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"Only Air Power can defeat Air Power. The actual elimination or even stalemating of an attacking Air Force can be achieved only by a superior Air Force."

- Alexander P. de Seversky

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Opinions and Analysis

With 25 airfields capable of launching ops, IAF well placed against Chinese air force in Himalayas

Air Marshal Anil Chopra (Retd)

Director General, Centre for Air Power Studies | 18 November 2021

Source: Firstpost | https://www.firstpost.com/india/iaf-well-placed-against-chinas-pla-in-the-himalayas-with-25-airfields-capable-of-launching-ops-10146951.html

Representational image. ANI

Notwithstanding the continuous flood of information that the Chinese state-controlled media handles are releasing about the new aerial platforms and technologies that are being developed by them, the Indian Air Force (IAF) is fairly well placed against the People's Liberation Army Air Force (PLAAF). One needs to remember that China is nearly 2.5 times the size of India. Its immediate strategic and tactical interests are in the South China Sea (SCS) and Western Pacific. It has to contend with a much more powerful US and also many free world countries that are grouping to take them on.

China effectively has three airfields close to eastern Ladakh, and around eight in Tibet. One more is coming up in Xinjiang. They are trying to upgrade infrastructure but have the disadvantage of very high altitude.

IAF's Current Broad Capabilities

As per open information, the IAF has around 32 fighter squadrons. These broadly include two of Rafale, 12 Su 30MKI, four MiG 21 Bison, three each of MiG 29 and Mirage 2000, six of Jaguar, and two of LCA. IAF's induction of both Rafale squadrons will complete by early 2022. The aircraft is clearly superior to China's J-10, J-11, and Su-27 fighter jets. Armed with long-range Meteor and MICA beyond visual range (BVR) air-to-air missiles, the Rafale fighters are expected to pose a significant threat to Chinese aerial assets.

The SCALP cruise missile and Hammer glide bombs have very high accuracy. Rafale also has the best electronic warfare suite in the region. The Sukhoi Su-30MKI is the IAF's primary air superiority fighter with capability to perform long range air-to-ground strike missions. Mirage 2000 and the MiG 29 have all been upgraded. With 11 C-17 and C-130 each, 17 IL-76, and over 100 upgraded An-32, IAF has significant global reach and cargo and troop lift capability. Similarly, having inducted 15 Boeing Chinook heavy-lift and 22 Apache AH-64E attack helicopters, and with already a significant fleet of 240 Mi-17 series medium-lift helicopters and nearly 100 ALH variants and smaller Chetak/Cheetah fleets, IAF is in a good position for rotary wing assets.

IAF has only three large AWACS aircraft and two indigenous DRDO developed AEW&C aircraft. Similarly, IAF has six IL-78 Flight Refueling Aircraft (FRA). Both these fleets need augmentation for a continental size country like

India which has also to cover the Indian Ocean Region (IOR).

India has a good chain of integrated radars to support network centric offensive and defensive operations. IAF's legacy surface-to-air missile systems like the SAM-3 Pechora and SAM 8 OSA-AK are being upgraded. With the induction of a large number of indigenous Akash AD systems, and also, to start arriving soon, five S-400 systems from Russia, the AD coverage will be significant. To cover the large Chinese border, more systems are being inducted. With the induction of the indigenous Astra and BrahMos, the IAF has a significant aerial weapons inventory.

The future is unmanned. Artificial Intelligence-supported autonomous systems will fly independently or in conjunction with each other in a swarm or with manned aircraft as a team. IAF has a significant number of UAVs. More are being developed indigenously or being acquired.

Expanding PLAAF

PLAAF has a larger fleet of fighter aircraft and air defence systems. Of its nearly 1,700 fighter/bomber aircraft, only around 800 are 4th generation plus. PLAAF already has around 40 fifth-generation J-20 fighters, and targets to have 200 of these by 2027. Meanwhile, the second FC-31/J-31 development is being accelerated. PLAAF has a strategic bomber fleet with 120 H-6 bomber variants, each carrying six cruise missiles. They also have relatively larger numbers of AWACS and FRA. China has an edge with a huge surface-to-surface missile force.

China's biggest strength is its indigenous aircraft industry that produces all types of aircraft and advanced helicopters. China has a huge indigenously built UAV fleet. China also has significant maritime air power, with the PLA Navy (PLAN) having two operational aircraft carriers and nearly 500 aircraft. Two more carriers are under construction and two further, larger ones, on drawing boards. That will add more air power.

IAF's Strategic Reach

IAF is looking at reach from the Persian Gulf to the Straits of Malacca, using long range aircraft supported by FRA and AWACS. More of these are being acquired. More airfields are becoming operational in the southern peninsula, and in Andaman and Nicobar Islands. This along with in-flight refuelling will add to the reach. The Lakshadweep islands are also being developed strategically. IAF is regularly exercising and increasing interoperability with major air forces of the world.

IAF's Operational Capabilities across Himalayas

IAF is very well placed with nearly 25 airfields capable of launching operations against China. China effectively has three airfields close to eastern Ladakh, and around eight in Tibet. One more is coming up in Xinjiang. They are trying to upgrade infrastructure but have the disadvantage of very high altitude. IAF will be able to launch a much larger number of missions. For a long time, India's military assets and infrastructure were Pakistan border-centric. This is fast changing, for both infrastructure build up and assets positioning. While border roads and connectivity are being improved, IAF has upgraded its Advanced Landing Grounds (ALG) near the China border.

All IAF airfields are getting hardened aircraft and equipment shelters. IAF now has a significant

number of Su-30 MKI squadrons facing China. Also, the new acquisitions like Rafale, C-130 J, Chinook and Apache helicopters have all been located in the eastern sector. The same is also applicable to air defence systems and weapons positioning.

Way Ahead

While IAF has been modernising steadily, more needs to be done. This is more so because India has a two-front threat from formidable adversaries. IAF must get back to the authorised force levels of 42 squadrons. Some often suggest that since Rafale and Su-30 MKI can achieve much greater effects than the older MiG 21s, why IAF should continue to seek 42 squadrons. The argument is flawed. India's adversaries already have fifth generation fighters. They are not cutting down numbers. Type of aircraft and weapon platforms must be comparable to the adversary. IAF also urgently needs additional AEW&C and FRA. The future being unmanned, IAF needs to invest more into combat UAVs.

India has also to defend itself against a possible sizeable Chinese surface-to-surface missile (SSM) attack. IAF will need more air defence SAM systems of the S-400 and there is a need to accelerate inductions of larger numbers of indigenous air defence systems. It is important to have a larger ammunition and missiles stocking. SSMs and cruise missiles are going to be important. India has a good missile programme. The Prithvi, Agni, BrahMos, Akash and Astra missiles are a success, and newer variants must be hastened.

India needs to invest more in game-changer technologies. These include cyber and electronic warfare, artificial intelligence, unmanned systems, hypersonic, among others. Hypersonic flight and weapons will be difficult to engage. They will act as force multipliers against high-value targets. There is a lot of action in Directed Energy Weapons. Lasers that can burn incoming missile electronics or dazzle electro-optical sensors.

For India to become significant, it must also master aircraft engine, and AESA radar technologies. Joint venture route is the best to imbibe high-end technologies. We need very long range weapons, including aerial missiles with around 400 km ranges. Similarly air-launched cruise missiles with ranges of around 1,500 km.

There is a backlog of modernisation. The obsolescence sets in much faster for aerial systems. To stem the increasing gap with China, India perhaps needs to increase its defence allocations, from current 2.15 percent of GDP to around 2.5 percent. IAF is well trained and operationally well exposed. IAF has a clear advantage in terms of the number of missions it can launch across the Himalayas. IAF can well match the PLAAF, but once the numbers increase, IAF will be much better placed. Time to act is now.

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Space Security Governance: Could a New Working Group Narrow the Divide?

Rajeswari Pillai Rajagopalan | 04 November 2021

Source: The Diplomat | https://thediplomat.com/2021/11/space-security-governance-could-a-new-working-group-narrow-the-divide/

Credit: Dipostphotos

Space security governance has been under stress for some time. Growing space security threats in the form of counter-space capabilities including kinetic kill anti-satellite (ASAT) weapons are a new reality, and if not halted, these developments could eventually make space inaccessible.

A number of resolutions were taken up in the U.N. General Assembly's First Committee earlier in the week, including a U.K.-sponsored resolution (with 36 co-sponsors), "Reducing space threats through norms, rules and principles of responsible behaviors"; one co-sponsored by Russia, China and the United States, "Transparency and confidence-building measures in outer space activities"; and additional resolutions, "Further practical measures for the prevention of an arms race in outer space," and "No first placement of weapons in outer space."

The U.K.'s co-sponsored resolution (A/C.1/76/L.52), part of the Preventing an Arms Race in Outer Space (PAROS) agenda, to establish a new U.N. Open Ended Working Group (OEWG) on outer space security, was voted through on November 1. The resolution found overwhelming support with 163 states voting for it, eight against and nine abstentions. China, Iran, North Korea, and Russia were among the countries that voted against the resolution. India, Israel, and Pakistan were among those that abstained from voting.

With the wide-ranging support for the U.K.-led resolution at the First Committee, it can be expected to be approved next month in the U.N. General Assembly. Not much change is expected between the First Committee and the General Assembly vote.

There are genuine concerns that if steps are not taken to halt the current trend toward space weaponization, space could become an active warfighting domain.

The U.K.-led resolution is a follow-up to last year's U.K. resolution 75/36 on "reducing space threats through norms, rules and principles of responsible behaviors," which kickstarted a new debate about what constitutes threatening and destabilizing space behavior. The U.K. also made it clear that the threats are not to be limited to behavior in space alone, but could be anywhere including ground infrastructure, signals, and data links which together constitute the space infrastructure. As the U.K.'s minister responsible for space, James Cleverly, noted, such threatening behavior needs to be addressed

because of the possibilities of miscalculation, leading to escalation and conflict. The U.K. stated that the current resolution is an effort to ensure that an open international order extends to outer space as well. Interestingly, the U.K. also noted the importance of an inclusive process to deal with the "threats to our collective security, and prevent an arms race in outer space."

The large support base for the U.K.'s resolution is remarkable and speaks to the extensive outreach that the U.K. has undertaken over the past few years. But the key task is to bring the naysayers into supporting the work of the OEWG. Nevertheless, the current momentum holds promise to build something more concrete in maintaining space as a peaceful domain and act in a manner that would "reduce threats to space systems in order to maintain outer space as a peaceful, safe, stable and sustainable environment, free from an arms race and conflict." The resolution further seeks to establish "channels of direct communication, including for the management of perceptions of threats," urging that these efforts be carried out so that it is beneficial to all.

According to the resolution, the OEWG will meet in Geneva for two five-day sessions in 2022 and 2023. Participation is open to intergovernmental institutions, various departments and organizations of the United Nations, and other organizations that have received invitations to participate in the discussions as observers. Commercial players and civil society members are also allowed to take part in the sessions, in line with standard practices. The chair of the OEWG could also hold intersessional consultative meetings with interested stakeholders that would facilitate exchange of ideas and views on issues of interest to the OEWG.

The OEWG in these sessions will review existing international agreements and normative frameworks that relate to threats in outer space from state behavior; take stock of "current and future threats by States to space systems, and actions, activities and omissions that could be considered irresponsible; make recommendations on possible norms, rules and principles of responsible behaviors relating to threats by States to space systems, including, as appropriate, how they would contribute to the negotiation of legally binding instruments, including on the prevention of an arms race in outer space." A report from the OEWG sessions will be submitted to the General Assembly at its 78th session in 2023-2024. As in the case of the work of the Conference on Disarmament and other disarmament forums, the work of the OEWG will be conducted based on the consensus principle.

There is a broader recognition among the policy community that while the OEWG is being established via the U.N. General Assembly route, it is being located in Geneva in an effort at rekindling the disarmament and arms control work there. This is important given the stagnant nature of engagement at the Conference on Disarmament. The OEWG could possibly revitalize the overall spirit within the conference, including on issues such as PAROS.

It is also noteworthy that the First Committee

resolution on transparency and confidence building measures (TCBMs) was co-sponsored by China, Russia, and the United States. As David Edmondson, the U.K.'s policy lead on space security and advanced threats, commented, "there's an understanding that, if we don't get this right, we wreck the space environment." Given the generally worsening security situation, including in outer space, there is a broader recognition of the need to get something done, irrespective of philosophical disagreements among key states on the challenges and solutions

The U.K's resolution could have the effect of bringing every key state to engage in a cooperative arrangement, in which at least some baby steps are agreed to, gradually progressing from voluntary measures to developing more binding legal rules. But the language of the resolution — that it will make "recommendations on possible norms, rules and principles of responsible behaviors" that could then "contribute to the negotiation of legally binding instruments, including on the prevention of an arms race in outer space" – goes only half-way for those who insist on legal measures for space security governance. Still, that there is a focus on state behavior rather than mere technologies is also significant. Also noteworthy is that resolutions on both the PAROS and the TCBMs were adopted unanimously. The United States had previously abstained or voted "no" on the PAROS resolution because it included the Russia-China draft treaty, the Prevention of the Placement of Weapons in Outer Space and of the Threat or Use of Force against Outer Space Objects (PPWT).

Overall, there appears to be a positive momentum on space security governance and arms control in space. There are genuine concerns that if steps are not taken to halt the current trend toward space weaponization, space could become an active warfighting domain, to the detriment of every single nation, whether they have active satellites in orbit or not. It remains to be seen how the discussions might proceed, but the OEWG work in the next two years could possibly narrow the divide between the varying state agendas being pursued in the space security realm.

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Return of ASATs and counterspace technologies: A slippery slope to weaponisation?

Almudena Azcarate Ortega | 19 October 2021

Source: ORF | https://www.orfonline.org/expert-speak/return-of-asats-and-counterspace-technologies/.

Counterspace technology is not a new phenomenon. In 1958, only one year after the successful launch of the erstwhile Soviet Union's satellite, Sputnik 1—the first artificial satellite to ever complete an orbit around the Earth—the first nuclear tests in outer space were conducted. This was a cause for concern for the international community, which aimed to ensure that outer space did not become a new stage for warfare. And yet, despite this, counterspace capabilities remain an issue that has never been properly regulated. This regulatory gap nowadays presents a greater danger than ever: The more important space technology becomes to humankind—particularly for military purposes—the more eager states would be to protect their space assets. As such, in recent years, some states have been increasingly investing in the development and testing of anti-satellite weapons (ASATs), creating an escalatory cycle that threatens to pave the way towards the weaponisation of space, and eventually could lead to it becoming a theatre of conflict.

The recent sharing of views on space security, prompted by a UN resolution, has highlighted that legally binding treaties and non-binding norms are not necessarily incompatible.

After the 1958 tests, the United Nations (UN) passed a resolution expressing the need "to avoid the extension of present national rivalries into this new field." The growing concern also led to the creation of the Committee on the Peaceful Uses of Outer Space (COPUOS), and it was under its auspices that the 1967 Outer Space Treaty was eventually drafted, with a key objective of serving as an arms control treaty.

Despite this, the Outer Space Treaty does not actually provide much guidance on how to keep space secure. Only "plac[ing] in orbit around the Earth any objects carrying nuclear weapons or any other kinds of weapons of mass destruction, install[ing] such weapons on celestial bodies, or station[ing] such weapons in outer space in any other manner" (art. IV OST) is prohibited, which leaves states free to use conventional weapons in space as long as such weapons are not used aggressively against another space actor. As long as states comply with international law, including the UN Charter, they are essentially free to develop any defensive and offensive military capabilities they deem necessary to protect their national security interests in space.

Some states have been increasingly investing in the development and testing of anti-satellite weapons (ASATs), creating an escalatory cycle that threatens to pave the way towards the weaponisation of space, and eventually could lead to it becoming a theatre of conflict.

As such, the use of ASATs—as long as it is not directed against another actor— is considered legal. The international community nevertheless recognises the danger they pose. ASAT testing suggests that a state possesses the capabilities required for conducting attacks against others should it wish to do so. The demonstrated ability to target or compromise another state's space technology has caused states to enact changes in their domestic space policies and strategies, raised tensions between adversaries and contributed to arms race dynamics.

Some states have been increasingly investing in the development and testing of anti-satellite weapons (ASATs), creating an escalatory cycle that threatens to pave the way towards the weaponisation of space, and eventually could lead to it becoming a theatre of conflict.

The international community has made attempts to reduce those tensions and arrest the weaponisation of space. Emerging in 1978 during the 10th Special Session of the UN General Assembly on Disarmament, The Prevention of an Arms Race in Outer Space (PAROS), has been the primary objective of multilateral dialogue on space security, featuring regularly in UN resolutions and in the mandates of working groups.

Under PAROS, there have been several proposals to ban or to restrict the use of counterspace technology. Examples include the Sino-Russian draft Treaty on the Prevention of the Placement of Weapons in Outer Space (PPWT), first introduced in 2008 (and updated in 2014) and the EU International Code of Conduct for Outer Space Activities, also from 2008. However, none of these initiatives have managed to rally enough support to move forward. This is because of a fundamental disagreement between states on what the nature of a proposal to achieve the goals of PAROS should be. Certain states favour the enactment of a legally binding instrument while others prefer non-binding norms, and these methods have often been viewed as irreconcilable.

Yet the lack of consensus on solutions belies the emphasis states continue to put on addressing the issue: On 7 December 2020, the UN General Assembly passed Resolution 75/36 on "Reducing Space Threats Through Norms, Rules, and Principles of Responsible Behaviours." This resolution encouraged states to "share their ideas on the further development and implementation of norms, rules, and principles of responsible behaviours and on the reduction of the risks of misunderstanding and miscalculations with respect to outer space." A total of 30 States, the European Union, and nine non-state organisations (including UNIDIR) submitted their views, which were compiled in a report by the UN Secretary General. These submissions served to highlight a number of similarities in the concerns of many UN member states. Chief amongst these concerns is the testing and use of counterspace technologies, as they can cause severe physical damage to space assets through the creation of debris as well as interference. The reverberating effects of their use can also be significant: From the destruction or disruption of space objects, through kinetic or non-kinetic means, to the detriment of services they provide on Earth negatively impacting

humanity.

The international community generally recognises the dangers of kinetic ASATs, but has shied away from condemning their use as illegal when done in the context of testing.

This bottom-up approach that allowed states to submit their views on space security served to pave the way to common understandings on space security matters, which could, in turn, de-escalate tensions and reduce the incentives for an arms race. However, whether the goals of this resolution will be achieved is yet to be seen. Could this be a step in the direction of finally achieving the goals of PAROS, and mark a shift away from the weaponisation of outer space? In theory, yes. The sharing of views on space security prompted by the resolution has highlighted that legally binding treaties and non-binding norms are not necessarily incompatible.

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However, any regime—whether based on legally binding or non-binding mechanisms—is only as effective as states' willingness to comply with it. While recent developments in the diplomatic sphere are encouraging, the hope for cooperation that they bring can easily be eclipsed by some states' continued insistence on developing and testing ASATs. These actions endanger any progress made towards achieving the goals of PAROS.

Certain types of ASATs have been criticised to the extent that proposals for ASAT Test Guidelines have gained traction amongst states. The international community generally recognises the dangers of kinetic ASATs, but has shied away from condemning their use as illegal when done in the context of testing. In the face of this reluctance, several experts are urging the UN to consider a kinetic ASAT Test Ban Treaty. However, while such initiatives are commendable, on their own, they are insufficient to solve the problem. It is, therefore, imperative that states work to arrest their weaponisation of outer space, not only through diplomatic negotiations, but also through avoiding engaging in ASAT development and testing to foster de-escalation and prevent current tensions from blowing up into a full-blown conflict.

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Why Russia Is Pouring Billions Into Hypersonic Weapons

Mark Episkopos | 12 November 2021

Source: The National Interest | https://nationalinterest.org/blog/buzz/why-russia-pouring-billions-hypersonic-weapons-196240

"It is obvious that it is important for us in the process of drafting a new state armaments program to take into account all the basic world trends in developing military hardware and armaments," said Putin on Wednesday during a state meeting. "First of all, this relates to introducing advanced information and bio-cognitive technologies and to promoting hypersonic systems and weapons based on new physical principles, the latest reconnaissance, navigation, communications and control systems," Putin added.

Moscow has made sweeping investments into hypersonic weapons technology in recent years.

Moscow has made sweeping investments into hypersonic weapons technology in recent years. Kh-47M2 Kinzhal, a nuclear-capable air-launched ballistic missile capable of accelerating to hypersonic speeds, was introduced into service in December 2017. The first missile regiment of the Avangard hypersonic glide vehicle, which Putin previously described as "invulnerable to intercept by any existing and prospective missile defense means of the potential adversary," entered service in late 2019. Russia's 3M22 Tsirkon winged, hypersonic maneuvering anti-ship missile is reportedly in the final stages of state trials and will enter service starting from 2022. Russian military observers believe that Tsirkon, which can reportedly reach speeds of up to Mach 9, is capable of holding U.S. carrier strike groups (CSG's) at risk.

Poseidon, also known as Status-6, is a nuclear-powered underwater drone that is reportedly armed with a two-megaton atomic payload. Poseidon can allegedly detonate its warhead "thousands of feet" below the surface," generating a radioactive tsunami capable of destroying coastal U.S. cities and other infrastructure. Poseidon's current development status remains unclear, nor have Russian officials offered any details on the system's production and delivery timeline. Kinzhal, Avangard, Tsirkon, and Poseidon were among the new weapons unveiled by Putin during his widely-cited 2018 state-of-the-nation address.

Top U.S. military and defense industry officials have warned that the United States is lagging behind its Russian and Chinese rivals in the hypersonic weapons race. The United States does not "have systems which can hold [China and Russia] at risk in a corresponding manner, and we don't have defenses against [their] systems," said Under Secretary of Defense for Research and Engineering Michael Griffin during an earlier testimony to Congress.

Putin also stressed the need "to raise functionality and combat sustainability of military products, in particular, through the use of artificial intelligence," adding that Russia must emphasize the "broad use of robotics." Russian

defense manufacturers are currently developing a slew of unmanned weapons projects, including the Udar robotic tank, kamikaze drones capable of denying airspace to enemy UAV's, and the Grom and Okhotnik-B loyal wingman drones for Russian fifth-generation fighters. The Russian military plans to open a dedicated drone testing site, located to Moscow's west, next year.

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Air Power

India conducts key flight test of Anti-Airfield Weapon

Rahul Singh | 04 november 2021

Source: Hindustan Times | https://www.hindustantimes.com/india-news/india-conducts-key-flight-test-of-anti-airfield-weapon-101635984577194.html

SAAW has been designed and developed by DRDO's Research Centre Imarat with support from IAF.(Twitter)

On Diwali eve, the Indian Air Force (IAF) and the Defence Research and Development Organisation (DRDO) successfully tested an indigenous smart weapon that can target enemy airfield assets such as radars, bunkers, taxiways and runways, at a firing range in Rajasthan, officials familiar with the development said on Wednesday.

This was the second successful test firing of the smart anti-airfield weapon (SAAW) from the Jaguar fighter plane in a week -- it was earlier fired on October 28. The weapon has a range of 100 km.

The November 3 test is significant as it involved the imaging infrared seeker technology that exponentially enhances the terminal accuracy of the weapon, said one of the officials cited above.

The weapons earlier tested -- SAAW has been test fired around 10 times -- were equipped with GPS-based navigation and terminal guidance systems.

"The two different configurations based on satellite navigation and electro optical (EO) sensors have been successfully tested. EO seeker-based flight test of this class of bomb was conducted for the first time in the country. EO configuration of the system is equipped with imaging infrared seeker technology that enhancing the precision strike capability of the weapon," the defence ministry said in a statement.

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In both tests, the newly adapted launcher ensured smooth release of the weapon and intended targets were hit with high accuracy, it added.

"SAAW is an important tactical weapon whose equivalent glide bombs have thus far been imported. Once inducted, SAAW will fill a critical indigenous capability gap," said Air Marshal Anil Chopra (retd), director general, Centre for Air Power Studies.

The November 3 test came a week after India carried out the latest test of the 5,000 km range Agni-V missile from the APJ Abdul Kalam Island off the Odisha coast, a significant step towards boosting the nuclear deterrence against China.

In January 2021, Hindustan Aeronautics Limited (HAL) announced that a Hawk-i aircraft successfully fired SAAW for the first time off the coast of Odisha. It was seen as a significant boost to an upgrade programme for the Hawk advanced jet trainer operated by IAF and navy.

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Agni-V and the end of India's north-eastern dilemma

Sandeep Unnithan | 31 October 2021

Source: India Today | https://www.indiatoday.in/india-today-insight/story/agni-v-and-the-end-of-india-s-northeastern-dilemma-1871754-2021-10-31

File photo of Agni 5 intercontinental ballistic missile; (PTI Photo)

On October 27, India tested the 5,000-km range Agni V intermediate range ballistic missile. This was the first 'user trial' of the missile by the Strategic Forces Command (SFC) that deploys India's nuclear arsenal. The Agni V can carry a 1.5 tonne payload, possibly a boosted-fission device tested in 1998.

Until now, the 3,500 km Agni III, first tested in 2006, served as the backbone of the Indian nuclear deterrent against China. It could target all of Pakistan but only parts of mainland China. Even so, the rail-mobile Agni III would need for the SFC's train-based ballistic missiles to travel for a launch to northeast India—closest to eastern and southern China. Ground-based invasions like the one China launched in 1962 can be halted by over 200,000 soldiers currently deployed by the army's Kolkata-based Eastern Command—two Army Corps with two divisions each and a Mountain Strike Corps--for limited cross-border offensives. Indian military planners have continued to worry about the vulnerability of the 22-km-wide Siliguri corridor to a Chinese offensive from the Chumbi Valley. (The army's Eastern Command recently conducted a week-long media tour to demonstrate its enhanced military posture.)

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The Agni V has a range of between 5,000 and 5,500 km (even longer with a lighter payload) and allows Indian nuclear weapons to be launched from mainland India. Its induction thus ends the strategic dilemma Indian strategic planners face—a belligerent nuclear-armed China which could inflict punitive missile strikes all along the Indian mainland from the Tibetan plateau but whose own industrial heartlands and population centres, further away on the east coast, remain shielded from retaliatory strikes. This dilemma dates back to the 1960s when Indian strategic thinkers had begun advocating nuclear weaponisation to counter Maoist China.

The missile brings all of China within the range of India's delivery systems and enhances its credible nuclear deterrence.

Sometime in 1968, Indira Gandhi's influential

principal secretary P.N. Haksar made a strong case for India to go nuclear. Haksar was conscious of the formidable natural barrier in the million square kilometres of Chinese-occupied Tibet. Hence, he called for 'the making of nuclear arms in the shape of medium range (2,000-3,000 miles) capable, from sites within India's frontiers, of striking with success not only a few chosen targets in Tibet but ranging as far afield as the industrial heart of China in Manchuria and in the great river valleys south of it which include some of her principal industries and urban centers of population'.

Scholar Vivek Prahladan reproduced this startling policy document, titled 'Need for India in a changing world to reassess her national interests and foreign policy', in his 2017 book The Nation Declassified. In one of the earliest references on the need for nuclear-powered ballistic missile submarines (SSBNs), Haksar also called for 'the development simultaneously of submarines driven by nuclear power fitted to carry nuclear missiles'.

Haksar's note came just six years after the border war with China and four years after the country had tested a nuclear weapon in the sandy wastes of Lop Nor in Xinjiang. It is not unreasonable to believe that the paper became the basis for India's nuclear force planning.

Haksar had long discussions with Indira Gandhi, which apparently changed her views on the nuclear issue. The former bureaucrat, who passed away in 1998, gave a rare interview to senior journalist Raj Chengappa, which was reproduced in his insightful 2000 book, Weapons of Peace, on the shaping of India's nuclear deterrent. Haksar quotes a passage from the historian L.V. Namier's book In The Margins of History to Mrs Gandhi: 'The weight of argument greatly depends on him who uses it: that of the strong has 'force' and carries 'conviction'; that of the weak, if unaswerable, is called quibble and apt to cause annoyance.'

India first nuclear test in 1974 was followed by over a decade of nuclear dormancy before the Rajiv Gandhi government revived it in the 1980s. Yet, without long- range delivery systems, nuclear weapons in themselves are useless. The missile development path has followed a slow curve of increasing range in the face of international opprobrium. The Agni technology demonstrator was test-fired in 1989 but further tests were shelved after US pressure in the mid-1990s. It was revived only after the nuclear tests of 1998 when Agni-II, with a range of approximately 2,200 km, was tested on April 11, 1999.

India's security establishment had been careful not to mention China as the primary focus of its nuclear arsenal, though this had begun changing by the 1990s. In 1998, the then defence minister George Fernandes called China India's 'potential threat number one'.

In an off the record conversation with a few Indian journalists in London in 2000, Fernandes recommended they read the BBC journalist's Humphrey Hawksley's 1997 novel Dragon Strike, where a hawkish Chinese despot launches a nuclear attack on India.

In a letter to US President Bill Clinton (which appeared in the New York Times on May 13, 1998), Prime Minister A.B. Vajpayee hinted at the 'deteriorating security environment, specially the nuclear environment' as one of the unstated reasons for India's May 11, 1998 nuclear tests. 'We have

an overt nuclear weapon state on our borders, a state which committed armed aggression against India in 1962,' the letter elaborated. 'Although our relations with that country have improved in the last decade or so, an atmosphere of distrust persists mainly due to the unresolved border problem. To add to the distrust that country has materially helped another neighbour of ours to become a covert nuclear weapons state.' The Agni V is thus an antidote for India's worries over a collusive two-front security threat turning into a two-front nuclear nightmare.

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India Tests Its Own 'Super Bomb' 60 Years After Russia Tested The World's Most Powerful Weapon – Tsar Bomba

Nitin J Ticku | 30 October 2021

Source: The Eurasinan Times | https://eurasiantimes.com/india-test-its-own-super-bomb-60-years-before-russia-tsar-bomba/

Indian SU-30MKI – Wikimedia Commons

In what can be considered as a stern warning to China, India successfully test-fired Agni-5 surface-to-surface intercontinental ballistic missile that can strike targets up to 5,000 kilometers away and can strike deep into China.

Soon after the Agni-5 missile test, India conducted its tenth test of heavy-duty, Smart Anti-Airfield Weapon (SAAW). This smart weapon has a range of 100 kilometers and can engage ground opponent airfield assets such as radars, bunkers, taxi tracks, and runways.

Going on, India didn't seem to stop there, conducting the nation's own mother of all bomb test for the first time. This Long-Range Bomb (LRB) was successfully flight-tested by an Indian Air Force (IAF) team and the Defence Research and Development Organisation (DRDO) from a Sukhoi-30 fighter jet.

The bomb struck a target range inside the sea using laser guidance at approximately 11 a.m. Indian time, successfully completing all mission objectives.

The LR Bomb was designed and developed by the DRDO's Research Centre Imarat (RCI) and can carry 1000 kilograms of the warhead. The Indian Defence Minister praised all of the teams involved in the trial flight including IAF and DRDO. He went on to say that the achievement will be a "force multiplier for the Indian Armed Forces."

In the midst of a persistent border dispute with China, India has recently been demonstrating its ability to stand firm in the face of China's attempts to assert supremacy.

The Indian Air Force has regularly depended on Israeli-made laser-guided bombs from the Kargil war to Operation Bandar in Balakot in 2019. This LRB will be a useful addition to India's arsenal, allowing the Indian Air Force to stay firmly within its own territory when striking the target at 100km away with high accuracy.

Mother of All Bombs

In 2017, US forces dropped one of the largest non-nuclear weapons ever unleashed by the US military in Afghanistan. The weapon, also known as 'Mother of all Bombs', weighs 21,600 pounds.

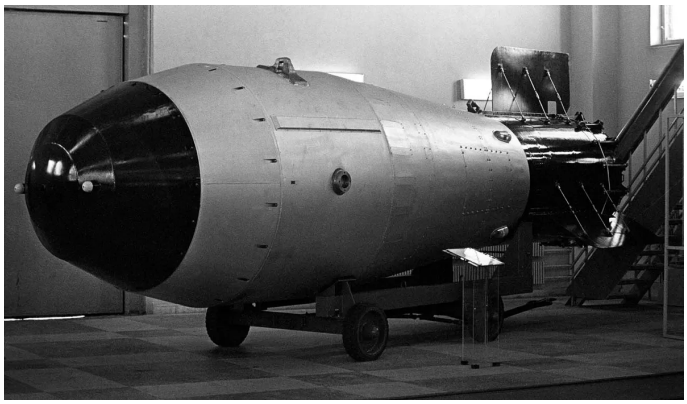
MOAB was initially tested using the explosive tritonal on Range 70 at Eglin Air Force Base in Florida on March 11, 2003.

The weapon was originally created for use in the Iraq war at a reported cost of $16 million per weapon. However, it was never used in action until 2017. It's a GPS-guided munition that's dropped from an MC-130 transport plane's cargo doors and explodes before it touches the ground.

Father of All Bombs

The FOAB, a thermobaric bomb with a destruction radius of almost 1,000 feet and a detonation yield of nearly 44 tonnes of TNT, was tested by Russia in 2007. It's worth mentioning that this was Russia's response to MOAB.

This devastating non-nuclear bomb detonates in mid-air, igniting a mixture of fuel and air. It evaporates targets and causes structures to collapse, resulting in enormous shocks and tremors.



Tsar Bomba: The Most Powerful Nuclear Weapon Ever Built

FOAB is reported to be capable of releasing 44 tonnes of explosives and is so deadly that it has been compared to nuclear weapons. According to reports, Russia's FOAB is four times more potent than the United States' MOAB.

The FOAB has a blast radius of 300 meters, about double that of the MOAB, and produces double the temperature.

Tsar Bomba: Weapon of Last Resort

Exactly sixty years ago, the Soviet Union successfully tested the world's largest nuclear weapon. The fact that this bomb was 10 times more powerful than all of the bombs used during World War II explains the gravity of its might.

A Tupolev Tu-95 plane took off from the Olenya airstrip on the Kola Peninsula on October 30, 1961 and the bomb was dropped above the Arctic archipelago of Novaya Zemlya.

About 57,000 kilotons of energy were released in the explosion. During World War II, the bombs detonated on Hiroshima and Nagasaki were comparable to 15 and 21 kilotons, respectively.

The mushroom cloud from the bomb rose to a height of 60 to 70 kilometers above the ground but fortunately, it did not make contact with the earth and resulted in relatively less radiation.

The "Tsar Bomba" or the Soviet RDS-220 hydrogen bomb developed in the USSR is considered till date the most powerful nuclear weapon ever created and tested. The humongous bomb was 26 feet long, had a diameter of nearly 7 feet and weighed over 27 tonnes.

Codenamed Ivan or Vanya, the bomb was so big that it was forced to be carried by the huge, swept-wing, four-engined Soviet Tu-95 bomber, with the device deemed too big to fit inside the aircraft's internal bomb bay.

According to Philip Coyle, the former head of US nuclear weapons testing under President Bill Clinton, who helped design and test atomic weapons for 30 years – "The US had been very far ahead because of the work it had done to prepare the bombs for Hiroshima and Nagasaki. And then it did a large number of tests in the atmosphere before the Russians even did one,"

"We were ahead and the Soviets were trying to do something to tell the world that they were to be reckoned with. Tsar Bomba was primarily designed to cause the world to sit up and take notice of the Soviet Union as an equal."

The Tsar Bomba was carried to the drop zone by a modified version of the Tu-95 'Bear' bomber

(Credit: Alamy)

On the morning of October 30, 1961, the Tsar Bomba which was referred to as the "City Destroyer" was dropped by the Tu-95 bomber with the help of a giant parachute, which slowly drifted down to the height of 13,000 feet and detonated over Novaya Zemlya, a sparsely populated archipelago.

The detonation created a massive fireball five miles wide, which could be seen from 1,000 kilometers away, with the bomb's mushroom cloud soaring to 64 kilometers high.

The effects were catastrophic as a village in the 55-kilometer radius of the detonation had all its houses completely demolished, with districts in the hundred-mile radius also reporting collapses

of houses, roofs and other damages.

According to a cameraman on-board the aircraft – "The clouds beneath the aircraft and in the distance were lit up by the powerful flash. The sea of light spread under the hatch and even clouds began to glow and became transparent. At that moment, our aircraft emerged from between two cloud layers and down below in the gap a huge bright orange ball was emerging,"

The ball was powerful and arrogant like Jupiter. Slowly and silently it crept upwards… Having broken through the thick layer of clouds it kept growing. It seemed to suck the whole Earth into it. The spectacle was fantastic, unreal, supernatural."

The power of the bomb persuaded nuclear physicist Andrei Sakharov to renounce nuclear weapons

(Credit: Science Photo Library)

The nuclear bomb unleashed an enormous amount of energy, believed to be in the order of 57 megatons, or 57 million tons of TNT, 1,500 times that of the Hiroshima and Nagasaki bombs combined, and 10 times more powerful than all the munitions expended during World War Two.

The sensors which registered the bomb's blast wave saw the wave orbiting the Earth three times. The detonation was followed by global condemnation by the likes of the UK, US, Sweden and others.

The aftermath was so immense that even the bomb's chief architect Andrei Sakharov began efforts to rid the world of the very weapons he had helped create.

According to Frank von Hippel, a physicist and head of Public and International Affairs at Princeton University – "He (Sakharov) was really apprehensive about the amount of radioactivity it would create and the genetic effects that could have on future generations. It was the beginning of his journey from being a bomb designer to becoming a dissident."

The bomb was considered too big and powerful for its own good and since it couldn't even be placed on a missile or a plane due to its weight, if it were to be used, the operation would only be deemed as a one-way mission.

"It's hard to find a use for it unless you want to knock down very large cities. It simply would be too big to use," said Coyle.

According to Sakharov, the bomb could cause global fallout and spread toxic dirt across the planet, therefore, while the USSR was successful in detonating the most powerful, deadly nuclear bomb known to mankind, the option just wasn't suitable for anyone, not even for the USSR.

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India receives S-400 air defence system, first unit to be deployed near western front

Manjeet Negi | 14 November 2021

Source: India Today | https://www.indiatoday.in/india/story/india-defence-western-front-1876562-2021-11-14

India had signed a USD 5 billion deal with Russia to buy five units of the S-400 air defence missile systems. (Representative File Photo)

Russia has started supplying the S-400 Triumf air defence systems to India, the first unit of which will be deployed near the western front. The announcement was made by the Director of Russian Federal Service for Military-Technical Cooperation Dmitry Shugaev in Dubai air show.

FSMTC is the Russian government's main defence export control organisation.Industry sources said the first parts of the squadron have already started reaching India, and they would be deployed on a location where it can take on threats from both Pakistan and Chinese airspace.

According to sources, the parts of the missile systems are coming via both air and sea routes and would be quickly deployed on the designated locations.

The first squadron delivery would be completed by the end of this year and after its deployment, the Indian Air Force would start focusing towards the eastern front, they said. The IAF would also dedicate some of the resources for training its personnel within the country also. .

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AAI likely to procure two counter-drone systems worth ₹9.9 crore in 2022-23

14 November 2021

Source: The Hindu | https://www.thehindu.com/news/national/aai-likely-to-procure-two-counter-drone-systems-worth-99-crore-in-2022-23/article37485256.ece

Photo Credit: Shaikmohideen A. (Representative Image)

Russia The Airports Authority of India (AAI) is likely to procure two counter-drone systems worth ₹9.9 crore in 2022-23, according to an official document.

"The counter-drone system should provide a multi-sensor based complete and comprehensive solution with regards to drone detection, tracking, identification and neutralisation," said the document issued by airport systems directorate of the AAI.

The document—which has been accessed by PTI—stated that the AAI is projected to purchase two counter drone systems with an estimated value of procurement of ₹9.9 crore in financial year 2022-23.

In June this year, rogue drones had dropped two bombs at the Indian Air Force station at Jammu airport, injuring two of its personnel.

In June this year, rogue drones had dropped two bombs at the Indian Air Force station at Jammu airport, injuring two of its personnel.

Reacting to the Jammu attack, Smit Shah, director - Partnerships, Drone Federation of India (DFI), in June had said that India needs to invest more in counter-drone research and technology and procure them in a planned manner to address the security concerns arising from rogue operations, the unmanned aerial vehicles.

India has a few companies doing indigenous research and a few companies partnering with foreign vendors but more focus needs to be brought in this domain of counter-drone technology, he had noted.

Counter-drone technology uses radars, radio-frequency devices, electro-optical methods, acoustic mechanisms or combined sensors technology to stop the unmanned aerial vehicles.

In October 2019, the Civil Aviation ministry had issued a policy document primarily to deal with possible security challenges from rogue drones to key installations like nuclear power plants and military bases.

Titled 'National Counter Rogue Drones Guidelines', the document said it was a matter of concern that small drones were proliferating at a rate that has alarmed battlefield commanders and planners alike.

"The utilisation of armed drones by extremist groups to carry out reconnaissance and targeting strategic Israeli installations during Israel-Lebanon war is an example of escalation of terrorist and insurgent drone capabilities," according to the document.

The policy document said multiple incidents of sightings of drones in the vicinity of commercial

airliners and major airports like New Delhi and Mumbai have raised flight safety concerns.

"Further, the upsurge in drone use has also increased the threat quotient for VVIPs who can be targeted through rogue drones," it said.

There is no official data about the number of civilian drones operating in India. However, it is estimated that there are about 4-6 lakh drones in the country. A significant number of parts — which are used in manufacturing drones—are imported from China and many other countries.

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Space

Russia Tests an ASAT Weapon: Space Sustainability Takes a Hit Again

Gp Capt TH Anand Rao | 21 November 2021

Source: CAPS India | https://capsindia.org/russia-tests-an-asat-weapon-space-sustainability-takes-a-hit-again/

Close on the heels of the 76th session of United Nations General Assembly, in which the First Committee approved a draft resolution on "Reducing space threats through norms, rules and principles of responsible behaviors" on November 01, 2021 – to address a widespread concern against any debris creating activity in space – the world witnessed yet another Anti-Satellite Test (ASAT), this time by Russia. The global space community is outraged and anguished with Russia for violating the norms of behaviour in space and a total disregard for sustainability of the space environment. India too faced a similar situation when it conducted an ASAT test in March 2019, albeit at a lower altitude with much less debris fallout.

In the early hours of November 15, a new debris field was detected in Low Earth Orbit (LEO) by the United States space surveillance network and Leo Labs (a commercial space

tracking entity). The new debris field which was observed at altitudes of 400 – 450 km, was identified as a split up of a Russian dead satellite – Cosmos 1408 – which orbits at an altitude of around 480 km. This event posed an imminent risk of collision with the International Space Station (ISS) which orbits at an altitude of 419 km and forced a debris avoidance action by the crew onboard. A day later, the Russian news agency announced an ASAT missile test that targeted an old Russian satellite with precision and denied allegations by the US and UK that the test had been dangerous for orbiting spacecraft. Media reports have indicated that Cosmos 1408, a satellite which had been in orbit since 1982, was deliberately struck by an A-235 PL-19 Nudol 'satellite killer' missile fired from the Plesetsk cosmodrome. 1500 pieces of debris have been reported from this ASAT event.

There is widespread shock and condemnation for this deliberate act by Russia. Some even termed it as a reckless act which will de-stabilise outer space and lead to weakening the efforts at arms control in space. More countries could follow suite as there are no legal regulations that could prevent weapons proliferating into outer space. Russia on the other hand defended its action. A Russian defence ministry official was quoted saying that Russia was forced to strengthen its defence capabilities because of weapons tests by the US and the formation of a Space Force. He also denied that the test could pose any risk to the ISS. The fact that US, China and India have conducted similar tests in the past could not possibly be a justification for any country to create more debris in space, let alone Russia.

The Americans seem to be more concerned about the risk to the ISS than about the addition of more debris in space. Russian cosmonauts are also onboard the ISS and it is very unlikely that Russia would do anything that could harm this harmonious joint working arrangement. There are speculations though, that Russia perhaps timed the ASAT test to raise tensions in region and alarm US prior to a possible military action on the Uzbekistan border where Russian troops and military equipment are deployed. The weapon used for the ASAT test is said to be the PL-19 Nudol, which has been launched several times in the past successfully. However, this is the first successful physical impact with a satellite. It can thus be said that the test was a requirement to validate the PL-19 Nudol's ASAT capability. This also means that the Russian ASAT is a likely weapon to be used in any future conflict, debris notwithstanding. It calls into question Russia's commitment to their proposals for long term sustainability of outer space and their inclination to prevent an arms race in outer space. It may be recalled that Russia and China had together drafted the treaty on the Prevention of the Placement of Weapons in Outer Space (PPWT) in 2008 which could not gather a consensus amongst member states. Also, in the response submitted to UN General Assembly following Resolution 75/36 on reducing space threats through norms, rules

and principles of responsible behaviours, Russia had expressed a strong desire for prohibition on ASAT testing and on proliferation of debris creating weapons into space.

On the issue of space debris, it is certainly a setback for every space aspiring nation. The worry is not much about the 1500 pieces of debris that have been added to the existing debris count, but it is the spread of debris cloud which ranges from 300 km to 1100 km which is a matter of serious concern. Though most of the debris will re-enter the atmosphere in time durations varying from months to years, some of the debris may stay in orbit for many decades. The uncertain nature of the debris gives rise to many complications. Firstly, this height band has the highest density of satellites and many more satellites in constellations are planned to be inserted. SpaceX has already inserted 1584 Starlink satellites in a 550 km orbit against the planned 12000. One Web has already inserted 358 satellites in a 1200 km orbit. Many more companies are entering the LEO arena, and existing constellations are set to expand. By 2030, it is projected that the active satellite count will reach 100,000. Even today, 83% of all satellites are orbiting in LEO which makes it a very dense environment. Any additional debris creating event will only make the LEO environment more complicated to operate in. Secondly, collision events in LEO may be seen more often due to the absence of any regulations towards space traffic management. Also, most small satellites are not manoeuverable or have limited collision avoidance capability. Any collision will increase the debris count manifold, making space traffic management more complicated. Thirdly, the existing space observation capabilities have severe limitations, which precludes visibility of small objects with size less than 10 cm. Also, vast portions of outer space remain unscanned. This means that the uncertainty quotient will always remain. We need to develop ways to operate in such an environment.

Russia has taken the world a step backward in their efforts towards reducing threats in space. Though it is not clear as to why they had to do this test, the event may have presented another opportunity to make a push towards banning kinetic ASAT tests through a test ban treaty. Gathering a consensus on a ban treaty may take time. In the meanwhile, the proposed 'Guidelines for ASAT tests' could be revisited. In 2018, the United Nations Institute for Disarmament Research (UNIDR) had suggested three ASAT guidelines which could not be implemented due to a lack of consensus. The guidelines were:

- States testing ASAT capabilities should not create any space debris.
- If debris is inevitable during an ASAT test, it should be carried out at an altitude sufficiently low so that debris is short-lived.
- Notification needs to be issued prior to an ASAT test, to avoid misidentification.

Notwithstanding the rationale, Russia's action of deliberately creating orbital debris in the most crowded region of Earth orbit is

extremely irresponsible. Orbital debris poses a risk of loss of space services and contamination of the space environment, an issue as serious as the global warming phenomena. The reading on the wall is very clear. If we disregard the sanctity of the space environment, space will defy us. Exploitation of outer space needs to be regulated with a firm space governance mechanism. Transparency in space operations and punitive actions for defaulters are the need of the day. The issues brought out need to be viewed dispassionately to resolve them in a time bound manner. The UN mandated establishments can play a proactive role in gathering consensus amongst member states.

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Japan to launch second outer space operations unit in fiscal 2022

14 November 2021

Source: Nikki Asia | https://asia.nikkei.com/Politics/Japan-to-launch-second-outer-space-operations-unit-in-fiscal-2022

Japan launched in May 2020 the first space operation unit tasked with monitoring space debris, asteroids and other threats to artificial satellites, based in Fuchu, western Tokyo.

Tokyo (Kyodo) - Japan will set up a second space operations unit at an Air Self-Defense Force base in the country's west to monitor any threat via electromagnetic waves to its satellites within fiscal 2022, Defense Minister Nobuo Kishi said Sunday.

The establishment of the unit in the Hofu Kita Air Base in Yamaguchi Prefecture is part of Japan's efforts to beef up its capabilities in new domains such as outer space, as China and Russia are building up their own capacity in the electromagnetic spectrum.

"As we expand our operations in new domains - the fields of outer space, cyberspace and the electromagnetic spectrum - it is extremely important to secure the stable use of outer space," Kishi told ASDF personnel at the base.

The creation of the unit follows the launch in

May last year of Japan's first space operation unit tasked with monitoring space debris, asteroids and other threats to artificial satellites. The ASDF unit is based in Fuchu, western Tokyo.

The launch of the second unit was included in the Defense Ministry's budget requests for fiscal 2022, starting in April next year, unveiled in August.

In Yamaguchi, a space surveillance radar is currently under construction and is expected to be operational in fiscal 2023.

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Isro enters X-band telemetry & command regime with new 18m Antenna

Chethan Kumar | 11 November, 2021

Source: Times of India | http://timesofindia.indiatimes.com/articleshow/87652642.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

Isro chairman K Sivan said the antenna has been developed by ECIL (Electronics Corporation of India Limited) with some key systems coming from Bhabha Atomic Research Centre.

The Indian Space Research Organisation (Isro) has commissiond a new 18m antenna, which for the first time, allows the space agency to conduct telemetry and command operatiuons on the much faster X band (frequency). So far, Isro only used X band for payload data downloading and used the S band for telemetry and command.

Compared to S band, which operates with 2GHz to 4GHz, X band functions in 8GHz to 10GHz. Sources at Isro, terming this a major milestone, said this has two advantages: "First, it increases the speed of commands and second, reduces possibility of any interference given that the S band is now also used by telecom companies for 5G."

The antenna was developed from the funds meant for Aditya-L1 — India's first solar missions

expected to be launched in late 2022 — and will be used for other deep space mission in the future too aside from being available for international customers.

"The indigenous antenna and station is capable of performing transmit and receive operations in both S and X bands. It is equipped with auto tracking features in both the bands and is remotely operable from the Isro Telemetry, Tracking and Command Network (Istrac) network control and is CCSDS (Consultative Committee for Space Data Systems) compliant facilitationg interoperability and cross-support among different space agencies," a senior scientist told TOI.

Another scientist said that with international agencies like Nasa having already migrated to X band for telemetry and command operations, Isro was unable to offer services so far. With the commissioning of the new antenna, the space agency will be able to attract more collaborations.

Confirming the developments, Isro chairman K Sivan, said: " Developed by ECIL (Electronics Corporation of India Limited) with some key systems coming from BARC (Bhabha Atomic Research Centre), the antenna has been commissioned in Byalalu here. It marks a new era as we can do telemetry operatuons in a new band, and it will also provide opportunities fo NSIL to commercialise it in the future."

Sivan said the the demand for the said antenna arrived from Aditya-L1 and has been commissioned as part of the preparations for the missions. "But other deep space missions and satellites can also use it in the future," he said.

Aditya-L1 is India's first dedicated space-based solar observatory of India and will be around the Earth-Sun Language point L1. "With the inclusion of multiple payloads, this project also provides an opportunity to solar scientists from multiple instituitions within the country to participate in space-based instrumentation and observations. Thus the enhanced Aditya-L1 project will enable a comprehensive understanding of the dynamical processes of the sun and address some of the outstanding problems in solar physics," according to Isro.

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Space Force General Admits That US Lagging Behind Russia, China in Hypersonic Weapons

Staff Writers | 23 November 2021

Source: Space War | https://www.spacewar.com/reports/Space_Force_General_Admits_That_US_Lagging_Behind_Russia_China_in_Hypersonic_Weapons_999.html

Last month, the US military botched its own hypersonic missile testing, while China reportedly conducted a test of a missile capable of sending nuclear weapons around the globe this summer. Russia also successfully test-fired its "Zircon" hypersonic missile in the arctic on 18 November.

US Space Force General David Thompson on Saturday warned that American hypersonic missile capabilities are "not as advanced" as those of China or Russia, implying that the US is falling behind in producing the newest and most cutting-edge weaponry.

In an interview conducted at the Halifax International Security Forum in Canada, Thompson stated that the United States falling behind the other two countries could be detrimental to national security.

"We have catching up to do very quickly. The Chinese have an incredible hypersonic programme", he said. "It's a very concerning development ... it greatly complicates the strategic warning problem".

Thompson also compared the use of hypersonic missiles to a snowball fight during his interview, saying they are "changing the game" for national defence and security. When a snowball is thrown, you can usually predict where it will land. However, if the projectile is thrown in a different direction, it is more difficult to detect - but it will still hit you.

"That's what a hyperglide vehicle does", he said in reference to another class of hypersonic missiles. "You no longer have that predictability. So every launch of a certain type, regardless of where it's headed, now has the potential to be a threat".

When speaking about China's position in terms of technological capabilities compared to the United States, the general noted that the speed with which China has caught up with the most developed countries and the United States is amazing, and the Chinese have "moved incredibly quickly in space".

"In terms of their technology and capability, I would argue that we, both the US and our close partners and allies, are still the best in the world in that technology", he noted. "But they have come very close very quickly. And they are cycling their technology much quicker, at twice the rate we are".

According to Thompson, if this speed persists

for an extended length of time, China is "likely to exceed us in terms of capability".

"They intend to use space the way they have watched us use it for decades", the general stressed.

Answering the host's question about how the Chinese managed to establish such a fast cycle of production and innovation implementation, Thompson echoed his colleagues, blaming the excessive bureaucracy in the US military.

"Part of it is, I'll say the bureaucracy that we've built into our defence and acquisition enterprise, not just in space but other areas", he underscored, "and that has slowed us down in many areas".

He added "the fact that we have not needed to move so quickly", in the past couple of decades in terms of technology development contributed to the slowdown as well.

Moreover, according to an October report by the Congressional Research Service (CRS), the US is falling behind China and Russia because "most US hypersonic weapons, in contrast to those in Russia and China, are not being designed for use with a nuclear warhead".

"As a result, US hypersonic weapons will likely require greater accuracy and will be more technically challenging to develop than nuclear-armed Chinese and Russian systems", the service's experts stated.

The US is planning to spend $3.8 billion on hypersonic missiles in the fiscal year that runs through 2022, according to the paper.

And earlier on Saturday, the Defence Department announced that the Alabama-based company Dynetics has been awarded a $478 million contract to construct Hypersonic Thermal Protection System prototypes for the US Army.

"Dynetics [of] Huntsville, Alabama, was awarded a $478,598,908 ...contract for the development of Hypersonic Thermal Protection System prototypes, support materials research, and novel inspection and acceptance criteria", the Defence Department said in a release on Friday.

Hypersonic missiles are classified as weapons that travel at a speed of Mach 5 or higher, meaning at least five times the speed of sound.

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China's Hypersonic test leaves Pentagon officials 'Baffled' by Beijing's advance

Staff Writers | 23 November 2021

Source: Space War | https://www.spacewar.com/reports/Chinas_Hypersonic_test_leaves_Pentagon_officials_Baffled_by_Beijings_advance_999.html

file illustration of China's Hypersonic Glider Vehicle WU-14.

The alleged July test of a hypersonic Chinese missile has sparked concerns in the United States over how Washington seems to lag behind Beijing in the field of hypersonic weapons' capabilities.

The US military and intelligence officials were caught off-guard by China's reported hypersonic missile test carried out in July at five times the speed of sound - an unprecedented feat, The Financial Times reported.

Experts from the Pentagon's advanced research agency Darpa are struggling to understand how China managed to master a technology that allowed its hypersonic glide vehicle to fire a separate missile mid-flight over the South China Sea, people familiar with the matter told the outlet.

Among those baffled by the reported Chinese missile test and the advanced capabilities it demonstrated is the US National Security Council.

"This development is concerning to us as it should be to all who seek peace and stability in the region and beyond," a spokesperson for the National Security Council told The FT. "This also builds on our concern about many military capabilities that the People's Republic of China continues to pursue."

The official also went on to assert that the United States will continue to maintain capabilities needed to "defend and deter against a range of threats" from Beijing.

Other US military officials are also concerned about China's head start in the field of hypersonic weapons, with US Space Force General David Thompson asserting that Washington has "catching up to do very quickly", describing the Chinese missile program as "incredible", but noting that it "greatly complicates the strategic warning problem".

The Chinese embassy, however, has denied the reports about the alleged missile test, saying that it was "not aware" of it.

"We are not at all interested in having an arms race with other countries," Liu Pengyu, the embassy spokesperson, told The FT. "The US has in recent years been fabricating excuses like 'the China threat' to justify its arms expansion and development of hypersonic weapons."

The US officials continue to voice concerns that China may step away from its "minimum

deterrence" posture that had been maintained for decades, with Washington recently announcing it intends to quadruple its nuclear warheads to as much as 1,000 weapons in the coming decade..

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Global Aerospace Industry

L3 Harris Technologies awarded $121 million to upgrade Space Force weapons

Nathan Strout | 26 October 2021

Source: C4ISRNET | https://www.c4isrnet.com/home/2021/10/25/l3harris-awarded-121-million-to-upgrade-space-force-weapons/

Airmen from the 4th Space Control Squadron take a picture in front of the Counter Communications System Block 10.2 on March 12 on Peterson Air Force Base, Colo. (Airman 1st Class Andrew Bertain/U.S. Air Force)

WASHINGTON — The U.S. Space Force has awarded L3Harris Technologies $121 million to upgrade 16 secretive weapons that can jam enemy communications.

Under the contract, L3Harris will upgrade fielded Block 10.2 Counter Communications Systems, which can "reversibly deny satellite communications, early warning and propaganda," according to the Oct. 22 announcement.

The systems are spread out over Peterson Space Force Base in Colorado, Vandenberg Space Force Base in California, Cape Canaveral Space Force Station in Florida and classified locations. Work is expected to be complete by February 2025. The Space Force said the competition received two

submissions.

While the military has had for years the Counter Communications Systems — the first iteration was delivered in 2004 — there is little publicly available information on the system's technical capabilities. In 2020, the Space Force hailed an upgraded version of the system as its first offensive weapon system. L3Harris has been the primary contractor for both major upgrades to this point.

In a 2020 interview with C4ISRNET, L3Harris explained the transportable electronic warfare system as "a deployable system basically for counter communications."

"Think of it as a platform that various custom missions run on," said Praveen Kurian, general manager of L3Harris' space control division. "It doesn't permanently damage [targets], right? You're talking about reversibly denying communications, and then when you shut down your system, you're back to being able to operate."

The company was awarded $72 million by the Air Force in January to sustain the system and develop another upgrade, dubbed Meadowlands, which will provide improved capabilities and a smaller form factor.

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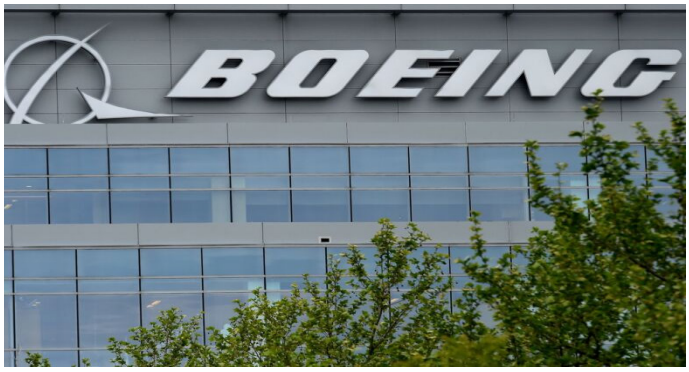
FCC approves Boeing satellites, rejecting SpaceX's interference claims

Jon Brodkin | 04 November 2021

Source: Space News | https://arstechnica.com/information-technology/2021/11/fcc-approves-boeing-satellites-rejecting-spacexs-interference-claims/



Enlarge / Boeing office building in Arlington, Virginia.

The Federal Communications Commission today gave Boeing permission to launch 147 broadband satellites. While that's a fraction of the number of satellites approved for other low Earth orbit (LEO) constellations, the decision allows Boeing to compete in the emerging LEO satellite broadband market.

"As detailed in its FCC application, Boeing plans to provide broadband and communications services for residential, commercial, institutional, governmental, and professional users in the United States and globally," the FCC said in its announcement approving the license.

The 147 planned satellites include 132 low-Earth satellites orbiting at an altitude of 1,056 km and 15 "highly inclined satellites" that would orbit at altitudes between 27,355 and 44,221 km. The FCC authorized Boeing to conduct space-to-Earth transmissions in the 37.5–42.0 GHz

frequency bands and Earth-to-space operations in the 47.2–50.2 GHz and 50.4–51.4 GHz bands.

In its 2017 application to the FCC, Boeing said its plan to operate satellites at both high and low altitudes is "a cost-effective means to achieve global coverage." The combination will "provide high-speed broadband communications to consumers wherever they are located, while also providing the benefits of very low latency through LEO communications," Boeing said. Boeing previously proposed a constellation that could have included nearly 3,000 satellites, but it scaled back its plans.

SpaceX claimed interference

Starlink operator SpaceX claimed that Boeing's plan would cause interference, but the FCC rejected SpaceX's argument that Boeing should face additional requirements.

"SpaceX raises concerns about interference from Boeing's uplink beams to its highly inclined satellites and recommends that Boeing utilize higher gain antennas on those satellites with corresponding reductions in uplink power levels. We decline to adopt SpaceX's proposal," the FCC said.

The FCC previously declined to adopt additional requirements to prevent interference in its rules for non-geostationary satellites, instead opting for a "framework for co-existence" that satellite companies would use to cooperate. That earlier decision factored into the FCC's ruling against SpaceX's request:

SpaceX provides no basis on this particular issue to warrant departure from the established framework already in place to address concerns regarding interference between NGSO [non-geostationary satellite orbit] systems, and to adopt a special condition on this grant. Pursuant to our rules, NGSO FSS [fixed satellite service] operators must coordinate in good faith the use of commonly authorized frequencies. When there is potential for interference, the parties involved must agree on measures to eliminate this interference (i.e., satellite diversity) or, in the absence of an agreement, be subject to certain default procedures. Accordingly, NGSO FSS operators must agree on measures to eliminate the risk of interference by taking into account each system's power levels and design.

Objections from rival satellite operators are common in these proceedings. SpaceX recently blasted Amazon for objecting to Starlink plans, saying that Amazon was using an "obstructionist tactic" to delay a competitor. Amazon pointed out that SpaceX itself "routinely raises concerns with respect to its competitors' currently filed plans, including with respect to interference."

Boeing in no rush to launch

Boeing doesn't seem to be in any rush to launch satellites despite being far behind SpaceX, which has already deployed over 1,700 satellites and has FCC permission to launch nearly 12,000. Amazon has FCC permission to launch 3,236 satellites and plans to launch two test satellites in late 2022. OneWeb has permission for 2,000 satellites and has launched 358.

FCC rules require satellite licensees to launch 50 percent of licensed satellites within six years and the remainder within nine years. The FCC said that Boeing asked for a waiver of that requirement:

Boeing seeks to launch the first five highly inclined satellites within six years after license grant, which, Boeing argues, would satisfy the (now-eliminated) domestic geographic coverage requirement in the commission's rules. Boeing seeks to launch the remaining ten highly inclined satellites and 132 LEO satellites within 12 years of grant, which, Boeing argues, would satisfy the (now-eliminated) international coverage requirement in the commission's rules. Boeing states that its revised milestone schedule would allow it to introduce service into new geographic regions on a phased basis.

Boeing's waiver request denied

The FCC rejected this request, saying that "Boeing has not provided sufficient grounds for a waiver of the commission's milestone requirements." The FCC said granting the waiver "would undermine the purpose of the rule," adding:

In particular, Boeing does not explain why it cannot deploy a greater number of satellites, a figure closer to 50 percent, within the requisite timeframe in order to prevent [spectrum] warehousing concerns. Moreover, Boeing's representation at this point that it would launch and deploy the full system in 12 years, rather than the nine required by our rule is not supported by sufficient justification for us to grant waiver at this time, again, noting the underlying concern of spectrum warehousing. Accordingly, we deny Boeing's waiver request at this time.

While this means the 147-satellite constellation is still subject to the 6- and 9-year launch requirements, the FCC said Boeing can resubmit the request in the future "when it will have more information about the progress of the construction and launching of its satellites and will therefore be in a better position to assess the need and justification for a waiver."

The FCC imposed a few standard conditions on Boeing's license. Boeing will have to submit a final orbital debris mitigation plan and get FCC approval of that final proposal. Also, "Boeing must coordinate physical operations of spacecraft with any operator using similar orbits, for the purpose of eliminating collision risk and minimizing operational impacts," the FCC said.

"Advanced satellite broadband services have an important role to play in connecting hard-to-serve communities. We are committed to a careful and detailed review of all such applications," FCC Chairwoman Jessica Rosenworcel said regarding today's approval.

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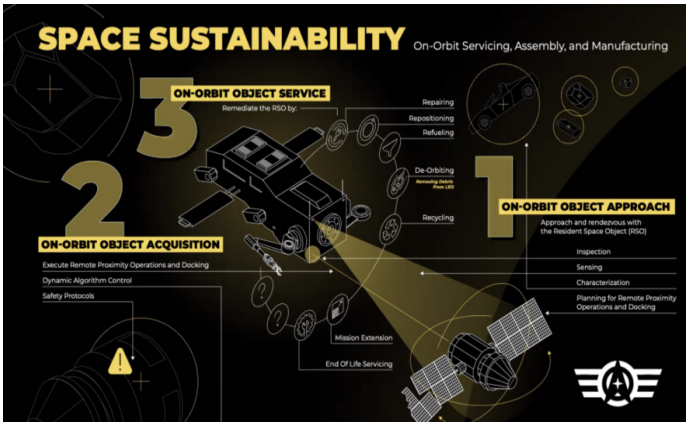
Space Force launches 'Orbital Prime' program to spur market for on-orbit services

Sandra Erwin | 04 November 2021

Source: Space News | https://spacenews.com/space-force-launches-orbital-prime-program-to-spur-market-for-on-orbit-services/



WASHINGTON - The U.S. Space Force is kicking off a new initiative to fund commercially developed technologies for orbital operations.

The program known as "Orbital Prime" will focus on the emerging market sector known as OSAM, short for on-orbit servicing, assembly and manufacturing. This includes a broad range of technologies to repair and refuel existing satellites, remove orbital debris and create new capabilities in space.

Orbital Prime will focus on the emerging market sector known as OSAM, short for on-orbit servicing, assembly and manufacturing.

Orbital Prime is run by SpaceWERX, the space-focused arm of the Air Force technology incubator AFWERX. In 2020 AFWERX sponsored Agility Prime, a project to advance the market for electric-powered pilotless aircraft that take off and land vertically. Orbital Prime will be a similar effort to spur government and private investment in OSAM technologies.

The plan is to award multiple Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) contracts. To compete for Orbital Prime awards, businesses have to partner with academic and nonprofit institutions. Teams can win up to $250,000 in the first round of contracts and up to $1.5 million in the second round. Successful projects will be eligible for much larger "strategic financing" awards that require companies to secure matching funds from private investors. Orbital Prime winners also will get non-monetary assists such as access to testing ranges and mentoring on regulatory and contracting processes.

Orbital Prime Phase 1 contracts could be awarded in early 2022. The goal is to launch an in-space demonstration within three years, Lt. Col. Brian Holt, co-lead of AFWERX Space Prime, told SpaceNews.

Gabe Mounce, deputy director of SpaceWERX, said the entire project could be worth as much as $100 million although it has yet to be determined how much of that will be funded by the government and how much by the private sector.

Mounce said Orbital Prime is intended to help "prime the pump, if you will, on a nascent market in national security space and signal to the industry what direction the government wants to go in."

DoD investment 'long overdue'

Space industry investors welcome initiatives like Orbital Prime, said Meagan Crawford, co-founder and managing partner of the venture capital firm SpaceFund.

The government as a market driver in the OSAM sector is "something that's been talked about for a long time in this industry," Crawford said. With Orbital Prime, the Space Force is "finally planting a flag" and putting in real money.

Among the startups that will be competing for Orbital Prime contracts is Rogue Space Systems. CEO Jeromy Grimmett said the company is working on a cubesat designed to perform in-orbit inspections of other satellites or debris objects.

A Space Force program focused on orbital capabilities is "long overdue," said Grimmett, as the United States is behind other countries in developing technologies to de-orbit satellites and clean up debris

"I think SpaceWERX is going to provide a great pathway to help us advance technologies and start getting ahead and leading the world in these capabilities," Grimmett said. "The market, I really believe, is going to drive some pretty interesting ideas."

Even though a $250,000 SBIR award is not a large sum, "it's a start," he said. "A lot of small companies like us, we need the signal. We need the endorsement. And then the private capital is eventually going to take over."

A company that wins a Phase 1 award, after a performance period of 90 to 120 days can compete for Phase 2 awards of $1 million. The big prize is strategic financing, or STRATFI, which can reach $30 million when combined with private matching investments.

"That is not going to build a fleet, but it will definitely get you going in the right direction," said Grimmett.

It's not just technology that is needed to conduct orbital operations, he said. "You also need a strategy" and a plan for the deployment of spacecraft. In space, just like on Earth, "it's all about location, location, location.".

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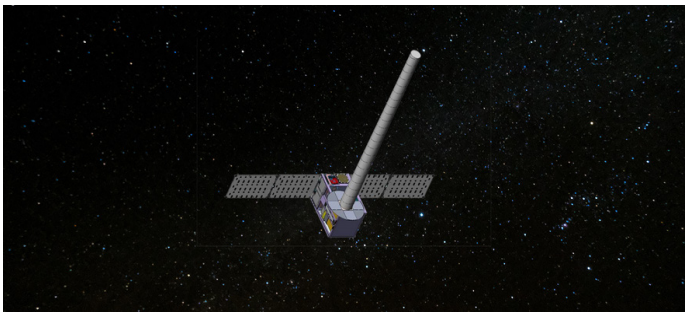
Blue Canyon wins $14 million contract for deep-space inspector satellite

Sandra Erwin | 22 November 2021

Source: Space News | https://spacenews.com/blue-canyon-wins-14-million-contract-for-deep-space-inspector-satellite/



Rendering of a Blue Canyon Technologies satellite equipped with Viasat's Link 16 communications terminal. Credit: Blue Canyon Technologies

WASHINGTON — Blue Canyon Technologies won a $14.6 million contract to produce a small inspector satellite for operations beyond geosynchronous Earth orbit.

According to a Nov. 22 announcement, Blue Canyon was selected by the Air Force Research Laboratory to develop a satellite under AFRL's Space Situational Awareness Micro-Satellite Bus program. The company has to deliver by February 2023 a small satellite bus that can operate and maneuver for up to three years in orbits beyond GEO and can support a broad range of payloads.

Blue Canyon, based in Lafayette, Colorado, is a small satellite manufacturer. In December 2020 it was acquired by Raytheon Technologies.

The Space Situational Awareness Micro-Satellite Bus was a competitive award under a U.S. Air Force Small Business Innovation Research program. The goal is to produce a small space situational awareness satellite system with significant orbital maneuverability so it can move across orbits..

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Russia's state arms exporter to offer kamikaze drones, heavy UAVs to foreign customers

Sandra Erwin | 07 October 2021

Source: TASS | https://tass.com/defense/1366093

National Reconnaissance Office Director Chris Scolese speaks Oct. 7 at the 2021 GEOINT Symposium.

Credit: USGIF

MOSCOW, November 25. /TASS/. Russia's Rosoboronexport (part of the state tech corporation Rostec) is gearing up to offer kamikaze drones and heavy strike unmanned aerial vehicles (UAVs) for exports, Company CEO Alexander Mikheyev said on Thursday.

"Rosoboronexport sees a considerable growth in foreign partners' interest in Russian-made unmanned aerial vehicles. We are preparing to promote new models, in particular, kamikaze drones and heavy strike aerial vehicles," the Company's press office quoted the chief executive as saying.

Russia has offered the Orion-E reconnaissance/strike drone to the world arms market this year and over ten contractual negotiations on this unmanned aerial vehicle are currently underway. Also, Russia has delivered over 50 Orlan-10E drones to customers this year, he added..

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Indian Aerospace Industry

Made-in-India stealth fighter project set to take off in 2022

Rajat Pandit | 22 November 2021

Source: Times of India | https://timesofindia.indiatimes.com/india/made-in-india-stealth-fighter-project-set-to-take-off-in-2022/articleshow/87838884.cms

NEW DELHI: India is now finally getting set to launch its most ambitious indigenous military aviation project to build a fifth-generation fighter or the advanced medium combat aircraft (AMCA) with advanced stealth features as well as 'supercruise' capabilities.

The case for the full-scale engineering development of the twin-engine AMCA prototypes has been finalized and will be sent for approval to the Cabinet Committee on Security (CCS) by early next year after consultations between the defence and finance ministries, top sources said on Sunday.

Production of fifth-generation jets is an extremely complex and expensive affair, with the American F/A-22 Raptor and F-35 Lightning-II Joint Strike Fighter, the Chinese Chengdu J-20 and Russian Sukhoi-57 being the only operational ones around the globe at present.

Experts, however, contend the J-20 and Sukhoi-57 fighters are still somewhat short of being true-blue fifth-generation fighters. The 36 Rafales being inducted by IAF, under the Rs 59,000 crore deal inked with France in September 2016, are 4.5-generation jets.

As of now, the development cost of the 25-tonne AMCA is estimated to be around Rs 15,000 crore, with the first prototype's "rollout" by 2025-26 and production of the Mark--1 jets slated to begin in 2030-31 under the "aggressive timelines" set by DRDO and its Aeronautical Development Agency (ADA). A more realistic timeframe for the AMCA induction to kick-off, however, would be around 2035.

The AMCA project is critical of IAF, which is grappling with just 30-32 fighter squadrons and will not reach its sanctioned strenght of 42 squadons even with "planned inductions" over the next 10-15 years.

The detailed AMCA desgning, which was sanctioned in December 2018, meets IAF's "preliminary staff qualitative requirements" but the requisite powerful engine remains a major problem

Consequently, the first two squadrons of AMCA Mark-1 will have the existing General Election-414 afterburning turbofan engine in the 98 Kilonewton thrust class, while the next five mark-2 squadrons will have a more powerful 110 Kilonewton engine. "With the foreign collaboratir to be selected by early-2022, the new engine will concurrently developed indigenously,: said a sourse.

The advanced strealt features in the swing-role AMCA will range from "seroentine air-intake" and an internal bay from smart weapons to radar absorbing materials and conformal antenna.

The fighter will also have the supercruise capability to achieve supersonic cruise speeds without fusion and multi-sensor integration wit AESA (active electronically scanned array) radars.

In the interim, IAF's planned inductios include 73 Tejas Mark-1A fighters and 10 trainers, which will be delivered in the 2024-2028 timeframe under the Rs 46,898 crore deal inked with Hindustan Aeronautics in February this year.

Then there is the long-pending "Maked in India" project for 114 new-generation fighters with "some fifth-generation capabilities" for over Rs 1.25 lack crore, which has seven foreign contenders and it likely to get the initial "acceptance of nescessity" next year

There are some discussions also underway about whether India should leapfrog from the Tejas Mark-1A directly gto the AMCA. "IAF will certainly require additional Tejas jets after the next 83 are delivered, whether they are enhanced variants of Mark-1A or Mark-2. Many technologies proven in their manufacture will be scaled up for AMCA," said a source

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Govt approves proposal for GSAT-7C satellite for Air Force

23 November2021

Source: Deccan Herald | https://www.deccanherald.com/national/govt-approves-proposal-for-gsat-7c-satellite-for-air-force-1053844.html

The space agency was to launch two earth observation satellites, one navigation satellite, one purely scientific mission, and the first unmanned flight under the Gaganyaan mission as per its revised targets for the year.

Two approved the procurement of GSAT-7C satellite and ground hubs worth Rs 2,236 crore for the Indian Air Force for real-time connectivity of software defined radios.

The complete design, development and launching of satellite will be in India, and it will enhance the ability of Armed Forces to communicate beyond the line of sight, the ministry said.

The decision was taken during Defence Acquisition Council (DAC) meeting held under the chairmanship of Defence Minister Rajnath Singh.

During the meeting, it was accorded Acceptance of Necessity (AoN) for one Capital Acquisition proposal of Indian Air Force for its modernisation and operational needs amounting to Rs 2,236 crore under the category of 'Make in India'.

The procurement proposal of Air Force was for GSAT-7C satellite and ground hubs for real-time connectivity of software defined radios (SDRs).

Induction of GSAT-7C satellite and ground hubs for software defined radios (SDRs) will enhance the ability of Armed Forces to communicate among one another in all circumstances in a secure mode.

SAT-7A is the latest addition to the GSAT series of geosynchronous communications satellites designed and manufactured by the Indian Space Research Organisation (ISRO).

It will enhance the Air Force's global operations and network-centric warfare capabilities.

GSAT-7A spacecraft is configured on ISRO's standard I-2000 kg (I-2K) Bus. The satellite is built to provide communication capability to the users in Ku-band over the Indian region.

ISRO had launched first GSAT-7A on December 19, 2018. At present, the satellite is placed in an orbit with a perigee (nearest point to earth) of 35,800 km and Apogee (farthest point to earth) of 36,092 km with 0.2 deg inclination which is very close to the its final orbit, the ISRO said.

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Technology Development

Hack-proof communication network, self-eating-rockets, vanishing-satellites: ISRO working on disruptive future tech

Sibu Tripathi | 23 November 2021

Source: India Today | https://www.indiatoday.in/science/story/hack-proof-communication-network-self-eating-rockets-vanishing-satellites-isro-working-on-disruptive-future-tech-1880068-2021-11-23

Isro is also working on finding a solution to space debris | Isro (Representative Image)

The Indian Space Research Organisation (Isro) is working on several key technologies as the space race intensifies. The Indian space agency is exploring new tools from quantum communications to self-vanishing satellites to humanoid robots to sharpen its edges as it competes with global giants like Nasa and Roscosmos.

Isro chairman K Sivan on Tuesday highlighted the new technologies at the 'DTDI-Technology-Conclave-2021, a summit aimed at unlocking the potential tech for the space sector.

Sivan mentioned a plethora of futuristic technologies on which Isro has initiated research and development, including satellite-based quantum communication, quantum radar, self-eating-rocket, self-vanishing-satellite, self-healing materials, humanoid robotics, space-based-solar-power, intelligent satellites and space-vehicles, make-in-space concept, artificial-intelligence-based space applications among others.

New technologies like self-eating rockets will revolutionise the space sector, which is marred by growing concerns about space debris. Recent debris created by an anti-satellite test from Russia had endangered not just the International Space Station (ISS) but also the astronauts onboard. Isro is working on finding a solution to debris created from defunct satellites in orbit or rocket boosters and payload fairings that remain in orbit post launch.

Meanwhile, its research on quantum communication will make the relay faster and much more secure in the coming era of quantum computers that explore quantum mechanics. Isro tested this technology in an open space separated by 300 meters earlier this year. China already has a satellite dedicated to quantum information science, Micius, and demonstrated quantum communication in a laboratory over a coiled optical fibre up to 404 kilometers long.

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US Air Force Tests Smart 'StormBreaker' Munition on F-35 Fighter Jets

Ameya Paleja | 25 November 2021

Source: Interesting Engineering | https://interestingengineering.com/us-air-force-tests-smart-stormbreaker-munition-on-f-35-fighter-jets

The weapon can classify and prioritize targets

The U.S. Air Force has begun the process of integrating the StormBreaker smart weapon on its F-35 Joint Striker aircraft and recently conducted a drop test, said a press release from the makers of the weapon, Raytheon Missiles and Defense.

StormBreaker, known through its development as the Small Diameter Bomb (SDB) II, is an air-launched glide bomb. Bad weather, smoke, or dust can be used by adversaries as a cover from fighter aircraft weaponry. The U.S. military was therefore keen on a weapon that could work even in inclement weather.

Raytheon's offering for such a weapon was a small bomb not more than seven inches (18 cm) wide, 69 inches (176 cm) long weighing just over 200 pounds (93 kg). Due to their relatively small size, the U.S. military can pack up to 20 such weapons on a single F-15E Strike Eagle.

Adding to the firepower on the StormBreaker are the different capabilities of its warheads. According to the press release, the StormBreaker is equipped with "shape charge jets, fragmentation, and blast charge effects." What this essentially means is that the bomb can be used against a wide range of targets ranging from infantry to structures, armors as well as patrolling boats. Raytheon also boasts of an optional smart delayed fuze that is powerful enough to blow up a tank.

It is the tri-mode seeker that makes the SDB II, the StormBreaker that it claims to be. Equipped with an infrared imager and multimeter wave radar, the weapon can seek its targets in fog, smoke, and even heavy rains. It can then use data from semi-active laser or GPS-based guidance systems to identify its target. Users also have the option of a semi-autonomous mode, where the weapon can use the data to classify and prioritize potential targets before hitting them.

With a range of 45 miles (72 km) for stationary as well moving targets, fighter aircraft can aim at their targets from safe distances without engaging in high-risk areas. Thanks to its networking capabilities, the weapon can be fired, and its control then handed over to another platform to complete the mission, Raytheon claims.

Last year, the U.S. Air Force cleared the StormBreaker for use on the F-15s and initiated the trials on the F/A-18E/F Super Hornets which are next in line to get the weapon. The drop test on the F-35 was to check the communication link between the weapon and a secondary aircraft, Raytheon said in its press release.

As workhorses for the U.S. military in the near future, the F-35s definitely need such a versatile weapon.

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A famous photograph showing test pilot George Aird ejecting from a pre-production version of the English Electric #Lightning fighter in September 1962.

Fortunately the pilot survived after coming down in a greenhouse full of tomatoes

Spot the difference : American F-35 Vs Chinese J -31

When everything seems to be going against you, remember that the airplane takes off against the wind, not with it.

- Henry Ford

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

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

Editorial Team: AVM Anil Golani, Gp Capt T H Anand Rao,

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