ambassador to Bolivia Mikhail Ledenyov officially stated that 'Financial operations can now be carried out using national currencies. Direct correspondent accounts in Rubles and Bolivianos was opened between Gazprombank and Union, the largest Bolivian state-owned bank'.

CHILE PLANS TO NATIONALISE ITS LITHIUM ASSETS

By holding the largest lithium reserves in the world, Chile plans to acquire its lithium-producing industry with the aim to boost Chile's economy. "Lithium" is a key metal used for making electric vehicle batteries and the lithium industry in Chile is majorly under private-owned industries. However, the plan is facing political and technical challenges as per the claims made by political analysts based in Chile. The industrialists are fearing the possible outcome of political rivalries as the analysis suggests.

MEXICAN DURG TRAFFICKING ROW: USA CHARGED 28 MEMBERS INCLUDING SEVERAL CHINESE CITIZENS

The US Department of Justice has charged 28 members of the Sinaloa cartel, one of the most powerful drug trafficking organisations in Mexico, for running illegal drug labs and supplying harmful drugs. As per the charge report, many Chinese citisens are also seen involved in supplying precursor chemicals required to make "fentanyl". The United States has arrested 8 drug peddlers from a total number of 28, while others are absconding.

EUROPE

EUROPEAN UNION TO SEND MISSION TO ASSIST MOLDOVA AMIDST RUSSIAN FEAR

The European Union (EU) has announced to send a non-military mission to Moldova to assist the country to fight against the Russian threat. Recently, the Moldovan authorities accused Russia of the attempt of destablising the government in Moldova. The delegation from the EU will aim to provide Moldova with cyber and political capabilities against any Russian attempt. As per the sources, Moldova has applied for EU membership last year fearing Russian power.

FRANCE- INDIA BUSINESS SUMMIT HELD IN APRIL TO CELEBRATE 25 YEARS OF BUSINESS FRIENDSHIP

On the occasion of completing 25 years of business friendship between India and France, a summit was held to bolster further ties to cooperate in the field of defence, technology and green energy. The summit also discussed the cooperation of both countries while dealing with the Indo-Pacific region. The Indian delegation was co-chaired by Piyush Goyal, union minister of Commerce and industry, who was also on a visit of France from April 11th to 13th.

GERMANY SHUTS DOWN ITS NUCLEAR POWER PLANTS

Germany has made the nuclear exit by shutting down its last three nuclear power plants. According to the sources, Germany has pledged to shut down all of its nuclear power plants after 2011 Fukushima disaster in Japan where radiation was spewed in the air causing major harm to the human world. “The risks of nuclear power are ultimately unmanageable,” says Environment Minister of Germany Steffi Lemke.

TURKEY AND HUNGARY ASKED BY USA TO RATIFY SWEDEN’S NATO MEMBERSHIP

The United States has urged Turkey and Hungary to ratify Sweden’s NATO membership which is pending for since long as Turkey is blocking the way. The relations between Turkey and Sweden became cold after Qur'an burning incident and Kurd issues, and in response, the Turkish leadership

has attempted all possible ways to block Sweden's way to joining NATO. However, the United States has now urged Turkey as well as Hungary to forget the rivalries and clear the path for Sweden to become a permanent member of NATO.

AFRICA

SUDAN CRISIS: VIOLENCE BECAME UGLY, USA THREATENS SANCTION

The skirmishes in Sudan became more violent with 100,000 civilians already fled the country since the beginning of the conflict. The American government has threatened the country with aggressive sanctions if a ceasefire does not happen soon. Diplomatic efforts are initiated by International authorities to bring the rivals to the negotiation table, though the results seem in vain as the violence continuous. Hundreds of deaths are already reported with a large number of displacements.

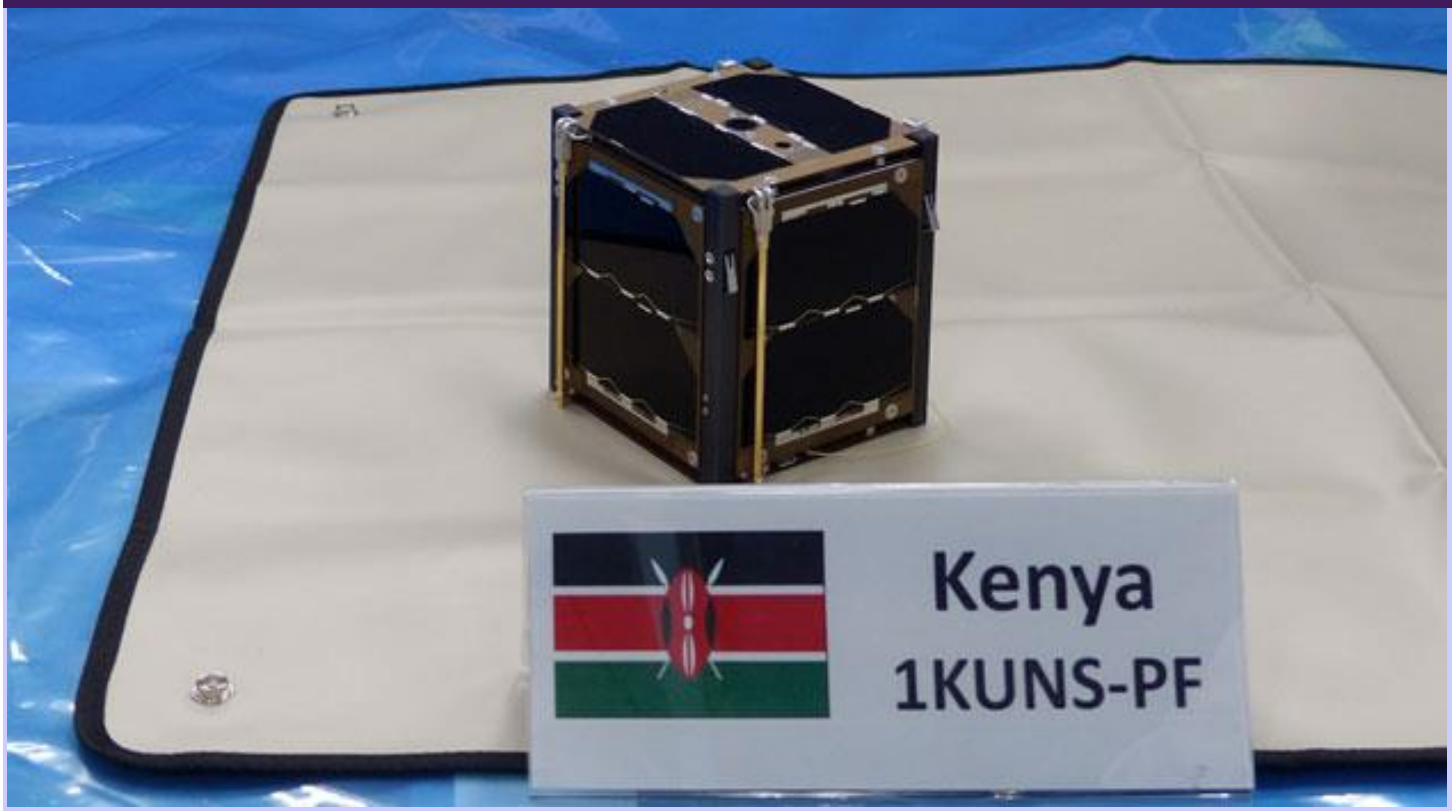
MALI GETS MILITARY ASSISTANCE FROM CHINA

Mali has received the delivery of military equipment from China to boost the defence capabilities against terrorist groups currently fighting against the government in many of Mali states. The delivery included armoured and tactical vehicles, logistical vehicles, medical ambulances, individual and collective weapons and individual combatant equipment. Earlier to the Chinese equipment delivery, Mali has also received military assistance from Russia and Turkey to counter the terror threats.

FIRST BRICS MEETING ON REMOTE SENSING SATELLITE CONSTELLATION HELD ON APRIL 13

The first working group meeting on BRICS remote sensing satellite constellation was held by video conferencing with representatives from all member countries joining the meeting. In the meeting the annual data exchange plan and BRICS space capabilities were discussed along with the possible road-map of enhancing BRICS space technology. South Africa would hold the rotating presidency of BRICS constellation.

KENYA LAUNCHES ITS FIRST SATELLITE IN SPACE



Kenya has launched its first operational satellite in space from a Space X rocket from US state of California. The Kenyan Taifa-1 (Nation-1), designed and developed by Kenyan researchers, is aimed to provide data for agriculture and environmental monitoring in Kenya to help the country revived from the prolong drought. The launch is celebrated as an important milestone in Kenya as per the sources.

MILITARY EXERCISES

India participating in international and bilateral military exercises

EXERCISE AJEYA WARRIOR – 2023

The 7th edition of joint military exercise "AJEYA WARRIOR-23" between India and the United Kingdom is being conducted at Salisbury Plains, United Kingdom from 27 April to 11 May 2023. It is a biennial training event with the United Kingdom which is conducted alternatively in the United Kingdom and India, the last edition was held at Chaubatia, Uttarakhand in October 2021. Soldiers of the 2 Royal Gorkha Rifles from the United Kingdom and Indian Army soldiers from the BIHAR Regiment are participating in the exercise.

The Indian Army contingent arrived at Brize Norton on 26 April 2023 by an Indian Air Force C-17 aircraft with indigenous weapons and equipment. The scope of this exercise involves a Command Post Exercise (CPX) at the Battalion level and Company level Field Training Exercise (FTX). During the exercise, participants will engage in a variety of missions testing their operational acumen in various simulated situations; showcasing and refining their tactical drills, and learning from each other's operational experience.

INIOCHOS-23

The Indian Air Force (IAF) is participating in Exercise INIOCHOS-23, a multi-national air exercise hosted by the Hellenic Air Force (Greece). The exercise is being conducted at the Andravida Air Base in Greece from 24th

April 2023 to 04th May 2023. The Indian Air Force is participating with four Su-30 MKI and two C-17 aircrafts.

EXERCISE ORION

Indian Air Force is participating in Exercise Orion at Mont-de-Marsan in France from 17 April to 05 May 2023. The IAF will participate in this multi-national exercise with a contingent comprising of four Rafales, two C-17s, two ll-78MKI aircraft and 165 air warriors. This would be the first overseas exercise for the IAF's Rafale aircraft. Besides the IAF and the FASF (France), Air Forces from Germany, Greece, Italy, Netherlands, United Kingdom, Spain and the United States of America would also be flying in this multilateral exercise.

EXERCISE COPE INDIA 2023

Exercise Cope India 23, a bilateral Air Exercise between the Indian Air Force (IAF) and the United States Air Force (USAF) was held at Air Force Stations Arjan Singh (Panagarh), Kalaikunda and Agra.

The first phase of the exercise commenced on 10th April 2023. This phase of the exercise focused on air mobility and involved transport aircraft and Special Forces assets from both the Air Forces. Both sides fielded the C-130J and C-17 aircraft, with the USAF operating an MC-130J, as well. The

exercise also included the presence of Japanese Air Self Defence Force aircrew, who participated in the capacity of observers.

The next phase commenced at Kalaikunda on 13 April 2023. This segment of the exercise witnessed the participation of B1B bombers of the United States Air Force (USAF). F-15 fighter aircraft of the USAF joined the exercise subsequently. The Indian Air Force (IAF) element included the Su-30 MKI, Rafale, Tejas and Jaguar fighter aircraft. The exercise was supported by aerial refuellers, the Airborne Warning and Control System and Airborne Early Warning and Control aircraft of the IAF. The exercise concluded on 24 April 2023. This joint exercise provided a valuable opportunity for the participants of all countries to exchange ideas and imbibe best practices through interactions, exchanges & combined missions.

Exercise KAVACH

India through Andaman and Nicobar Command (ANC) conducted a large-scale Joint Military Exercise 'Ex KAVACH' involving the assets of the Indian Army, Indian Navy, Indian Air Force and Indian Coast Guard. The exercise was conducted between February 23, 2023 and April 07, 2023.
The exercise was aimed at fine-tuning joint warfare capabilities & Standard Operating Procedures (SOPs) and enhancing interoperability and operational synergy between the forces. Elements of Army, Armed Forces Special Operations Division (AFSOD), Special Forces of the Navy and Amphibious troops of the ANC, participated in the multi-domain exercise involving amphibious landing, air-landed operations, heli-borne operations and rapid insertion of the Special Forces from the mainland on a remote Island of the Andaman and Nicobar Islands.

SLINEX-23

The 10th edition of India-Srilanka bilateral maritime exercise SLINEX-23 was held in Colombo from 03 - 08 April 2023. The exercise was conducted in two phases: the Harbour Phase from 03-05 April 2023, followed by a Sea Phase from 06-08 April 2023. Indian Navy was represented by INS Kiltan, an indigenous Kamorta class ASW corvette and INS Savitri, an Offshore Patrol Vessel. The Sri Lanka Navy was represented by SLNS Gajabahu and SLNS Sagara. Maritime Patrol Aircraft, helicopters and Special Forces from both sides also participated in the exercise.

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