CENTRE FOR AIR POWER STUDIES (CAPS)
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AEROSPACE NEWSLETTER

We wish all our readers good health and happiness in the New Year 2022

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""Man must rise above the Earth—to the top of the atmosphere and beyond—for only thus will he fully understand the world in which he lives."

- Socrates, circa 399 BC

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Opinions and Analysis

Requiem For A True Soldier

Air Vice Marshal Anil Golani (Retd)

Additional Director General, Centre for Air Power Studies | 24 December 2021

Source: Bharat Shakti | https://bharatshakti.in/requiem-for-a-true-soldier/

There will be an added push on 'Atmanirbhar Bharat' in defence in 2022. (Representative photo/ Reuters)

While speculation is rife on the appointment of the next CDS, after the tragic and untimely demise of Gen Bipin Rawat, and clamour for urgency grows in the media, the government of the day goes about silently, doing what needs to be done. There is a process that needs to be followed, with due diligence, and unnecessary speculation and lobbying must give way to patience and faith in the system.

The Department of Military Affairs or DMA, that got created with the appointment of the CDS in December 2019 was a monumental reform executed by the present government towards increasing synergy and accountability in the existing system. As per its mandate, the DMA was to play a crucial role in bringing jointness in procurement, training, posting and staffing for the services through joint planning and integration of their requirements. In addition, the DMA also proposed integration through the formation of theatre commands, which was a 'work in progress' at the time of the untimely demise of the Secretary DMA, Gen Bipin Rawat.

The fact that the persona of Gen Bipin Rawat lent urgency to implement change and bring about reform should not lead us to despondency or despair that the reforms would not progress or get derailed in his absence. While people or personalities, especially leaders leave their legacies, men in uniform must ceaselessly and silently continue doing what must be done and need to be done in the national interest. The mettle of a true military leader though not tested in major battles or conflicts, nonetheless, is forged through years of training, sweat and toil and in consonance with the adage, "The more you sweat in peace, the less you bleed in war."

There appears to be undue importance given to the present situation that lends itself to the post of the CDS being occupied by an Army General. The justification that has come in some quarters is based on the logic that since India has unresolved border issues with our neighbours and there is an active engagement across the 'line of control, LoC' and the 'line of actual control, LAC,' an Army General would be best suited for the job at hand. This logic tends to not only sways us away from the mandate of the CDS and the QRs for the incumbent but also lends credibility to the very opposite of what has been envisaged in the military reforms in the creation of the DMA i.e

synergy and jointness towards the attainment of national objectives through the military.

The present scenario may find itself in favour of the serving Army Chief being considered as the best choice if the seniority principle is applied, but should that be the case? The other chiefs are no less if the capability is to be considered, having reached the pinnacle of their careers as service chiefs.

If the situation at present is unprecedented, so could the choices be, as long as national interest reigns supreme. The factor of mutual trust and faith also comes in when relationships between political and military leaders weigh in during the decision-making process. The equation between Prime Minister Jawaharlal Nehru and Gen BM Kaul during the 1962 Indo – China war and the relationship between Mrs Indira Gandhi and Field Marshal, then General Sam Manekshaw leading to the 1971 Indo – Pak war is much talked and written about.

Both the Prime Ministers, father and daughter, shared uncanny ease and similarity in their equations with the military leaders of the day, albeit leading to widely contrasting and diverse consequences. In the aftermath of the 1962 conflict, Gen BM Kaul resigned and Gen Sam Manekshaw was made the first Indian Field Marshal. The consequences of the Indo-China war even after six decades are still being felt with a continuing unease in the situation along the LAC, while the 1971 conflict lead to the emergence of a new nation, Bangladesh, which continues to prosper and grow.

The nation collectively mourned the loss of Gen Bipin Rawat and his spouse Mrs Madhulika Rawat, and the twelve others that perished in the unfortunate crash of the Mi17 V5 on 8 December, as never before. The outpouring of grief and mourning cut across the nation, through regions and religions and communities with an emotion that truly portrayed our country as a great secular democracy that binds together its varied tapestry, unflinchingly, into a bond that cannot be easily severed.

We must also, however, refrain from jingoism, as every life lost in the service of the nation is one too many. The death of Mrs Madulika Rawat, the spouse of the senior-most serving military officer in uniform, in the line of duty, should also serve as a reminder to the nation of the sacrifice and the perils that the families of men in uniform have to endure in their silent service to the nation.

The men in uniform, serving or veterans must abide by the ethos of the soldier that calls upon them to silently do what needs to be done in the line of duty, and a true requiem for Gen Bipin Rawat and his entourage would be to have faith in the nation and its leaders. The political establishment reposes trust and faith in the military, to deliver when the need arises, and the same must be reciprocated by the military in equal measure.

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Future Ready: Defence Forces Eye Modernisation Through Indigenisation, CDS Appointment in 2022

Amrita Nayak Dutta | 22 December 2021

Source: News 18 | https://www.news18.com/news/india/future-ready-defence-forces-eye-modernisation-through-indigenisation-cds-appointment-in-2022-4576862.html

There will be an added push on 'Atmanirbhar Bharat' in defence in 2022. (Representative photo/Reuters)

The year 2021 was a mixed bag for the Indian defence establishment and clearly, quite challenging for the Indian Armed Forces, in terms of operational matters, even as there was a significant progress on key acquisitions and modernisation of defence forces.

Amidst China standoff and tension in northeast, the government is pushing for self-reliance in defence. Big acquisitions, which will add to defence capabilities, will be delivered in 2022.

If one has to touch upon a few of the key operational challenges the Indian defence forces faced this year, the continuing impasse at the Line of Actual Control (LAC) with China remains right at the top of the list.

Then, there was no headway in about a month-long anti-terror operation near the Line of Control (LoC) in Poonch, after nine Indian soldiers were killed in firing exchanges with terrorists in October.

There were troubles in the northeast too. In November, the commanding officer of 46 Assam Rifles, his family and four other soldiers were killed by insurgents in an ambush in Manipur.

The botched operation by the Army's special forces in Nagaland killed 14, including 13 civilians earlier this month. A Court of Inquiry and a special investigation team are looking into the incident even as locals protest across the state over the repeal of Armed Forces Special Powers Act (AFSPA).

As the year was drawing to a close, India's first Chief of Defence Staff General Bipin Rawat was killed in a tragic helicopter crash on December 8 along with his wife, and 12 Army and Indian Air Force personnel, leaving the country in shock

The Narendra Modi government has begun the process of narrowing down on the next CDS of the country who will take forward the agenda of creating theatre commands and bringing jointness within the defence services.

Modernisation of Armed Forces, however, saw some progress with a few major acquisitions carried out under the emergency powers and some deliveries of the defence platforms for which the contracts were signed in the previous years.

For instance, 33 French Rafale fighters of the 36 earlier bought have already been delivered to India and has been inducted into the IAF.

Similarly, Russia has also begun deliveries of the S-400 air defence system. The long-pending

deal of jointly manufacturing AK 203 assault rifles in Amethi was also signed with Russia earlier this month when President Vladimir Putin visited India.

Last month, the Navy commissioned Visakhapatnam, the first of the P 15B destroyers. The service has also commissioned four of the six boats of the indigenous Scorpene class submarines—the third boat, Karanj, was commissioned in March, and the fourth boat, Vela, in November. The fifth boat, Vagir, has also been launched.

Moreover, in the backdrop of the military standoff with China, the services have procured significant quantities of ammunition and spares.

Under the emergency powers, the defence ministry has also initiated a few critical capital procurements—ranging from anti-drone systems to additional numbers of HAMMER air-to-ground precision-guided weapon systems for its Rafale fighter jets.

Armour-piercing fin-stabilised discarding sabot (APFSDS) ammunition fired by the T-72 and T-90 main battle tanks, more number of Heron drones, Man Portable Air Defence System (MANPADS) as well as loitering munitions, Spice Bombs, were some of the other procurements.

Both 2020 and 2021 saw major progress in the border infrastructure front, particularly in the northeastern states and close to the LAC in eastern Ladakh.

In October, the defence ministry announced the launch of five major road projects in Ladakh to be carried out by the Border Roads Organisation (BRO). Earlier this year, defence minister Rajnath Singh inaugurated 10 roads in Arunachal Pradesh, and one each in the Union Territories of Ladakh and Jammu and Kashmir. Eleven bridges were also inaugurated in Ladakh this year.

Among higher defence reforms, Gen Rawat had aggressively begun pursuing the exercise of integration in the armed forces by initiating multiple studies on forming the theatre commands and their structures.

Much of the work was also centered around improving defence procurements—both for faster purchases and providing a push to the government's 'Atmanirbhar Bharat' plans.

For instance, the revised Delegation of Financial Powers to Defence Services (DFPDS-2021) was unveiled by Rajnath Singh in September this year, which gave out details of financial powers allotted to the three defence services.

Similarly, the defence ministry came out with a second positive indigenisation list of 108 items to push for the 'Atmanirbhar Bharat' campaign. The first list of 101 items was notified in August 2020.

Modernisation of Indian Military in 2022

The defence establishment is looking forward to the appointment of the next CDS who will carry forward the agenda of modernising the Indian military and establishing theatre commands. The process of shortlisting the officer is also underway in the government.

Some of the major acquisitions of the Armed Forces, which will add to India's defence capabilities, will be finally delivered in 2022. This includes a variety of drones—such as four Israeli Heron TPs—which were bought last year.

The deliveries of the remaining three Rafale jets, their armaments, such as the HAMMER weapon systems, are expected to be delivered by 2022.

A large number of spares for the weapon systems currently in use as well as ammunition, bought under emergency powers, are also likely to be delivered by 2022.

It remains to be seen if there would be any further progress on some of the major capital purchases from foreign countries which were on cards—such as the Kamov 226-T helicopters and the Igla-S Very Short Range Air Defence (VSHORAD) systems from Russia, as well as the naval utility helicopters planned to be bought under the strategic partnership route and the 30 predator drones that India is seeking to buy from the United States.

State-owned Hindustan Aeronautics Ltd (HAL) will manufacture four light utility helicopters (LUHs) under limited series production by 2022-23, with the defence ministry approving the procurement of 12 LUH from the PSU for around Rs 1,500 crore in November this year.

HAL has also started deliveries for the Light Combat Helicopters but it is yet to sign a contract with the defence ministry for production. There is also likely to be some decision on the procurement of the Advanced Towed Artillery Gun System (ATAGS) being developed by DRDO.

News18.com has learnt that there will be an added push on 'Atmanirbhar Bharat' in defence in 2022.

There is likely to be a third positive indigenisation list, and a higher share of capital procurement budget in 2022, up from the 64%, that was earmarked for the current financial year.

Additionally, a defence procurement manual is also likely to drafted that will lay down rules for all defence revenue procurements.

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India's Nuclear Arsenal Takes A Big Step Forward

Matt Korda and Hans Kristensen | 23 December 2021

Source: Fadration of American Scientists | https://fas.org/blogs/security/2021/12/indias-nuclear-arsenal-takes-a-big-step-forward/

Following both launches of the Agni-P, the Indian Government referred to the missile as a "new generation" nuclear-capable ballistic missile. Back in 2016, when the Defence Research and Development Organisation (DRDO) first announced the development of the Agni-P (which was called the Agni-1P at the time), a senior DRDO official explained why this missile was so special

On 18 December 2021, India tested its new Agni-P medium-range ballistic missile from its Integrated Test Range on Abdul Kalam Island. This was the second test of the missile, the first test having been conducted in June 2021.

Our friends at Planet Labs PBC managed to capture an image of the Agni-P launcher sitting on the launch pad the day before the test took place.

"As our ballistic missiles grew in range, our technology grew in sophistication. Now the early, short-range missiles, which incorporate older technologies, will be replaced by missiles with more advanced technologies. Call it backward integration of technology."

The Agni-P is India's first shorter-range missile to incorporate technologies now found in the newer Agni-IV and -V ballistic missiles, including more advanced rocket motors, propellants, avionics, and navigation systems.

Most notably, the Agni-P also incorporates a new feature seen on India's new Agni-V intermediate-range ballistic missiles that has the potential to impact strategic stability: canisterization. And the launcher used in the Agni-P launch appears to have increased mobility. There are also unconfirmed rumors that the Agni-P and Agni-V might have the capability to launch multiple warheads.

Canisterization

"Canisterizing" refers to storing missiles inside a sealed, climate-controlled tube to protect them from the outside elements during transportation. In this configuration, the warhead can be permanently mated with the missile instead of having to be installed prior to launch, which would significantly reduce the amount of time needed to launch nuclear weapons in a crisis. This is a new feature of India's Strategic Forces Command's increased emphasis on readiness. In recent years, former senior civilian and military officials have reportedly suggested in interviews that "some portion of India's nuclear force, particularly those weapons and capabilities designed for use against Pakistan, are now kept at a high state of readiness, capable of being operationalized and released within seconds or minutes in a crisis—

not hours, as had been assumed."

If Indian warheads are increasingly mated to their delivery systems, then it would be harder for an adversary to detect when a crisis is about to rise to the nuclear threshold. With separated warheads and delivery systems, the signals involved with mating the two would be more visible in a crisis, and the process itself would take longer. But widespread canisterization with fully armed missiles would shorten warning time. This would likely cause Pakistan to increase the readiness of its missiles as well and shorten its launch procedures—steps that could increase crisis instability and potentially raise the likelihood of nuclear use in a regional crisis. As Vipin Narang and Christopher Clary noted in a 2019 article for International Security, this development "enables India to possibly release a full counterforce strike with few indications to Pakistan that it was coming (a necessary precondition for success). If Pakistan believed that India had a 'comprehensive first strike' strategy and with no indication of when a strike was coming, crisis instability would be amplified significantly."

For years, it was evident that India's new Agni-V intermediate-range missile (the Indian Ministry of Defense says Agni-V has a range of up to 5,000 kilometers; the US military says the range is over 5,000 kilometers but not ICBM range) would be canisterized; however, the introduction of the shorter-range, canisterized Agni-P suggests that India ultimately intends to incorporate canisterization technology across its suite of land-based nuclear delivery systems, encompassing both shorter- and longer-range missiles. While Agni-V is a new addition to India's arsenal, Arni-P might be intended—once it becomes operational—to replace India's older Agni-I and Agni-II systems.

MIRV technology

It appears that India is also developing technology to potentially deploy multiple warheads on each missile. There is still uncertainty about how advanced this technology is and whether it would enable independent targeting of each warhead (using multiple independently-targetable reentry vehicles, or MIRVs) or simply multiple payloads against the same target.

The Agni-P test in June 2021 was rumored to have used two maneuverable decoys to simulate a MIRVed payload, with unnamed Indian defense sources suggesting that a functional MIRV capability will take another two years to develop and flight-test. The Indian MOD press release did not mention payloads. It is unclear whether the December 2021 test utilized decoys in a similar manner.

In 2013, the director-general of DRDO noted in an interview that "Our design activity on the development and production of MIRV is at an advanced stage today. We are designing the MIRVs, we are integrating [them] with Agni IV and Agni V missiles." In October 2021, the Indian Strategic Forces Command conducted its first user trial of the Agni-V in full operational configuration, which was rumored to have tested MIRV technology. The MOD press release did

not mention MIRVs.

If India succeeds in developing an operational MIRV capability for its ballistic missiles, it would be able to strike more targets with fewer missiles, thus potentially exacerbating crisis instability with Pakistan. If either country believed that India could potentially conduct a decapitating or significant first strike against Pakistan, a serious crisis could potentially go nuclear with little advance warning. Indian missiles with MIRVs would become more important targets for an adversary to destroy before they could be launched to reduce the damage India could inflict. Additionally, India's MIRVs might prompt Indian decision-makers to try and preemptively disarm Pakistan in a crisis.

India's other nuclear adversary, China, has already developed MIRV capability for some of its long-range missiles and is significantly increasing its nuclear arsenal, which might be a factor in India's pursuit of MIRV technology. A MIRV race between the two countries would have significant implications for nuclear force levels and regional stability. For India, MIRV capability would allow it to more rapidly increase its nuclear stockpile in the future, if it so decided—especially if its plutonium production capability can make use of the unsafeguarded breeder reactors that are currently under construction.

Implications for India's nuclear policy

India has long adhered to a nuclear no-first-use (NFU) policy and in 2020 India officially stated that there has been no change in its NFU policy. Moreover, the Agni-V test launch in October 2021 was accompanied by a reaffirmation of a "'credible minimum deterrence' that underpins the commitment to 'No First Use'."

At the same time, however, the pledge to NFU has been caveated, watered-down, and called into question by government statements and recent scholarship. The increased readiness and pursuit of MIRV capability for India's strategic forces could further complicate India's adherence to its NFU policy and could potentially cause India's nuclear adversaries to doubt its NFU policy altogether.

Given that Indian security forces have repeatedly clashed with both Pakistani and Chinese troops during recent border disputes, potentially destabilizing developments in India's nuclear arsenal should concern all those who want to keep regional tensions below boiling point.

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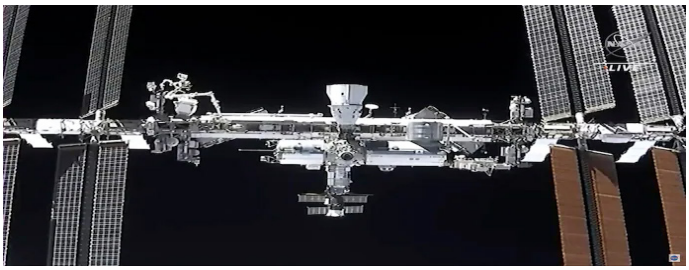
Tensions with Russia are now spilling into space, complicating International Space Station partnership

Christian Davenport | 21 December 2021

Source: Washington Post | https://www.washingtonpost.com/technology/2021/12/21/us-russia-space-station-tension/



The International Space Station, seen from the SpaceX Crew Dragon spacecraft, on Apr. 24. (NASA TV/AP)

For more than 20 years, the International Space Station has served not just as an orbiting laboratory for science but as a vehicle for diplomacy, hosting astronauts from 19 different countries who work side-by-side in space when, in some cases, their leaders could not get along on the ground.

The size of a football field and hurtling through space at 17,500 mph, the station has been a symbol of collaboration through wars and turmoil, and is, to many in the space community, worthy of a Nobel Peace Prize to recognize it as "the largest international peacetime endeavor in human history," as Dylan Taylor, a longtime space entrepreneur, argued in a 2020 blog post.

But the fragile coalition that has kept the space station going all these years is fraying, as tensions between Russia and the United States, the two main partners on the station, grow to levels not seen in years. And while the countries have kept their alliance on the station going despite geopolitical tensions, the fence that has kept the station and civil space endeavors walled off from other problems is beginning to erode.

All of which are complicating efforts to extend the life of the station and keep the partnership going.

The space station "might be a high-water mark for U.S.-Russia relations," said Scott Pace, the director of the Space Policy Institute at George Washington University and the executive secretary of the National Space Council during the Trump administration. "But it's not invulnerable … If we were to start over today, we would not have the Russians as partners on the station. That was done in another, more hopeful, era."

Today, Russia and the United States are at odds over several issues, including Russia's possible invasion of Ukraine. The Biden administration has also leveled sanctions on Russian leaders for the poisoning of Alexei Navalny, the opposition leader and one of Russian President Vladimir Putin's most outspoken critics. It also has sanctioned Russia for its interference in U.S. elections as well as punishing Russian companies for supporting Russian hackers.

To make matters worse, Gen. David Thompson, the Space Force's first vice chief of space operations, recently told The Post that Russia and China are constantly attacking U.S. satellites a number of ways, including lasers, jammers and cyber breaches.

"The threats are really growing and expanding every single day," he said. "And it's really an evolution of activity that's been happening for a long time."

The tensions have breached the sanctity of the

countries' civil space efforts, which traditionally have been walled off from military and political skirmishes.

Last month, Russia fired a missile that destroyed one of its dead weather satellites, creating a massive field of more than 1,500 pieces of debris that threatened the space station. After the test, NASA astronauts and Russian cosmonauts had to huddle in their spacecraft, waiting to see if the station was hit and if they would have to abandon it for home.

The missile strike was roundly condemned by members of the Biden administration.

"By blasting debris across space, this irresponsible act endangered the satellites of other nations, as well as astronauts in the International Space Station," Vice President Harris, who serves as the chair of the National Space Council, said earlier this month.

NASA Administrator Bill Nelson called it "reckless and dangerous" and said he was "outraged by this irresponsible and destabilizing action." He added that the attack was an act of the military and that he believed members of the Russian space agency "didn't know anything about this. And they're probably just as appalled as we are."

Earlier this year, Ars Technica reported that Russian officials accused NASA astronaut Serena Auñón-Chancellor of drilling a hole in the space station during a personal crisis. After the article was published, top NASA officials came to her defense. "We stand behind Serena and her professional conduct," Kathy Lueders, NASA's associate administrator of the space operations mission directorate wrote on Twitter. "We do not believe there is any credibility to these accusations."

The tensions will complicate plans to extend the life of the space station, which after more than 20 years in the vacuum of space, is showing signs of age. Congress is expected to extend the life of the station to 2030, and NASA is looking ahead to what would replace it. Instead of building a government-owned and operated station, NASA instead wants to help commercial companies develop stations of their own that it could then use.

This month, NASA awarded three contracts, worth $415.6 million combined, to Jeff Bezos's Blue Origin, Nanoracks and Northrop Grumman, to begin development of commercial stations. But it's not clear when those would be ready.

To avoid a gap in the meantime, NASA needs to keep the ISS going. But Russia's actions are making that complicated.

The idea for international collaboration had been around for years but finally was approved in 1993 as part of an effort to boost ties with Russia and its President Boris Yeltsin. At the time, The Washington Post reported that the Clinton administration "painted the Russian partnership as a historic opportunity to beat swords into plowshares, or more literally to convert the deadly missiles of the Cold War into peaceful long haul trucking for the orbital facility."

The ISS was "the product of a fairly unique moment in time when the U.S. government was looking to change the relationship it had with Russia following the collapse of the Soviet Union," said

Brian Weeden, the director of program planning at the Secure World Foundation, a think tank. The station was born "for foreign policy reasons and to keep Soviet scientists and engineers working on space instead of selling their services to the highest bidder. It's clear those conditions have changed."

The tension also fueled in part by the fact that NASA no longer needs to pay Russia to transport its astronauts to the space station. After NASA retired the space shuttle in 2011, Russia significantly jacked up the price for launches to the station, reaching as high as about $85 million a seat and creating a steady revenue stream for the struggling space agency.

But along came Elon Musk's SpaceX. Under contract from NASA, it has restored human spaceflight from U.S. soil for the space agency last year, ending its dependency on Russia. That Weeden, said, has further destabilized the relationship.

"SpaceX has broken that monopoly," he said. "The U.S. doesn't need Russia to get to the space station anymore, And SpaceX is eating into, if not destroying Russia's commercial space launch business. So Russia feels like it is under quite a bit of threat from SpaceX."

Russia has also indicated it is willing to partner with China, which has begun to assemble a space station of its own in Earth's orbit. But unlike the partnership with the United States on the ISS, Russia would likely not be an equal partner on the Chinese station, officials have said.

As for extending the life of the ISS, Weeden said, "politically, that's going to be very difficult to do after what's happened over the past several years."

Despite the turmoil on the ground, there continues to be strong cooperation among the astronauts and cosmonauts engineers and technical leaders, who have long put politics aside. "We trust them and operate day-in, day-out with them," Pace said. American astronauts study Russian and work and live for long stretches in Russia, coming away with an understanding of the culture and respect for their counterparts.

Remaining bound together through the space program will ensure that the two countries share the same interests and work together to keep the astronauts and cosmonauts who live together on the space station alive. Russia recently announced that it would send a cosmonaut, Anna Kikina, to fly on SpaceX's Dragon spacecraft next year. A NASA astronaut is expected to fly on a Russian Soyuz rocket next year as well.

In a statement to The Post, Nelson said NASA wants the partnership with Russia to continue.

"For more than 20 years, NASA astronauts and Roscosmos cosmonauts have lived and worked together on the International Space Station — a success story that has yielded countless discoveries and enabled research not possible on Earth," the statement said. "That's the power of space — to unite nations for the benefit of humanity — and NASA is committed to continuing our very effective ISS partnership."

Having the Russians tied to the station is a good thing for future relations in space, said Todd Harrison, director of the Aerospace Security Project

at the Center for Strategic and International Studies.

"If anything, Russia conducting the [antisatellite missile] test is more reason to keep them on the station with us," he said. "If they're going to be creating thousands of pieces of debris, threatening the station, I'd like to have some of their cosmonauts bearing the risk. If they're not, then Russia has even less reason to be a good actor in space."

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Approaching the Third Rail? A Trilateral Treaty to Prohibit Space-Based Missile Defenses

16 December 2021

Source: Carnegie Endowment for International Peace | https://carnegieendowment.org/2021/12/16/approaching-third-rail-trilateral-treaty-to-prohibit-space-based-missile-defenses-pub-85965

Over the past few years, the United States has restarted its efforts to develop space-based missile defenses. In 2018, the U.S. Congress directed the Department of Defense to identify potential technologies for, and to estimate the costs of, deploying a space-based missile defense layer. Research into space-based defenses was funded throughout the remainder of the Trump administration. Given their absence from the Biden administration's Fiscal Year 2021 budget request, their short-term future is less clear—although, over the long term, the United States is likely to remain interested in them, while China and Russia are likely to remain concerned about them.

Space-based missile defenses—involving kinetic interceptors or nonkinetic technologies, such as directed-energy weapons—are capable, at least in theory, of addressing some of the weaknesses of terrestrial missile defense systems. For example, the United States' Ground-based Midcourse Defense system is vulnerable to decoys deployed in the vacuum of space or to hypersonic gliders that fly below the interceptors' engagement altitude. Space-based defenses could

overcome such countermeasures by engaging a missile in its boost phase, while its engines are still operating and before decoys can be deployed or a glider released. Alternatively, space-based defenses could be configured to intercept ballistic missiles during their midcourse phase when they are unpowered. In particular, directed-energy weapons offer the potential to engage large numbers of incoming warheads (and decoys).

Chinese and Russian officials have repeatedly expressed concerns over existing and possible future U.S. ballistic missile defenses. Russia's developmental exotic weapons are intended to circumvent them. Because some of these weapons—the Burevestnik cruise missile and Poseidon torpedo, in particular—could evade space-based interceptors, concerns that the United States may develop and deploy space-based defenses could make Russia less amenable to limits on its exotic systems. U.S. officials, meanwhile, have claimed that China is "looking at" nuclear-powered cruise missiles and torpedoes, perhaps because many of its existing programs to combat U.S. missile defenses—including arming missiles with multiple warheads and developing an intercontinental hypersonic glider—could theoretically be vulnerable to space-based defenses.

China, Russia, and the United States should conclude a treaty prohibiting the testing or deployment of space-based missile defense weapons.

These concerns may also lead China and Russia to deploy anti-satellite weapons in even larger numbers than currently planned to ensure that they are able to target the satellites on which interceptors would be based or the sensors that would enable them. Such deployments, even if undertaken solely to combat missile defenses, would increase the threat to all U.S. assets in low-Earth orbit.

Space-based missile defenses could also create significant escalation pressures for two reasons. First, to be most effective, attacks on space-based missile defenses would need to occur in advance of a nuclear exchange. Thus, if Russia, say, perceived an impending attack against its nuclear forces, it might attack space-based interceptors or their enabling capabilities preemptively (assuming, that is, that those enabling capabilities, which would include dual-use early-warning sensors, had not already been attacked during the preceding phases of the conflict). Second, space-based interceptors themselves could be used as anti-satellite weapons and thus be attacked, potentially quite early in a conflict, as a way to protect the satellites used to support conventional operations.

In addition to these risks, space-based missile defenses present daunting technical challenges and are likely to be extraordinarily expensive. To engage ballistic missiles during their boost phase, a space-based missile defense system would need to be designed so that interceptors were always located relatively close to all potential missile launch sites. Because satellites in low-Earth orbit are in constant motion relative to the Earth's surface, hundreds of platforms—close to a thousand, in fact, for global coverage—would be needed. Because missiles could be safely fired

during any gaps in coverage, which all participants have the space awareness capabilities to identify, space-based defenses would likely have no meaningful capability at all until hundreds of interceptors had been placed in orbit. Moreover, to combat missile volleys, each platform would need to be capable of engaging multiple targets in quick succession.

The development of a space-based system designed to intercept missiles during the midcourse phase of their flight would be somewhat less demanding—though still extremely difficult—because only tens of satellites might be required. However, such a system would also be less effective since incoming ballistic missiles would have a chance to release multiple warheads, decoys, and other countermeasures, and incoming gliders might have dropped below the minimum engagement altitude. Moreover, the kinds of high-powered, low-weight lasers and power supplies that could make such a system even remotely plausible are still a long way from being developed.

Space-based missile defenses present daunting technical challenges and are likely to be extraordinarily expensive.

As a result, the United States is unlikely to ever deploy a meaningful space-based missile defense capability. Nonetheless, its investments in technology development will continue to spur China and Russia to develop countermeasures. This is the central irony of space-based missile defense systems: the United States is likely to pay a significant political and strategic price for a system from which it will never benefit.

SOLUTION CONCEPT

A trilateral prohibition on the testing and deployment of any space-based weapons designed to counter ballistic or boost-glide missiles would provide a verifiable means to manage concerns about space-based defenses. It would apply to all such weapons—kinetic or nonkinetic—but would not affect the deployment of space-based sensors to detect missile launches or track missiles during flight. Such a ban would not require any state to forsake a capability that it was remotely likely to deploy but would lessen Chinese and Russian incentives to develop or retain potentially destabilizing countermeasures, such as exotic strategic capabilities and sophisticated anti-satellite capabilities.

In theory, a state would need to overcome two major hurdles to deploy a useful space-based missile defense system. First, space-based interceptors would need to be tested under realistic conditions—that is, launched from orbit to engage targets in the atmosphere. Without testing, space-based missile defenses would probably be highly ineffective. Indeed, the United States' experience with its Ground-based Midcourse Defense system highlights the challenges of obtaining reliability even after more than two decades of testing. Second, hundreds or thousands of interceptor platforms would need to be built and launched into orbit, requiring many dozens, if not hundreds, of launches—which is well beyond the ability of any of these countries to conduct in a limited time with current launch

resources.

Although prohibiting either testing or deployment would be enough to prevent the development of reliable space-based missile defenses, the proposed prohibition covers both, while relying on National Technical Means for verification. The proposed fifteen-year time horizon, with an option to extend the agreement in five-year increments, represents a potential compromise between the United States (which would likely prefer a politically binding agreement) and China and Russia (which would presumably prefer a treaty with no expiration provisions).

The United States is unlikely to ever deploy a meaningful space-based missile defense capability. Nonetheless, its investments in technology development will continue to spur China and Russia to develop countermeasures.

A PROHIBITION ON THE TESTING AND DEPLOYMENT OF SPACE-BASED MISSILE DEFENSE WEAPONS

China, Russia, and the United States should conclude a treaty prohibiting the testing or deployment of space-based missile defense weapons for fifteen years, with the option of extending the agreement in five-year increments by mutual consent.

Specifically, the parties should agree to prohibit the following:

- The testing of space-based missile defense weapons
- The deployment of space-based missile defense weapons in orbit

In implementing these provisions, the following definitions would apply:

- "Space-based missile defense weapon" means any weapon, based on any physical principle, that is located in Earth orbit and designed to counter ballistic missiles or boost-glide missiles or their elements in flight trajectory.
- "Ballistic missile" means a weapon-delivery vehicle that has a ballistic trajectory over most of its flight path.
- "Boost-glide missile" means a weapon-delivery vehicle that sustains unpowered flight through the use of aerodynamic lift over most of its flight path. A reaction control system designed to change a vehicle's attitude is not considered capable of powering flight.

The parties should hold an annual implementation meeting to discuss compliance or implementation issues. They should also commit to discussing urgent compliance concerns through regular diplomatic channels.

VERIFICATION

The prohibition would be verified through National Technical Means (NTM), with efforts primarily focused on assessing compliance with the ban on testing.

Preparations for the launch of a target missile could be monitored with satellite imagery and potentially other information-collection techniques (including signals and human intelligence). Such preparations would probably not constitute definitive evidence of noncompliance since it would likely be unclear

whether the planned test was of a prohibited space-based missile defense weapon, but they could cue enhanced intelligence-gathering efforts.

The test itself would present various opportunities for detection, depending on whether the missile defense weapon was kinetic or nonkinetic and at what point in its trajectory the target missile was engaged. In all cases, the launch of the target missile could be monitored with early-warning satellites. For a successful boost-phase engagement, the target missile's plume (ejected hot gasses that are the source of intense infrared radiation that can be detected by satellites) would presumably be rapidly and prematurely extinguished.

Space situational awareness capabilities could also be useful for verification. They might be capable of detecting the launch of kinetic interceptors or the debris resulting from an engagement, especially during the midcourse of a target's trajectory. In theory, ground-based sensors, such as radars, could be used. In practice, space-based sensors, which provide continuous coverage, would likely be more useful. (The benefits and limitations of different space situational awareness technologies are discussed in appendix C.)

Telemetry—the data transmitted from the target missile and the missile defense weapon for diagnostic purposes—could also be useful in detecting a test. Such signals could be intercepted with electronic-intelligence satellites or ground-based radars. Even if they were encrypted, as seems likely, their existence would still be evidence of a prohibited test.

The biggest verification challenge might be that a state could try to test space-based missile defense weapons against other satellites rather than against target missiles. However, a state would have little incentive to do so. First, this approach would risk creating a significant quantity of orbital debris that could threaten the state's own satellites. Second, testing missile defense weapons against satellites would not contribute much to the development of boost-phase defenses. It would be more helpful in the development of midcourse defenses—but because reentry vehicles are likely more resilient than satellites and would likely be comingled with decoys and booster debris, the development of a reliable midcourse missile defense capability would probably require additional tests against target missiles under more realistic conditions.

Any illicit program to develop space-based missile defenses would have to be large-scale, complex, and prolonged, providing plenty of opportunities for detection.

Ultimately, to gain a meaningful operational capability, a state would need to conduct a lengthy testing campaign, requiring significant resources and personnel. Such a campaign would be difficult to conceal against multiple intelligence-collection techniques (technical and human), even if the state sometimes managed to hide individual tests.

The deployment of space-based ballistic missile defenses could also be monitored with NTM—though here the need to distinguish prohibited space-based interceptors from permitted space-based anti-satellite weapons

(or perhaps even permitted space-based ground-attack weapons) could arise. Helpfully, the deployment pattern of a boost-phase space-based missile defense system should be very distinctive. A high degree of coverage and redundancy would be needed to gain any value from such a system. Thus, the deployment of large numbers of weapon-carrying satellites in orbits that provide continuous coverage of potential missile launch sites would provide fairly clear evidence of a state's intentions—and could be easily detected—even if the exact capabilities of the weapons on any given platform were ambiguous.

Distinguishing between a midcourse space-based missile defense system, which could involve tens of satellites, and space-based anti-satellite weapons could be more difficult (which is partly why the prohibition on testing presents the best opportunity for assessing compliance). Yet deploying either system would require a major and prolonged effort, potentially yielding intelligence to help understand that state's intent. Moreover, as already noted, midcourse space-based missile defense systems are unlikely to be technologically feasible within the lifetime of the proposed agreement and would, in any case, be significantly less effective than boost-phase systems.

FEASIBILITY

Technical feasibility: The proposed treaty should be straightforward to negotiate, largely because it would rely on NTM for verification. Its technical feasibility would therefore hinge on each state's national capabilities. At least four types of NTM capabilities besides human intelligence could be useful: electronic-intelligence collection, space-based reconnaissance, space situational awareness, and missile launch detection.

Electronic-intelligence collection capabilities and, to a slightly lesser extent, visual reconnaissance satellites are shrouded in secrecy. Publicly available information about each state's space situational awareness capabilities is discussed in appendix C. This information suggests that the United States' capabilities are sufficiently sophisticated and persistent to be of considerable use in verifying the proposed prohibition on testing. Chinese and Russian capabilities are likely less sophisticated but could play a meaningful role nonetheless, though there is more uncertainty here.

In terms of missile launch detection, the U.S. space-based early-warning system would allow the United States to reliably monitor the launch of any test target (and possibly even the launch of any space-based kinetic interceptors). Russia is currently rebuilding its space-based monitoring capability; with the launch of a fourth satellite in 2020, its new system reached its "minimum baseline configuration," suggesting it "can ensure round-the-clock coverage of the most critical areas." China may not yet have a comprehensive space-based early-warning system, though the U.S. Department of Defense assesses that it is now developing one, potentially with Russian assistance.

Altogether, the various known and unknown potential weaknesses in each state's NTM

capabilities should not prevent effective verification—simply because any illicit program to develop space-based missile defenses would have to be large-scale, complex, and prolonged, providing plenty of opportunities for detection. To be sure, U.S. capabilities are more sophisticated than Russia's or China's (though theirs are improving), but the United States would face particularly significant challenges in secretly pursuing a program of the required scale and complexity.

Political feasibility. Russia and China would likely support this proposal. Neither have shown any interest in developing space-based missile defenses, and they view the United States' potential deployment of such a system as a serious threat. Indeed, Beijing and Moscow have recently invoked the specter of U.S. space-based missile defenses to help argue for a treaty—which they have jointly proposed—that would prohibit the placement of weapons in outer space.

The primary political impediment to the prohibition on space-based missile defenses proposed here would be resistance within the United States, where there is strong domestic support for missile defenses. Space-based missile defense programs have had a constituency since president Ronald Reagan's Strategic Defense Initiative of the 1980s. While support for such programs today is less broad than for many other missile defense technologies, these programs still have vocal supporters, including in Congress, who invoke them as a potential route to invulnerability from a missile attack.

For this reason, it could be difficult for the U.S. administration to obtain the Senate's advice and consent for ratification of the proposed treaty. A politically binding executive agreement would be easier to obtain, of course, but would also be much less valuable to China and Russia, reducing their willingness to grant the United States significant concessions in return. (However, if U.S. policymakers consider a treaty to be totally infeasible, they could explore a joint political commitment or even coordinated unilateral moratoria.)

One feature of the proposed treaty that would help lessen domestic resistance in the United States is that it would only last fifteen years (with an extension option). Although Beijing and Moscow would presumably prefer an indefinite agreement, a time-limited treaty could help address U.S. concerns about the possibility that technological developments might increase the need for, or enhance the feasibility of, space-based missile defenses.

Another reason for considering a treaty is that limitations on space-based interceptors may be at least somewhat more palatable for the United States than limitations on ground-based missile defenses (which attract particularly intense domestic opposition). Support for developmental capabilities is never as strong as support for existing capabilities. Moreover, the costs associated with deploying space-based defenses are likely to be prohibitive for the foreseeable future. The United States has barely scratched the surface of the needed research and development

investments, and the large number of interceptor platforms that would need to be deployed for a system to be at all useful would be exorbitantly expensive.

Finally, if China and Russia want a prohibition of space-based missile defenses, they will have to make significant concrete concessions to the United States in return. One approach would be to package the proposed prohibition with separate U.S.-Russian and U.S.-Chinese measures that were similarly time-bound. For example, Russia and the United States could agree to a strategic offensive arms control treaty that included significant limits on Russia's exotic delivery systems (which are intended to defeat U.S. missile defenses). Meanwhile, China and the United States could agree to a bilateral fissile material cutoff because, with more clarity about the future trajectory of U.S. missile defenses, Beijing might be willing to commit to refraining from producing any new fissile material for military purposes (see chapter 4). Of course, this kind of triangular diplomatic dance could be difficult to orchestrate and, in practice, negotiators would need to capitalize on the trade-offs that seem attainable at the time.

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Air Power

J-20 Stealth Fighter: China Reveals Its Big Plans For The 'Mighty Dragon'

Ethen Kim Lieser | 18 December 2021

Source: 19fortyfive | https://www.19fortyfive.com/2021/12/j-20-stealth-fighter-china-reveals-its-big-plans-for-the-mighty-dragon/

Image: Creative Commons.

China Ramps Up Deliveries of J-20 Fighters Featuring Domestic Engines: It appears that the Chinese military's heavy investments in the J-20 "Mighty Dragon" in an effort to close the gap with the United States' much-vaunted F-22 and F-35 fighter jets are now paying off.

According to Liu Xuanzun at the Global Times, the manufacturer of the J-20 jets, Chengdu Aircraft Industry Group, has revealed that it "recently broke records in terms of aircraft delivery due to high demand."

The reporter added that experts have confirmed that the J-20 "has entered a mass production phase after it solved the last missing piece of the puzzle, the domestically developed WS-10 engine."

These particular engines, which were developed to eventually replace Russian engines that were in earlier versions of the J-20 fighter, were first showcased by the Chinese People's

Liberation Army Air Force to the general public at Airshow China 2021 in Zhuhai, south China's Guangdong Province, in late September. The Global Times noted that the switch to the domestically made engines made the ambitious transition to mass production possible.

During the same airshow, Wang Haitao, deputy designer of the aircraft, confirmed that China's aviation industry has the ability to satisfy any level of demand from the PLA Air Force.

"In a short time, we will be able to see J-20s operated by all eastern, southern, western, northern and central theater commands, and become the main force to safeguard China's sovereignty and territorial airspace security," Fu Qianshao, a Chinese military aviation expert, told the Global Times.

'Technically Mature'

According to a 2017 report by the China Power Project at the Center for Strategic and International Studies, it stated that the WS-10 engines would offer the J-20 low super-cruise ability, which means that it would have the capability to fly at supersonic speeds for extended periods.

CNN also noted that a Global Times report last June contended that China now being able to tap into its own engines proved that the "J-20 is becoming more and more technically mature."

"More PLA units based in different locations across the country are expected to get more J-20s, significantly enhancing the PLA Air Force's capability of safeguarding the motherland's sovereignty, airspace and development interests," it continued, citing anonymous expert in the military.

In addition, National Defense magazine pointed to a separate report that claimed that "the aircraft has high maneuverability, stealth characteristics, an internal weapons bay, advanced avionics and sensors providing enhanced situational awareness, advanced radar tracking and targeting capabilities, and integrated electronic warfare systems."

Other high-end capabilities include passive sensors, active electronically scanned array radar, low-observability features, range on internal fuel, and long-range missiles.

Paired With Drones

Late last month, the South China Morning Post reported that China has once again "hinted at a potential pairing of its most advanced aircraft, the J-20, with drones in a tandem strategy that would expand Beijing's combat capabilities."

"The future is a big era for drone development," Chinese air force pilot Liu Qihong was quoted as saying during an interview with state broadcaster CCTV.

"If teamed with four drones during a mission, the manned vehicle can have a wider surveillance area and clearer sense of danger. What's more, drones can overcome long endurance periods, high temperature and a lot of noise, which might become unbearable for human pilots," he continued.

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New generation nuclear capable ballistic missile Agni-P tested for second time

18 December 2021

Source: The Hindu| https://www.thehindu.com/news/national/india-successfully-tests-nuclear-capable-ballistic-missile-agni-p/article37984273.ece

This second flight-test has proven the reliable performance of all the advanced technologies integrated into the system. Photo: PIB Press Release.

New generation nuclear capable ballistic missile Agni-P was successfully tested from Dr. APJ Abdul Kalam island off the coast of Odisha at 11.06 a.m. on Saturday, the Defence Research and Development Organisation (DRDO) said. This is the second test of the missile. The first test took place in June last.

"Various telemetry, radar, electro-optical stations and down range ships positioned along the eastern coast tracked and monitored the missile trajectory and parameters. The missile followed text book trajectory meeting all mission objectives with high level of accuracy," a DRDO statement said.

Agni-P is a two-stage canisterised solid propellant missile with dual redundant navigation and guidance system and has a range of upto 2000 km. This second flight-test had proven the reliable performance of all the advanced technologies integrated into the system, the DRDO stated.

Improved parameters

DRDO officials termed Agni-P as a new generation advanced variant of Agni class of missiles with improved parameters, including manoeuvring and accuracy. Canisterisation of missiles reduces the time required to launch the missile while improving the storage and ease of handling.

Agni class of missiles are the mainstay of India's nuclear launch capability, which also includes the Prithvi short-range ballistic missiles, submarine launched ballistic missiles and fighter aircraft. Agni-V, an Inter-Continental Ballistic Missile (ICBM) with a range of over 5,000 km, had been tested several times and validated for induction.

In the last few years, India has operationalised its submarine-based nuclear launch capability, completing the nuclear triad. This is especially important given India's stated No-First-Use policy while reserving the right of massive retaliation if struck with nuclear weapons first.

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The second drone age is here and it's a free-for-all

Ruth Pollard | 03 January 2022

Source: Economic Times| https://economictimes.indiatimes.com/news/international/world-news/the-second-drone-age-is-here-and-its-a-free-for-all/articleshow/88659521.cms?from=mdr

Today's armed drones, she wrote, are tomorrow's killer robots.

The pandemic has already given the future a distinctly dystopian look. And then there's this: the burgeoning of the "second drone age."

That's how experts are describing the international drone market — which ranges from tiny startups selling $1,000-to-$2,000 off-the-shelf technology that can be easily weaponized by terrorist groups like the Taliban, to high-tech unmanned vehicles that can carry laser-guided munitions and Hellfire missiles. It's an even more highly autonomized proliferation of the first age of drones, which has been dominated by the U.S. since its first attack using a remotely piloted craft in 2001. Now, it's an an ungoverned, unregulated space with billions of dollars to be made and thousands of lives at stake.

The deadly shortcomings of this high-tech violence were placed squarely in the public eye with the U.S. drone strike in Kabul on Aug. 29 that targeted terrorists but instead killed 10 Afghan civilians, including seven children. It was a failure of military intelligence and, like so many other civilian fatalities of the US air wars, including those featured in a New York Times investigation published in December, there was no finding of wrongdoing against those involved.

The transformation of defense operations has been far-reaching: 102 countries now run active military drone programs. It's replaced thousands of troops on the ground with controllers behind computers located in bases far away from the air strikes they are launching. In the US, fewer troop deaths mean less pressure at the ballot box and less congressional oversight. It allows leaders of many countries and the proxies that support them to get away with what amounts to murder, often of their own citizens, as we've seen in the conflicts in Syria and Yemen.

All of this is happening without any overarching regulatory regime to protect civilian populations and uphold humanitarian laws, or to examine the operational and tactical ramifications of this remote-control warfare.

That's what worries experts like Paul Lushenko, a U.S. Army lieutenant colonel and a Ph.D scholar at Cornell University. Drones are not just a form of war but a tool of unregulated intra-state political violence, Lushenko told me, representing a "dystopian view of what's developing right now."

Lushenko, who co-edited the newly released

"Drones and Global Order: Implications of Remote Warfare for International Society" with Srinjoy Bose, a senior lecturer in international relations at the University of New South Wales, and William Maley, an emeritus professor at the Australian National University, is just one of many advocating for better regulation and more public scrutiny of drone operations. The U.S. withdrawal from Afghanistan in August provides an ideal moment for that post-mortem, he notes

There has been some attempt at oversight. The Missile Technology Control Regime, an informal political understanding among 35 members, seeks to limit the proliferation of and trade in missiles and missile technology — which arguably covers attack drones. But there's no enforcement mechanism, Lushenko says. It's certainly not equipped to regulate armed and networked drones, which can take as many as 200 people to operate, including those controlling them from the U.S., as well as launching them from bases abroad.

Drones are a gateway technology, Agnes Callamard noted in June as she marked the end of her five years as the United Nations special rapporteur on extrajudicial, summary or arbitrary executions. They've opened the door to weaponized artificial intelligence, algorithmic and robotic warfare, and loosened human control over the deployment of lethal force. Today's armed drones, she wrote, are tomorrow's killer robots. She says the absence of a control mechanism for a new new generation of weapons of mass destruction represents a significant threat.

Callamard, now the secretary general of Amnesty International, has called for a specific "Drone Technology Control Regime" and says nations should establish a multilateral process to develop standards for the design, export, and use of drones as well as stricter controls on the transfer of military technologies. Sales agreements, she says, should include civilian protection and adherence to international human rights and humanitarian law.

This gaping hole in international oversight has allowed major powers like the U.S. to flout global norms (like the U.S. drone strike that killed the commander of Iran's Islamic Revolutionary Guard Corps' elite Quds force, Qassem Soleimani, in Iraq in January 2020). Large-scale manufacturers now negotiate sales directly with prospective buyers who have clear military and security uses in mind. It's seen Turkey emerge as a drone superpower in the sector, which market intelligence firm BIS Research estimated was worth $28.5 billion in 2021.

The US has already expressed its concerns over Turkey's sale of weaponized drones to Ethiopia, where the government of Prime Minister Abiy Ahmed Ali is suspected of using them against rebel forces in the Tigray region in a civil war that's killed thousands of civilians and forced more than 2 million people to flee their homes. The conflict between Armenia and Azerbaijan over the disputed Nagorno-Karabakh region saw Azerbaijan emerge as the clear victor using Russian, Turkish, Israeli, and indigenous drones to overpower its neighbor's less sophisticated military.

All this illustrates the size of the logistical challenges facing the Biden administration and its plans for an "over-the-horizon" strategy in Afghanistan. The policy depends on other countries agreeing to house U.S. bases to enable Washington to continue its counterterrorism efforts, including the use of armed drones. But without regulation and oversight, the only certainty here is that the technology will continue to advance everywhere. There will be more civilian casualties — and no one will be held accountable.

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Need to quickly think about development of hypersonic cruise missiles

Dinakar Peri | 14 December 2021

Source: The Hindu | https://www.thehindu.com/news/national/need-to-quickly-think-about-development-of-hypersonic-cruise-missiles-rajnath/article37954715.ece

Union Defence Minister Rajnath Singh hands over DRDO developed products to Armed Forces and otehr security agencies at an event in New Delhi on December 14, 2021. | Photo Credit: Special Arrangement

Ballistic missile defences were getting "robust" day by day and to maintain a minimum credible deterrence, India should quickly think about developing hypersonic cruise missiles, Defence Minister Rajnath Singh said on Tuesday. He pointed to the fast-changing battlefield landscape with the emergence of new technologies.

"Our effort should be to make India the leader in defence technology. Those technologies which we have already developed are already ours, but along with that we should also acquire those technologies which today are only with a handful of countries," he stated at an event of the Defence Research and Development Organisation (DRDO).

"For example, ballistic missile defence are

getting robust day by day. So, in order to maintain our minimum credible deterrence, we should quickly think about developing hypersonic cruise missiles," he noted.

Hypersonic weapons are manoeuvrable weapons that can fly at speeds of at least Mach 5, five times the speed of sound. Several countries, including India, are currently developing them.

In 1998, India conducted nuclear tests under Phokran-II and in 2003, declared its nuclear doctrine based on credible minimum deterrence and a No-First-Use (NFU) policy. The concept of maintaining a minimum credible deterrence and a nuclear triad for delivery of nuclear weapons based on aircraft, missiles and nuclear submarines flow from that

At the event, Mr. Singh handed over five technologies developed by the DRDO to the three Services and Home Ministry as part of 'Azadi Ka Amrit Mahotsav'. He also handed over six Transfer of Technology (ToT) agreements for the technologies developed by the DRDO to seven public and private sector companies.

Emphasising on emerging technologies, he stressed that developments such as cyber, space, IT, robotics, Artificial Intelligence and big data analysis were adding news facets on the battlefield. Some of the products being developed by the DRDO were not just futuristic but also the first of the kind, he pointed out.

Technologies handed over

The technologies handed over by Mr. Singh include an anti-drone system for the three Services, a modular bridge for the Army, smart anti-airfield weapon and Chaff variants for the Air Force and a lightweight firefighting suit to the Home Ministry.

The ToT documents handed over comprise coastal surveillance radar, automatic chemical agent detection and alarm and chemical agent monitor, unit maintenance vehicle, unit repair vehicle, fused silica based ceramic core technology and fire suppressing gel.

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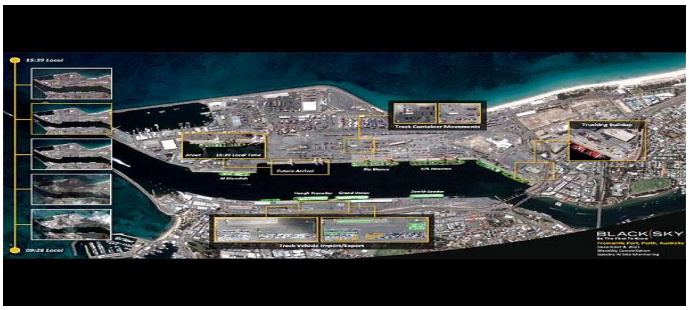
Space

Black Sky achieves highest revisit, dawn-to-dusk satellite coverage

Staff Writers | 15 December 2021

Source: Space Daily | https://www.spacedaily.com/reports/BlackSky_achieves_worlds_highest_revisit_time_diverse_dawn_to_dusk_satellite_constellation_999.html



BlackSky's high-resolution small satellite constellation has the highest revisit rate in the world, with a peak rate of 15 hourly visits per day over certain locations. BlackSky's Spectra AI platform tasks the company's 12-satellite constellation to collect and analyze insights on economic activity, patterns of life, and more. (Image: BlackSky)

BlackSky's high-resolution small satellite constellation has the highest revisit rate in the world, with a peak of 15 hourly visits per day over certain locations. The real-time geospatial intelligence company achieved a 12 small satellite constellation, doubling its imaging capacity, following Wednesday's successful Rocket Lab mission.

In less than 30 days the company launched six satellites on three different missions using two launch providers across two continents. Following each respective mission, the satellites achieved first light within hours after launch and were successfully commissioned into operations within 48 hours.

"This is an incredible achievement for BlackSky and the industry. Our ability to rapidly launch, deploy, and commission on-orbit capacity provides customers with confidence that they will have access to the insights they need to support critical operations," said Brian E. O'Toole, BlackSky CEO. "At a time when many suppliers are facing the challenges of an aging constellation, BlackSky is bringing significant capacity into the market."

The recently commissioned satellites provided imagery that was processed through the company's Spectra AI platform, delivering AI-enabled insights to customers within hours.

BlackSky's Spectra AI platform serves as a tasking and analytics engine that fuses multiple data sources of information with its geospatial imagery from the company's proprietary constellation. Through a subscription-based software-as-a-service (SaaS) model, Spectra AI delivers real-time geospatial intelligence products to customers with no humans in the loop.

Completing the 12-satellite constellation follows a year of high-paced execution that included raising $283 million during its IPO in September, a multi-year investment partnership with Palantir, and capturing several U.S. Government contracts.

"With our baseline constellation in place supplying images to a fully operational, AI-enabled SaaS platform we are now ready to

scale up services to meet strong commercial and government market demand," said O'Toole. "We are now entering a new era of commercial space and BlackSky is at the forefront of changing the way we see and understand our world."

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China sends classified Shijian satellites into orbit with milestone Long March launch

Andrew Jones | 10 December 2021

Source: Space News | https://spacenews.com/china-sends-classified-shijian-satellites-into-orbit-with-milestone-long-march-launch/

A Long March 4B lifts off from Jiuquan carrying the Shijian-6 (05) satellites. Credit: CNSA

HELSINKI — A Long March 4B launched the Shijian-06 (05) group of satellites Dec. 9, marking the 400th launch of China's Long March family of launch vehicles.

The Long March 4B lifted off from Site 9401 at the Jiuquan Satellite Launch Center at 7:11 p.m. Eastern, rising into a dark blue pre-dawn desert sky.

The Shijian-6 (05) satellites, which could be a pair of satellites to join four earlier pairs satellites in the series, with the previous launch occurring in 2010, were developed by the China Academy of Space Technology (CAST) and Aerospace Dongfanghong Satellite Co., Ltd.

The satellites will be used for space environment exploration and technology verification tests, according to the China Aerospace Science and Technology Corp., (CASC). No images of the satellites have been published.

Western analysis of the series and their roughly 585-kilometer Sun-synchronous orbits suggests Shijian-6 satellites are designed for signals intelligence or electronic intelligence purposes.

The Long March 4B was provided by the Shanghai Academy of Spaceflight Technology (SAST) which like CAST is a major CASC subsidiary. The launcher uses hypergolic propellant and is capable of carrying 2,800 kilograms of payload into Sun-synchronous orbit.

The mission was China's 49th orbital launch of 2021, extending a new national record for calendar year activity. The vast majority of launches have been Long March rockets, with additional launches from commercial firms Expace, iSpace and Galactic Energy.

Thursday's launch was also the 400th Long March rocket launch. The official space industry newspaper China Space News marked the Long March achievement with the term "YYDS," a Chinese equivalent of the abbreviation of GOAT, or "the greatest of all time."

The relative speed at which the new milestone was reached illustrates the rapid acceleration of China's launch rate in recent years.

The first Long March launch took place April 24, 1970. It took until June 2007—or 37 years—

to launch the first 100 Long March rockets, when a Long March 3A launched Xinnuo-3. The 200th launch followed seven and a half years later, in December 2014.

The 300th launch was conducted three and a half years later, in March 2019, meaning the latest 100 launches were carried out inside a period of two years and nine months.

The Long March rocket family has been responsible for 92.1 percent of China's orbital launches in the 51 years since the country's first launch, sending more than 700 spacecraft into space, with a launch success rate of 96.25 percent, according to CASC.

In comparison, SpaceX, a U.S. private company, has conducted more than 130 launches of its Falcon 9 family of rockets since the first in 2010, suffering one failure and one partial failure, while also developing and establishing first stage reusability.

CASC's first generation of Long March rockets are hypergolic, with the new Long March 5, 6, 7 and 8 rockets using cryogenic or kerosene fuel. With the demonstration of reusability by SpaceX, CASC is also working on a reusable variant of the Long March 8 and has reusable concepts for its future super heavy-lift launcher.

One major driver of Chinese launches in recent years has been the construction of Beidou, the country's own Global Navigation Satellite System. China is also building remote sensing and communications space infrastructure which other leading space powers already have on orbit.

In 2014 China also opened a new, coastal launch site at Wenchang to facilitate launches of new large, cryogenic and kerolox rockets for space station and deep space missions.

Chinese space-related activities are also increasing with the emergence and fostering of a commercial space sector since 2014. New spaceports are being constructed to allow for expanded launch activity and remove bottlenecks, including new facilities for sea launches.

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Military interest in the moon is ramping up

Leonard David | 06 December, 2021

Source: Space.com | https://www.space.com/military-interest-moon-cislunar-space

The U.S. Defense Advanced Research Projects Agency (DARPA) is moving forward on the Novel Orbital and Moon Manufacturing, Materials and Mass-efficient Design (NOM4D) program. (Image credit: DARPA)

There is growing interest in protecting strategic assets in cislunar space, the realm between Earth and the moon.

The U.S. Space Force is not the only entity engaged in reflecting on the topic of how best to extend military presence far from Earth. Other nations such as China are doing so as well.

Parallel to air, land and sea skirmishes between nations here on Earth, is cislunar space, and perhaps the moon itself, an emerging military "high ground" and new territory for conflict? There's a variance of views, according to experts Space.com talked to.

Cislunar primer

Earlier this year, the Air Force Research Laboratory distributed "A Primer on Cislunar Space," a document targeted at military space professionals who will answer the call to develop plans, capabilities, expertise and operational concepts for the region.

"Cislunar space has recently become prominent in the space community and warrants attention," the document explains.

As the U.S. Space Force "organizes, trains, and equips to provide the resources necessary to protect and defend vital U.S. interests in and beyond Earth orbit," the primer also underscores that new collaborations will be key to "operating safely and securely on these distant frontiers."

Visionary wish list

In the interim, the Defense Sciences Office at the U.S. Defense Advanced Research Projects Agency (DARPA) has blueprinted a wish list of new research to enable the fabrication of future space structures — including the use of lunar resources to enable those structures.

Some of that research will be performed by the Novel Orbital and Moon Manufacturing, Materials and Mass-efficient Design program, or NOM4D.

NOM4D aims to develop new materials, manufacturing, and design technologies to enable future structures to be built in Earth orbit or on the moon's surface. For instance, large solar arrays, large radio frequency reflector antennas and segmented infrared reflective optics are visualized.

Building a precision structure while minimizing the required mass fraction brought from Earth will enable a spectrum of Department of Defense systems to be built using lunar-derived materials, DARPA officials say.

"For the purposes of understanding the

hypothetical use case, proposers may consider fabrication of structures on orbit or on the lunar surface for relaunch back into orbit as long as the proposed system is consistent with the Outer Space Treaty," NOM4D documentation explains.

Contract negotiations are currently underway, with the selection of NOM4D winners soon to be announced, DARPA has advised Space.com.

Military moon

The U.S. military has eyed the moon before.

As far back as 1959, when NASA was still picking its first astronauts, the U.S. Army was concocting plans for a moon base, under the title of Project Horizon, explained Robert Godwin, a space historian and owner of Apogee Books, a Canadian publishing house that examines a variety of space history topics.

Some details of the U.S. military's past interest in the moon remain classified to this day, Godwin said. In particular, there were looks at a nuclear bomb detonation in orbit around the moon that would empower "the weapon" — an X-ray laser that would take out enemy satellites and spacecraft, he told Space.com.

"Cislunar space has recently become prominent in the space community and warrants attention," a recent Air Force Research Laboratory document states.

That was then. But valuable U.S. assets on the moon, such as planned commercial ventures there, will make "the military presence to ensure their safety," Godwin said, "almost inevitable."

"Back in 1959, the U.S. military was fretting over whether they could get supplies of toilet paper up there," he added. Looking back, he said those working on Project Horizon were coming out of World War II, practiced in moving hundreds of thousands of tons of heavy equipment around the world.

"The fact they were going to have to make that equipment 'go up' instead of 'sideways' seemed to be secondary to their thinking," Godwin said. To that end, things have progressed. For example, scientists now believe that there's a lot of water on the moon.

"But at the end of the day, you still go skin the cat. The way to do that could be more affordable now," Godwin said.

Record of choices

Daniel Deudney teaches political science, international relations and political theory at Johns Hopkins University in Baltimore, Maryland. He is author of "Dark Skies: Space Expansionism, Planetary Geopolitics and the Ends of Humanity" (Oxford University Press, 2020).

Particularly since the middle years of the 20th century, Deudney said, humanity has been forced to make governance decisions about new technologies, whether by default or design, with momentous implications.

"The overall record of choices made has been mixed. Perhaps the most notable failure was the weaponization of nuclear energy," Deudney said. "Momentous decisions have also had to be made about the vast and alien realms beyond the Earth's atmosphere. Here the pace of technological

advance, and thus the need to choose, has been slower. But here too the record has been quite mixed."

A major mistake was the weaponization of the rocket, which has almost certainly increased the probability of nuclear war, Deudney said.

Momentum is building

In part because of the sway of "frontier" analogs in thinking about space, a key fact about choices for Earth space has not been widely grasped, Deudney told Space.com. "Earth space, unlike frontiers, is marked not by 'both/and' opportunities, but by 'either/or' ones. Pursuing the military options will preclude, or make much more difficult, the realization of other paths," he said.

Due to the falling costs of accessing orbital space — long a bottleneck for all space activities (particularly those involving significant infrastructures) — it is increasingly likely that major space initiatives will be pursued, Deudney said.

"Due to the deterioration of terrestrial Great Power relations, the waning of the arms control and disarmament movements, and the decay of the Outer Space Treaty regime," Deudney said, "momentum is gathering for further major militarization and weaponization of space technologies and locales, most notably on Luna [the moon]."

Fog of peace

We need more governance in outer space, for all actors, said Jessica West, a senior researcher with Project Ploughshares, a Canadian peace research institute. She also serves as managing editor for the Space Security Index project.

"We need clear rules, and we need restrictions, and we need processes in place to implement them," West said. "Finally, we can no longer accept the fog of peace that shrouds military activities in outer space, whereby they are deemed 'peaceful' on the one hand yet outside the scope of rules and regulations for peaceful use on the other."

Space is harsh, West added, and the lunar environment particularly so. "We need to be promoting cooperation and commonality and working through frameworks of trust and transparency."

Deterrence and diplomacy

Michael Krepon is co-founder and distinguished fellow at the Stimson Center in Washington, D.C. The group delves into independent analysis and policy innovation in its international security research. He is author of "Winning and Losing the Nuclear Peace: The Rise, Demise, and Revival of Arms Control" (Stanford University Press, 2021).

"Major powers seek advantage and to avoid disadvantage," Krepon told Space.com.

If the purpose behind military activities that stretch out to cislunar space and to the moon itself is to seek dominance, the outcome will be foreordained, Krepon said. "Major powers that cannot accept someone else's dominance and have the means to negate it will act to do so."

Those negation strategies are termed "deterrence" when it comes to nuclear weapons.

"Deterrence is meant to be dangerous; otherwise it wouldn't deter," Krepon said. This is why deterrence capabilities look a lot like war-fighting capabilities. Because deterrence was and is so dangerous, major powers also had to signal during the Cold War that they preferred not to use war-fighting instruments, he said.

"Diplomacy was and is needed for purposes of reassurance — to take the sharpest edges off deterrence. We've managed to avoid nuclear war — so far — by the combination of deterrence and diplomacy. We forget this lesson at our peril," he said.

Wide waterfront

Indeed, diplomacy can cover a wide waterfront, Krepon added. "One diplomatic mechanism is the prevention of dangerous military practices and the codification of responsible and irresponsible behavior."

Krepon said that he's hearing echoes of the very origins of nuclear deterrence: People barely old enough to remember just how dangerous the nuclear arms race truly was are saying that warfare in space is inevitable and there's a need to dominate this new war-fighting domain.

"This is dangerous thinking. It's predicated in assumptions that badly need to be unwrapped," Krepon said. For example:

- Is escalation control likely in the event of space warfare?
- Is space debris management likely?
- Is a peer or near-peer competitor likely to accept being dominated in space warfare?
- Does that competitor have the means to prevent being dominated?
- What are the likely consequences of seeking "war-winning" capabilities?
- What are the likely consequences of assuming that space warfare is inevitable?

"If the answers to these questions are troubling, then we need to get to work on the diplomacy piece," Krepon said.

Destabilizing or threatening?

So there's a fair amount of cislunar angst out there. But Todd Harrison, director of the Aerospace Security Project at the Center for Strategic and International Studies in Washington, D.C., has a different viewpoint.

"I really don't think there's much to this," Harrison advised. Though the U.S. Space Force knows that eventually it will need to be concerned about what's going on in cislunar space, he said, "we're not at that point yet."

There could be some ancillary military benefits in building a very large aperture antenna in space, Harrison said. "Maybe that gives you some new sensing capabilities. But I don't see it as being destabilizing or threatening to other countries."

Threat-hyping

Harrison said there are some cislunar "threat hypers" out there — and he is not among them.

"Cislunar space is a very low priority for the Space Force compared to all the things going on in Earth orbit that it needs to be concerned about,"

Harrison told Space.com.

In Harrison's thinking, the most promising lunar resources are for civil and commercial space ventures.

"By far, that's what we're looking at," Harrison said, pointing to using materials from the moon for propulsion or building structures. "NASA is the lead when it comes to cislunar space. And that's the way it should be."

Still, in casting a futuristic eye outward, Harrison advised that "where commerce goes, conflict eventually follows."

There could be a military role, Harrison said, albeit 20, 30 or maybe even 50 years into the future, of helping to protect trade routes and U.S. interests. "But we're a long, long way from that happening."

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Russia and China Are Interfering With US Satellites 'Daily', Says Space Force

Can Emir | 01 December 2021

Source: Interesting Engineering| https://interestingengineering.com/russia-and-china-are-interfering-with-us-satellites-daily-says-space-force

NASA CINDI mission satellite in orbit around Earth.

A top Space Force General said that U.S. satellites in high orbit are under constant attack from China and Russia, and added that China could surpass the U.S. in the space race.

Space Force General David Thompson told Washington Post that the threats against U.S. satellites are really growing and expanding and it's really an evolution of activity that's been happening for a long time. "We're really at a point now where there's a whole host of ways that our space systems can be threatened."

Thompson said that Russia and China are attacking U.S. satellites using non-kinetic tools; tools that do not cause physical damage but carry out cyberattacks, use lasers, and radiofrequency jammers on satellites.

He later added that the U.S. should retaliate by the same methods, while experts warn that any kind of further damage would increase the space

debris around the world and eventually form a barrier-like structure that could entrap humanity.

Speaking about the Space Race, Thompson pointed out that China is rapidly developing new technologies and could overtake the United States as the top space power in the world by the end of the decade if they don't adapt. He said, "China is fielding operational systems at an incredible rate and is ahead of Russia. We are still the best in the world, in terms of capability but they're catching up quickly,"

As countries carried the competition to space after World War II, they are keeping their space activities intensely secretive, especially those that involve the military. Since many of the technologies involved in the space programs are useful for both civilian and military purposes, their capabilities are not fully clarified by the space agencies.

According to multiple reports, both China and Russia have been developing combat satellites that can attack other satellites. In July 2020, Russian space agency Roscosmos has conducted a non-destructive test of a space-based anti-satellite weapon, according to the United States Space Command. And just last month, China National Space Administration has fired a missile from a hypersonic vehicle, and a Pentagon report pointed out that the country is developing missiles and electronic weapons that could target satellites orbiting both high and low.

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China launches reconnaissance satellite Gaofen-11

29 November 2021

Source: Space Watch | https://spacewatch.global/2021/11/china-launches-reconnaissance-satellite-gaofen-11/

Image: Gaofen-7 satellite (Credit: Chinese social media).

China launched its third Gaofen-11 reconnaissance satellite on a Long March 4B rocket, Chinese state media reported.

The Gaofen satellites form China´s High-resolution Earth Observation System and comprise optical, multispectral and synthetic aperture radar spacecraft.

The new satellite would be "mainly used for land surveys, city planning, land rights confirmation, road network design, crop yield estimation and disaster prevention and mitigation," according to state media Xinhua.

The satellite´s data transmission and relay subsystems were developed by the Xi'an Branch of China Academy of Space Technology. Resolution capabilities along with other information has been published for the Gaofen series up to number 8. Data starting with Gaofen-8 have not been released which suggests they are being used for national defence purposes.

The series has large apertures, over 1.5 meter

in diameter for optical remote sensing. Gaofen-11 also has a resolution capability of 10 cm; further data is classified.

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Global Aerospace Industry

Mega Order For Airbus Kicks Off The $137 Biillion Deal Mark

Bikram Vohra | 16 November 2021

Source: India Aerospace & Defence Bulletin | https://www.iadb.in/2021/11/16/mega-order-for-airbus-kicks-off-the-137-biillion-deal-mark-on-day-2/

Even as the A350F targets the Boeing 747 freighter market the US manufacturer is seriously considering upping the stakes in this category with the stretched 777XF to take on the European competitor. On Day 2 of the Dubai Airshow Airbus striking gold was the top talk.

In a sweet tweet it said: Indigo Partners airlines order 255 #A321neo/#A321XLR – allowing @WizzAir@FlyFrontier@FlyVolaris@VuelaJetSMART to "continue to offer low fares, […] and improve their industry-leading sustainability profile."

Wizz Air (Hungary), Frontier (United States), Volaris (Mexico) and JetSMART (Chile, Argentina), Indigo Partners portfolio airlines new order brings the total number of aircraft ordered by the Indigo Partners' airlines to 1,145 A320 Family aircraft. The aircraft ordered today are a mix of A321neos and A321XLRs, which will be delivered to the individual airlines as follows:

Wizz Air: 102 aircraft (75 A321neo + 27 A321XLR)

Frontier: 91 aircraft (A321neo)

Volaris: 39 aircraft (A321neo)

JetSMART: 23 aircraft (21 A321neo + 2 A321XLR)

That narrow body purchase is right up there with the big ones and gives Airbus a major sales edge in the single aisle fleet purchase. These are not whistles in the wind. Airbus Chief Commercial Officer Christian Scherer has been quoted as saying traffic will fully recover between 2023 and 2025 if not more swiftly and we can see a 3.5% annual rise in traffic globally

One might recall that Emirates has 126 B777X's on order and Boeing can find comfort in that attractive order luring more carriers to consider its viability at least for its cost efficiency and 10% less fuel burn.

Meanwhile the UAE Ministry of Defence signs Dh5.23 billion worth of contracts and there should be more specifically in the drone and UAV categories bringing the deals for the day to $137 billion.

Two rather interesting innovations come from Lufthansa's sundeck concept that stretched out from a 737 on the ground to create a yacht

experience though no one is quite sure how much a lure that is. pass the suntan oil please.

Embraer also brings it shock liveried E2 Profit Hunter. It is marketed as the world's most efficient single-aisle aircraft delivering 25.4% better fuel burn per seat and 10% better fuel burn compared to its direct competitor according to the Brazilian manufacturer.

And up in in the sky India's Tejas LCA aerobatic team from the IAF and the Sarang choppers create a tapestry of incredible flying skills that dra spontaneous applause. So top draw it makes one proud.

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Blinken says US still prepared to sell jet fighters to UAE

15 December 2021

Source: Aljazeera | https://www.aljazeera.com/news/2021/12/14/uae-suspends-discussions-on-23bn-weapons-deal-with-us

An F-35 fighter jet arrives at the Vermont Air National Guard base in South Burlington, Vermont, on September 19, 2019 [File: Wilson Ring/AP Photo]

Secretary of State Antony Blinken said the United States was still prepared to sell F-35 fighter jets to the United Arab Emirates.

"We remain prepared to move forward… if that is what the Emiratis are interested in doing," he said during a visit to Malaysia on Wednesday.

Asked about the conditions the US has set, he did not give precise details, but said Washington wanted to ensure that Israel maintains its "military edge".

"We wanted to make sure that we could do a thorough review of any technologies that are sold or transferred to other partners in the region," he said.

His comments came after a day after the UAE embassy in Washington, DC informed the US that it is suspending discussions on a $23bn weapons deal that includes the advanced F-35 aircraft.

In a statement to The Associated Press, the embassy said the UAE would "suspend discussions" on the sale, while meetings at the Pentagon scheduled for later this week between the two sides on other issues would proceed as planned.

"The US remains the UAE's preferred provider for advanced defense requirements and discussions for the F-35 may be re-opened in the future," the embassy said on.

A UAE official also told the Reuters news agency in a statement on Tuesday that "technical requirements, sovereign operational restrictions, and cost/benefit analysis led to the re-assessment" of the agreement.

The Emirati embassy's statement comes days after the UAE agreed to buy a record 80 Rafale warplanes from France for $15.8bn during a visit by President Emmanuel Macron, indicating the oil-rich Gulf state has alternatives.

Former US President Donald Trump's administration first announced the $23bn arms deal with the Emirati government last year. It is linked to the so-called "Abraham Accords", which saw the UAE – as well as Bahrain, Morocco and Sudan – agree to normalise relations with Israel.

The $23.37bn package contained products from General Atomics, Lockheed Martin and Raytheon Technologies, including 50 F-35 Lightning II aircraft, up to 18 MQ-9B Unmanned Aerial Systems and a package of air-to-air and air-to-ground munitions.

The Wall Street Journal newspaper, which first reported on the impasse on Tuesday, said that the US was insisting on conditions to make sure the F-35s would not be vulnerable to Chinese espionage.

The multi-billion-dollar deal between Washington and Abu Dhabi also has faced opposition in the US Congress.

An effort to block it failed in the Senate in December 2020, after some lawmakers – including leading members of President Joe Biden's Democratic Party – raised concerns the weapons could worsen regional conflicts, notably in Yemen, where years of war have caused a humanitarian crisis.

Weapons deal reached during ex-President Donald Trump's administration includes sale of advanced F-35 aircraft to UAE.

Last April, a US Department of State official said the Biden administration would move forward with the proposed sales to the UAE, despite widespread criticism from rights groups and arms control advocates in the US.

The official also said the administration would "continue reviewing details and consulting with Emirati officials" related to the use of the weapons.

On Tuesday, Pentagon spokesman John Kirby said the US partnership with the UAE was more strategic and complex than a weapons sale and Washington was committed to working with Abu Dhabi to address their questions.

"We will always insist, as a matter of statutory requirements and policy, on a variety of end-use requirements," said Kirby, telling reporters

that those requirements on the use of American-made military equipment "are universal, non-negotiable, and not specific to the UAE".

Kirby said meetings later this week between US and Emirati officials would touch on broad topics, but that the weapons sale would likely come up. He referred questions about details of specific arms sales to the Department of State.

The Department of State said in a statement that the Biden administration "remains committed to the proposed sales … even as we continue consultations to ensure that we have a clear, mutual understanding of Emirati obligations and actions before, during, and after delivery".

A Department of State official also told Reuters on condition of anonymity that the Biden administration remained "hopeful that we can work through any outstanding issues".

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LCA Tejas: India Eyes Global Customers For Its Indigenous Aircraft After Spectacular Debut At Dubai Airshow

Ashish Dangwal | 18 November 2021

Source: Eurasian Times | https://eurasiantimes.com/tejas-makes-its-dubai-debut-its-maker-hal-hopes-to-clinch-deals/

India's Tejas LCA showcased its superior flying skills at the Dubai Airshow. (via Twitter)

This is the first time that Tejas, developed by the Hindustan Aeronautics Limited (HAL), has showcased its aerial maneuvers in the Gulf nation, according to news agency PTI.

So far, three countries have shown interest in the HAL Tejas — Malaysia, Argentina, and Egypt. The Royal Malaysian Air Force (RMAF), which has plans to buy 18 planes, with an option to add another 18 later, could emerge as the first foreign buyer of Tejas.

According to Malaysian media reports, six bids have been filed for RMAF light combat aircraft (LCA) tender. The MiG-35 from Russia, the L-15 from China, the FA-50 from Korea Aerospace Industries (KAI), the Hurjet from Turkey

Aerospace Industries (TAI), and the Leonardo M-346 from Italy are among the bidders.

The Pakistani-Chinese JF-17 Thunder, which was initially thought to be among the competitors, was not on the list. The Yakovlev Yak-130 and the Boeing T-7A Red Hawk were also missing.

Mid-air refueling, beyond-visual-range (BVR) combat, and supersonic flying capabilities are among the RMAF's tender requirements. Moreover, 30% of the aircraft manufacturing must be done in Malaysia, and delivery must start within 36 months of signing the deal.

R. Madhavan, HAL chief, told Business Standard that the company met practically all of the RMAF's conditions. "The Tejas outperforms the Chinese-Pakistani JF-17 and the other contenders in terms of technology.

"We can easily engineer one or two of the Malaysian parameters that we don't meet. For example, we can rapidly add the onboard oxygen generating system (OBOGS) that they requested," Madhavan explained.

According to the HAL chief, many of the other competitors do not match Malaysian requirements. The Chinese-Pakistani JF-17 lacks the required active electronically scanned array (AESA) radar, and its mid-air refueling capability is currently being evaluated.

Tejas Vs Rest Of Contenders

The Turkish aircraft is yet to take to the skies, but the Malaysian tender requires the offered fighter to have flown beforehand. Hence, Turkey's chances are low. Then, the Chinese jet is likely to be looked at with suspicion Given Beijing's aggression in the region.

HAL has pitched the RMAF its Tejas Mark-1A fighter, which features mid-air refueling, an AESA radar, EW capability, and the capacity to shoot BVR missiles.

For the RMAF, price is a major factor, anticipating to pay in the region of $900 million for 18 fighters, or $50 million each fighter. According to reports, the Tejas is being offered at that price.

The Indian Air Force (IAF) contingent has managed to grab eyeballs at the Dubai Air Show. The indigenous HAL Tejas light combat aircraft and two IAF aerobatics teams — Suryakiran comprising nine Hawk advanced jet trainers (AJTs), and Sarang, with four Dhruv helicopters — presented a spectacular aerial display at the event.

The Korean fighter is expected to be costlier than the Tejas and the Russian MiG-35 is even more expensive than the price mentioned.

Apart from Malaysia, a few more countries have shown interest in the Indian Tejas LCA.

Argentina

Buenos Aires is looking for 12 light fighters. The matter is being pursued by HAL, but there is a UK embargo on the export of British defense equipment to Argentina that dates back to the Falklands War.

Tejas incorporates several British-made components; hence there might be an export hurdle. Previously, the UK blocked the sale of South Korean fighter jets to Argentina.

So far, Argentina is believed to have received

only two proposals for its light fighter jet contract — one from China and a letter of intent from India's HAL.

Several systems and subsystems of the Tejas, which are made in the United Kingdom by companies including BAE Systems, Cobham, and Martin-Baker will need to be replaced by HAL to make the fighter jet eligible for export.

Madhavan earlier said more than 50 systems and subsystems, including the Martin-Baker ejection seat, will have to be replaced. Furthermore, the replacement parts will need to be tested and certified. He further stated that there will be a cost attached to it.

Egypt

Egypt had been rumored to be interested in the Tejas since the Bahrain air show 2018. Another reason for the Tejas' appearance at the Dubai Air Show is to gauge interest in the region. However, weaning Cairo off US platforms, which Washington has long provided at subsidized rates, will be a big challenge.

"It's for the reason that we're heading to Egypt. The plan is to build Tejas there by establishing a factory," Madhavan said.

The Egyptian Air Force is considering replacing its aging Dassault/Dornier Alpha aircraft, which was purchased in the 1980s and is nearing the end of its lifespan. The EAF seeks a full-fledged combat aircraft that may also be used for pilot training on occasions.

The service has recently purchased the Sukhoi-35 and Dassault Rafale. The EAF also operates the F-16, Mirage-2000, and Mirage-III aircraft.

Australia

As reported earlier by Eurasian Times, HAL claimed that it has proposed Tejas as a Lead-In Flight Trainer to the Royal Australian Air Force (RAAF).

According to HAL's annual report, the Royal Australian Air Force (RAAF) issued a Request for Information (RFI) for a trainer aircraft in July of last year, to which HAL has already responded. The RAAF trainer fleet now consists of roughly 30 'Hawk MK-127' LIFT aircraft that have been in service since 2001.

Sri Lanka

Sri Lanka has a small air force with only a few aircraft. During the civil war, these fighters were primarily responsible for bombing insurgents. Sri Lanka has already turned down Pakistan's offer of the JF 17 Thunder and is believed to have shown interest in the Indian Tejas.

Tejas makes use of more efficient technology and has an American engine. As a result, it will be less expensive to operate than Russian platforms that require a lot of maintenance or platforms that employ Russian engines.

However, it's unlikely that Sri Lanka, which is currently experiencing economic hardship, would like to spend funds on military hardware. Besides, the island nation does not face any major threat from any of its neighbors, and hence, its air force would have to manage with its existing fleet of aircraft.

Stratolaunch To Build Aerial Target For U.S. Hypersonic Defense Testing

Joseph Trevithick | 09 December 2021

Source: The Drive | https://www.thedrive.com/the-war-zone/43450/stratolaunch-to-build-aerial-target-for-u-s-hypersonic-defense-testing

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

Stratolaunch, the owner and operator of the massive Roc, the largest plane ever flown, has received a contract from the U.S. Missile Defense Agency to supply a target that mimics certain hypersonic threats to support the development of new defensive capabilities. Hypersonic weapons present significant challenges for defenders in terms of detecting and tracking incoming threats, as well as attempting to intercept them. Being able to test new sensors and interceptors against real representative targets will be essential going forward.

Stratolaunch announced its deal with Missile Defense Agency (MDA) yesterday, but provided only limited details about the expected work.

"We're excited to provide MDA with a threat-representative and threat-replicating target that allows them to understand how to engage and intercept hypersonic threats," Dr. Daniel Millman, Chief Technology Officer of Stratolaunch, said in a statement contained in a company press release.

"The company plans to augment existing Department of Defense flight test resources through affordable, commercially contracted, rapid-turnaround hypersonic flight testing for the Department of Defense and its prime contractor partners," that same release added.

This MDA contract is exactly the kind of work that Stratolaunch had said publicly back in December 2019 that it would start to seek out. That had represented a change in direction away from the firm's original focus on space launch services, with the Roc serving as a mothership for air-launching various expendable and reusable vehicles to put payloads into space. The shift to high-speed flight testing services had come after the company was sold to Cerberus Capital Management following the death of the company's founder, Microsoft co-founder Paul Allen, in 2018.

It's not clear from Stratolaunch's press release whether the target it will provide to MDA will be an entirely new development or one based on an existing design the company has been working on. The firm did announce the completion of a Critical Design Review of its Talon-A hypersonic test vehicle design in September and said that the goal was to conduct the first flight test of one of those vehicles next year. Separate testing is also ongoing to prepare the Roc, which was developed and built for Stratolaunch by Scaled Composites, a Northrop Grumman company, for its role as the

launch platform.

Talon-A is a resuable, unmanned vehicle with various modular payload spaces to support various flight test activities. It is expected to be able to reach speeds of at least Mach 6, with hypersonic speed being defined as anything above Mach 5.

The Talon-A, which is 28 feet long and has a wingspan of just over 11 feet, is a powered glider-type vehicle that uses a liquid fuel rocket motor to help propel it to the desired speed after launch. After completing its mission, it is designed to land on a conventional runway using its tricycle landing gear.

Stratolaunch is also working on a similar, but larger vehicle called Talon-Z, as well as a spaceplane called Black Ice that could be configured to carry cargo, and even possibly passengers.

The Talon-A design, or a derivative thereof, could be viable for use as a surrogate for hypersonic weapons that use unpowered boost-glide vehicles, such as Russia's Avangard or China's DF-17. North Korea also claimed to have tested a weapon of this type earlier this year. The mysterious fractional orbital bombardment system-like weapon that China has been testing recently appears to use some kind of hypersonic glider, as well.

These are, of course, only some of the hypersonic weapons currently known to be in development in Russia, China, and other countries around the world, including the United States, reflecting a growing arms race in this regard. This has, in turn, prompted the U.S. military, among others, to initial work on systems to defend against these threats.

Hypersonic boost-glide vehicles present particular obstacles for defenders due to their combination of high speed and maneuverability while traveling along an atmospheric flight trajectory. This is a general flight pattern that is dramatically different from the ones that most missile defense systems, which have been focused for years primarily on detecting, tracking, and intercepting more conventional ballistic missiles, are optimized to protect against.

In response, the U.S. military has been looking to expand and improve its missile defense sensor networks. This includes plans for new space-based systems, as well as terrestrial ones. Just this week, the Pentagon announced that the construction of its first new Long-Range Discrimination Radar (LRDR) array, at Clear Space Force Station in Alaska, had been completed. Another LRDR array is eventually set to be built in Hawaii.

LRDR has "the ability to search, track and discriminate multiple, small objects in space, including all classes of ballistic missiles," according to the Pentagon. "Future iterations of the radar's software will allow it to also track hypersonic missiles."

There is separate work being done on the development of new interceptors to actually try to shoot down incoming hypersonic weapons. MDA, together with the U.S. Navy, has previously announced plans to test a missile defense-specific

version of the highly capable SM-6 missile against a surrogate for an "advanced maneuvering threat," a term that has been used to refer to hypersonic boost-glide vehicles.

In November, MDA had announced that it had hired Raytheon, Lockheed Martin, and Northrop Grumman to provide competing designs for an all-new Glide Phase Interceptor (GPI). The goal of the GPI program is to acquire an interceptor capable of knocking down a hypersonic boost-glide vehicle in the midcourse portion of its flight.

Any new sensors or interceptors will need to be tested against representative threats and the U.S. military's need to expand testing capacity to support its growing work on hypersonic defense, as well as actual hypersonic weapons, has been increasingly clear. MDA has leveraged previous U.S. military hypersonic weapon tests as one way to help gather relevant data for hypersonic defense work.

However, having its own surrogate targets to test against, which could be built to be more representative of potential threats, would be a valuable addition to MDA's overall testing architecture. If the vehicle that Stratolaunch will now provide is designed to be reusable, it could introduce new economies to future testing regimens.

Stratolaunch's goal is for the Roc, which only flew for the second time ever in April, to be eventually able to carry up to three Talon-A-sized vehicles at once. "This unique capability enables multiple hypersonic flight opportunities on a single day or the near-simultaneous launch of three Talon vehicles, which may support specific operational scenarios," according to the company's website. This might point, potentially, to Roc's future ability to support testing representing multiple incoming hypersonic threats at once depending on the size of the target design.

In addition, a reusable vehicle combined with the Roc mothership would offer a very flexible system to support a high testing tempo at multiple locations. This could all be especially valuable given that the vast majority of U.S. hypersonic and missile defense-related flight and live-fire testing takes place at various locations across the Pacific.

For Stratolaunch itself, the new deal with MDA points to a more secure future for the company and for the Roc. After Paul Allen died, there were concerns that the entire enterprise might fold.

As it stands now, the world's largest airplane looks set to become an important addition to the test assets supporting future U.S. military hypersonic defense developments.

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Indian Aerospace Industry

TDB supports development and production of receiver modules essential for an app that provides navigation support

25 December 2021

Source: Ministry of Science & Technology | https://pib.gov.in/PressReleasePage.aspx?PRID=1785119

India will soon develop and manufacture receiver modules essential for the NavIC (NAVigation with Indian Constellation), an application developed by ISRO for constellation of seven satellites that, together, provide navigation support over India and 1,500 km around it. Support for scaling up this technology, which is also essential for GPS (Global Positioning Systems) s will be a significant step in positioning India as a global hub for Electronics System Design and Manufacturing following the vision of the Prime Minister.

Technology Development Board, a statutory body of Department of Science & Technology, Government of India, has approved financial support to Hyderabad based Manjeera Digital Systems Private Limited (MDS), a Digital Signal Processing (DSP), Research & Development company, which aims to design next-generation computing architectures for high-performance computing for manufacturing of receiver modules in bulk which will be essential for the NavIC App. This could help establish India's technological leadership in the areas of strategic importance and economic self-reliance.

The company has also designed and fabricated a baseband processor using patented Universal Multifunctional Accelerator (UMA). This UMA can be used in generic Digital Signal Processing (DSP) applications such as Server Acceleration, Edge Computing, Node Computing, Computer Vision, Signal Processing, etc.

"TDB has played a pivotal role in developing conducive ecosystems for growth of technology companies, be it Startups, MSMEs, or established companies. We, at TDB, are geared up for taking up challenges in the niche technologies of national interest like semiconductors, green hydrogen, defense, aerospace & similar sectors," Sh. Rajesh Kumar Pathak, IP&TAFS, Secretary, TDB, pointed out.

The company's CEO, Dr. Venu Kandadai, said, "TDB's assistance, at this juncture, is timely and of immense help in speeding its efforts in development and commercialization of indigenous products. We, at Manjeera, plan to design and develop many such chips that will contribute to the country's initiatives for self-reliance in electronic chip design and development.".

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Govt may include Indian space-tech startups in human spaceflight Programmes

Shouvik Das| 22 December 2021

Source: Live Mint | https://www.livemint.com/news/india/govt-may-include-indian-space-tech-startups-in-human-spaceflight-programmes/amp-11640140569638.html

The space policies expected in 2022 include space transportation, humans in space policy, remote sensing, satellite communications and much more.

NEW DELHI: While India prepares to launch humans into space over the next couple of years, the Union government is likely to tweak its draft 'Humans in Space Policy 2021' document to include private space-tech startups in the programme, say industry experts.

Pawan Kumar Chandana, chief executive officer of Indian space startup Skyroot Aerospace, believes the Indian space policy in 2022 will define the role that private startups will play in the nation's human spaceflight ambitions. "The space policies expected in 2022 include space transportation, humans in space policy, remote sensing, satellite communications and much more. The humans in space policy will apply to private players as well, and most of the upcoming regulations will be focused on catering to private entities in the space ecosystem," he asserted.

Skyroot Aerospace, alongside fellow startup Agnikul Cosmos, are two Indian space startups that are building their own rockets. Both recently showcased and test-fired their engines, of which both are largely made on Indian soil. Both Skyroot and Agnikul Cosmos are set to launch their first rockets into space in 2022.

Chaitanya Giri, founder of space analysis and intelligence firm Dawon A&I, concurred that the Indian spaceflight policy defining the role of private entities in human missions will likely come "at the juncture of the two uncrewed Gaganyaan test missions scheduled for 2022."

The Department of Science and Technology (DST), however, was yet to respond to an email for a comment on its upcoming policy at the time of going to press.

Jitendra Singh, union minister of state for the department of space and atomic energy, recently told Parliament that Gaganyaan--India's manned space mission--will launch in 2023. The first manned Gaganyaan mission will take place in early second-half of 2022. The second uncrewed mission, scheduled for the end of 2022, will include Vyommitra--a humanoid robot developed by the Indian Space Research Organisation (Isro).

India's own space station, meanwhile, is being earmarked for the year 2030, Singh further stated at the Parliament.

While the private Indian space industry, which includes space-tech startups, is expecting directives from the government on their specific

roles in manned missions, they do not expect the missions themselves to take off any time soon due to lack of adequate funds for private startups, and the government's need to understand the sector better.

"I see a horizon of 2035 and onward for human spaceflight involving private Indian players. The government needs prior expertise in this sector, and they already have bigger money bags than private players. The 2030 Indian space station plan, which would follow the Gaganyaan human spaceflight mission, will happen within the government's overview. This will be an inter-ministerial mission. Protocols and mechanisms from multiple ministries working on such projects would then be carried forward -- to allow in private startups and industry players gradually," explained Giri.

Homegrown space-tech startups, however, are not waiting--they already have plans involving human spaceflights. "We are into manufacturing rockets, and one of the very attractive long-term markets is human transport -- be it for tourism, exploration or other space-based services. This will be a natural evolution for us, but we'll take time to mature to a level when we can launch human missions," Chandana said.

Giri, however, cautioned that while the prospect of human spaceflight from Indian soil is attractive, the sector must not become overly dependent on it.

"The Indian space industry must not depend heavily on its civilian space programme. For commercial services, we should try to make sure that areas such as manufacturing of satellite constellations are facilitated in India -- instead of purchasing or sourcing from a foreign entity. We must ask questions around why launches are to be held from foreign soil -- and why our own Isro's PSLV is not to be used for the launch?"

Giri added that private space players in the country can boost their revenue to eventually build up to human missions by "picking-up commercial contracts, and catering to the country's own defence sector's space-related needs".

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France has agreed to jointly build aircraft engine

Dinakar Peri | 18 December 2021

Source: The Hindu | https://www.thehindu.com/news/national/have-conveyed-to-us-russia-others-that-equipment-for-indian-forces-has-to-be-produced-in-india-rajnath/article37984581.ece

Rajnath Singh said India will maintain friendship with these countries but at the same time will not hesitate to push for the production of key platforms on Indian soil. Photo: Twitter. @ficci_india

France has agreed to jointly build aircraft engine in collaboration with India, Defence Minister Rajnath Singh said on Saturday.

The government, he asserted, was committed to increasing the budget outlay for defence procurement from Indian industry. He believed that the Indian defence and aerospace manufacturing market, which was ₹85,000 crore now, would increase to ₹1 lakh crore in 2022 and ₹5 lakh crore by 2047.

"Yesterday, French Defence Minister agreed to build the engine with us, so far not made in India. A major French company will come to India and make the engine in strategic partnership with an Indian company," Mr. Singh stated at the 94th Annual General Body Meeting of the Federation of Indian Chambers of Commerce and Industry. However, he did not give details of the proposed engine development.

'Talks on with Safran'

A defence official observed that discussions have been on with Safran of France to develop the engine for the Advanced Medium Combat Aircraft (AMCA) and this was the same engine.

The government recently informed Parliament that it has proposed to develop indigenous engines for powering aircraft such as the LCA variants and the AMCA in association with an International Engine House. The Defence Research and Development Organisation had been in talks with leading engine manufacturers.

On efforts to boost domestic defence industry, he clarified that in this decade, they would increase the items under the Positive list for Indigenisation from current 209 to over 1000. Inviting global companies to invest in the Indian defence and aerospace sectors, he said, "Come Make in India, come make for India, come make for the world."

Highlighting the initiatives taken to increase the private sector participation and global companies, he remarked, "The Indian defence industry has realised that the opportune time has come for its take-off to higher trajectories. The corporatisation of the OFB is probably the biggest reform in defence production sector since Independence."

Due to India's 'stature' and its geographical location as well as the kind of security challenges it faces, "we cannot depend on other countries for our defence technologies", he added.

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Standing Committee on Defence recommends three aircraft carriers for Navy

Manu Pubby | 16 December 2021

Source: Economic Times | https://economictimes.indiatimes.com/news/defence/committee-on-defence-recommends-three-aircraft-carriers-for-navy/articleshow/88308905.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

In its response to queries raised by the committee on acquisition plans, the government has said that "the requirement of the third Aircraft Carrier will be worked out on the Indian Navy's committed liabilities and future acquisition projects", without committing on a timeline.

Making a strong recommendation that the Navy should have three aircraft carriers, the standing committee on defence has suggested that future acquisition plans need to take into consideration the requirement to enhance combat capabilities. The committee also went into the details of winter clothing for troops posted on the northern borders and bulletproof jackets for soldiers but the replies of the government have been deemed as classified and were redacted from the reports.

It has also suggested that the Border Roads Organisation (BRO) should concentrate on infrastructure projects along the northern borders and the feasibility of engaging another organisation for the development of coastal roads needs to be considered as an interim measure.

Making the point that a carrier each is required for the two coasts, the committee has said in its report submitted in Parliament that a third ship is needed to bridge operational deficiencies as repair work on the colossal vessels is a time-consuming affair.

"Taking into account the long coastline and hostile adversities on both sides of the Indian peninsula, an aircraft carrier on both sides of the coast is quintessential to uphold operational requirements. However, repair work of a huge vessel such as an aircraft carrier takes a considerably long time. Therefore, to bridge operational deficiencies thus arising, three aircraft carriers are an unavoidable requirement to meet any eventualities," the committee has suggested.

In its response to queries raised by the committee on acquisition plans, the government has said that "the requirement of the third Aircraft Carrier will be worked out on the Indian Navy's committed liabilities and future acquisition projects", without committing on a timeline.

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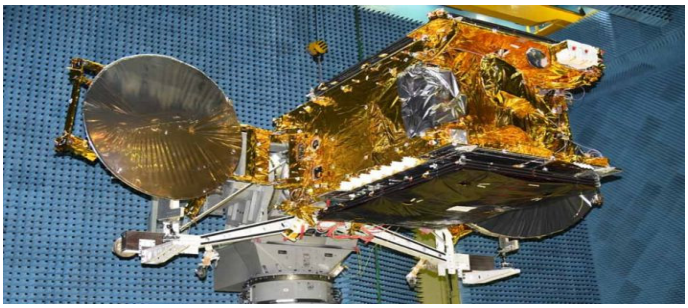
DAC Allocates Rs 2,236 Crores For GSAT-7C Satellite & Ground Hubs Under Make in India

23 November 2021

Source: Indian Aerospace & Defence Bulletin | https://www.iadb.in/2021/11/23/dac-allocates-rs-2236-crores-for-gsat-7c-satellite-ground-hubs-under-make-in-india/



New Delhi, 23 November 2021: Earlier today, the Defence Acquisition Council (DAC), accorded Acceptance of Necessity (AoN) for a Capital Acquisition proposal inorder to bolster the Indian Air Force's (IAF) modernization and operational requirements.

The DAC meeting was chaired by Defence Minister Rajnath Singh during which Rs. 2,236 crores were allocated for the procurement of GSAT-7C Satellite and Ground Hubs under the Make in India initiative.

What Will The Acquisition Offer?

The GSAT-7C Satellite and Ground Hubs offer real-time connectivity of Software Defined Radios (SDRs). The project envisages complete design, development and launching of satellites in India.

A press release issued into the development read, "The Induction of GSAT-7C Satellite and Ground Hubs for Software Defined Radios (SDRs) will enhance the ability of our Armed Forces to communicate beyond Line of Sight (LoS) among one another in all circumstances in a secure mode."

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Lockheed Martin Announces Indigenous Production Capability Of Fighter Wing Shipset At TLMAL Facility In Hyderabad

09 December 2021

Source: Indian Aerospace & Defence Bulletin | https://www.iadb.in/2021/12/09/lockheed-martin-announces-indigenous-production-capability-of-fighter-wing-shipset-at-tlmal-facility-in-hyderabad/

Lockheed Martin (NYSE: LMT) formally recognized Tata-Lockheed Martin Aerostructures Limited (TLMAL) as a potential co-producer of fighter wings. A ceremonial event marking the first fighter wing prototype built at the TLMAL facility in Hyderabad was attended by K.T. Rama Rao, Minister for Municipal Administration and Urban Development, Industries and Commerce, and Information Technology of Telangana; along with other government dignitaries; Lockheed Martin Aeronautics and Global Business Development executives; and Tata Advanced Systems Limited and TLMAL leadership.

"Lockheed Martin partnered with TLMAL to build one of the most technologically complex aerostructures — a fuel-carrying 9G, 12,000 hours, interchangeable/replaceable fighter wing," said Aimee Burnett, vice president of strategy and business development, Lockheed Martin

Integrated Fighter Group.

"This effort represents Lockheed Martin demonstrating to India, and the world, the degree of confidence that exists in our relationships with our partners in India. Lockheed Martin is one of the only aerospace and defence companies with a complex aerostructure capability for advanced fighters in India."

TLMAL — a joint venture between Tata Advanced Systems Limited and Lockheed Martin Aeronautics — was established in 2010. TLMAL exemplifies the government of India's Aatmanirbhar Bharat 'Make in India' goals and serves as the single global source of C-130J empennage assemblies that are installed on all new Super Hercules aircraft. TLMAL recently reached the milestone of manufacturing and delivering the 150th C-130J empennage.

Lockheed Martin and TLMAL signed an agreement to develop a fighter wing prototype in 2018. Through this prototype project, TLMAL demonstrated the capability to perform detailed part manufacturing and delivery of a fully compliant representative fighter aircraft wing shipset. This achievement further strengthens Lockheed Martin's partnership with India; and supports its F-21 offering to procure 114 new fighter aircraft — exclusively for India and the Indian Air Force — by proving additional indigenous production capability.

"The successful completion of the fighter wing shipset prototype project is another achievement added to the partnership between Tata Advanced Systems and Lockheed Martin," said Sukaran Singh, managing director and chief executive officer, Tata Advanced Systems Limited. "With this, TLMAL creates a new benchmark in complex and end-to-end defence manufacturing in India that demands utmost precision and quality in all aspects of the process."

Lockheed Martin continues to build upon more than seven decades of association and three decades of partnerships with India by nurturing and expanding collaborations with local industry to support the evolution of indigenous defence manufacturing ecosystems and advance India's strategic security and industrial capabilities. These range from transport, maritime and fighter aircraft to shipborne air and missile defence projects and abilities in civil sectors, including new and renewable energy. Lockheed Martin India's joint ventures, apprenticeships and founding member of the India Innovation Growth Program underscore its conviction to Indian industry, talent and progress.

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HAL signs ₹2,400 crore contract with BEL

16 December 2021

Source: The Hindu | https://www.thehindu.com/news/national/hal-signs-2400-crore-contract-with-bel/article37966762.ece

Hindustan Aeronautics Limited on Thursday, December 16, 2021, signed a contract with Bharat Electronics Limited for development and supply of 20 types systems for the LCA Tejas Mk1A programme. File photo

In a major boost to indigenisation, Hindustan Aeronautics Limited on Thursday, December 16, 2021, signed a contract with Bharat Electronics Limited for development and supply of 20 types systems for the LCA Tejas Mk1A programme.

The five-year contract spanning from 2023 to 2028 is valued at ₹2,400 crore and involves supplying critical avionics Line Replaceable Units (LRUs), flight control computers and night flying LRUs, Bengaluru-headquartered HAL said in a statement.

"This is the biggest ever order that HAL has placed on any Indian company boosting 'Atmanirbhar Bharat' campaign," it said.

"LCA Tejas programme is an excellent example of synergies between Indian Defence establishments such as HAL, DRDO & BEL. The current order for development and supply of 20 types of critical avionics LRUs for Tejas Mk1A is a shot-in-the-arm for Make in India activity," said HAL CMD R. Madhavan.

"We are pleased to receive this order from HAL for the prestigious LCA Tejas programme and look forward to continuing strong partnership and joint success with HAL," said BEL CMD Anandi Ramalingam.

The order for supply of these systems for 83 Tejas Mk1A fighter fleet will be executed by two Divisions of BELat Bengaluru and Panchkula (Haryana). All the contracted items will be delivered by BEL to HAL in a ready-to-board condition, the statement said.

Deliveries under 83 Tejas Mk1A order to IAF will commence from 2023-24. The home-grown fighter is slated to be equipped with indigenous flight control computers, air data computers which would also be supplied by BEL under this contract. These systems have been designed and developed by various labs of DRDO and Aeronautical Development Agency, Bengaluru.

The contract documents were handed over by General Manager LCA Tejas Division, HAL, E.P. Jayadeva to General Manager (EW&A) BEL, Manoj Jain.

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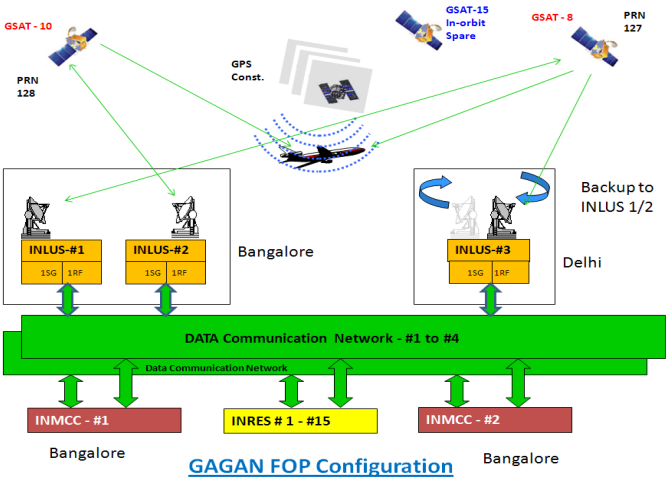
Big Breakthrough: India's Rustom-2 Drone Demonstrates Critical Capabilities Using Own GPS System

Ashish Dangwal | 17 November 2021

Source: Eurasian Times | https://eurasiantimes.com/indias-rustom-2-drone-critical-capabilities-using-own-gagan/?amp



GAGAN FOP Configuration

Recently, India's Defence Research and Development Organisation demonstrated the Rustom II drone's ability to take off and land autonomously which was hailed a big milestone.

In a tweet, the DRDO said – Expanding the envelope of indigenous MALE UAV Rustom II, critical technologies of Autonomous Take-Off and Landing (ATOL) & also using GAGAN Satellite system successfully proven at Bengaluru.

The breakthrough was announced by the DRDO on 13 November. During the trial, the Rustom II also demonstrated its ability to utilize India's GAGAN satellite-based navigation system, the DRDO added.

The Rustom II is a twin turboprop-powered drone that has been developed for surveillance, and reconnaissance (ISR) missions. The UAV has an overall length of 9.5 m and a wingspan of 20.6 m. It can carry payloads such as gimballed electro-optical sensors of up to 350 kg.

India Accelerating Drone Development

The war in Nagorno-Karabakh demonstrated the value of unmanned aerial combat vehicles (UACVs) to the entire world where Armenia was left defenseless against Turkish-origin drones.

India, likewise, has paid careful attention to the Armenia-Azerbaijan conflict, with armed forces attempting to draw crucial lessons as they seek to induct UACVs.

The Rustom-II developed by the Defence Research and Development Organisation (DRDO) is a medium-altitude long-endurance (MALE) drone. Its navigation was done using GAGAN satellites through the onboard SATCOM system.

The acronym GAGAN stands for GPS Aided GEO Augmented Navigation, which was developed by the Indian Space Research Organization (ISRO). The evaluations were completed in Bengaluru.

In September 2019, the Rustom-II had crashed near Chitradurga in the southern Indian state of Karnataka during assessments. A year later, the DRDO restarted drone flight testing.

In October 2020, the drone soared for eight hours at a height of 16,000 feet. Rustom-II is also known as Tapas-BH (Tactical Airborne Platform for Aerial Surveillance-Past Horizon 201).

The UAV is part of the Rustom-series of drones, which also includes the Rustom-I,

Rustom-H, and Rustom-C. In February 2018, Rustom-II completed its first test flight with a high-power engine.

This UAV can carry a wide range of payloads (up to 350kg) is equipped with artificial aperture radar, digital intelligence programs, and situational awareness programs.

India's MALE Drone

Aeronautical Development Establishment (ADE), a Bengaluru-based premier lab of DRDO, designed and developed Rustom-II, with HAL-BEL as the production partners.

It's also the first R&D prototype UAV to be certified and qualified for the first flight by the Center for Military Airworthiness & Certification (CEMILAC) and the Directorate General of Aeronautical Quality Assurance (DGAQA).

After its induction, the Indian armed forces will use the Rustom-II for surveillance and reconnaissance operations. It can be controlled up to 100 km away via a Line of Sight (LOS) system. Additionally, the aircraft can be commanded by SATCOM beyond 100 km.

The UAV is actually named after Rustom Damania, a former professor at the Indian Institute of Science (IISc), Bengaluru. In the 1980s, he led the National Aeronautical Laboratories' light canard research aircraft (LCRA) program.

The LCRA platform and R&D provide the preliminary drive for DRDO ADE's eventual Rustom-II design, which intends for a high elevation of 35,000-40,000 feet.

The drone will undergo significant structural and engine improvements for its use by all three services — the Army, Navy, and Air Force — and will probably replace the Israeli Heron/Searcher UAVs in service with the Indian armed forces.

The UAV has a 20-meter wingspan and will be deployed using the traditional manner rather than the launcher used in Lakshya and Nishant. Rustom will be able to gaze into enemy territory from a distance of 250 km and will be equipped with a range of sensors for monitoring.

Rustom-II is being designed to acquire real-time, high-quality pictures and signal intelligence from fields of concern at medium to long ranges.

It is worth mentioning that the development of UAVs makes a significant contribution to the 'Make-in-India' and 'Atmanirbhar Bharat' (self-reliant India) initiatives. Many important systems such as the airframe, landing gear, flight control, and avionics subsystems are being built in India with the assistance of private enterprises.

What is GAGAN?

The GPS and geo-augmented navigation system (GAGAN) is India's initiative to develop a regional satellite-based augmentation system (SBAS). It is a system that provides reference signals to increase the accuracy of a global navigation satellite system (GNSS) receiver.

The Airport Authority of India is implementing the project in three phases, with the help of technology developed by the Indian Space Research Organisation (ISRO). The vision is to develop a navigation system that can be used for

all stages of flight over Indian airspace and the surrounding area

It can be used in crisis situations and meets the performance standards set by international civil aviation regulatory authorities.

Wide Area Augmentation System (WAAS) codes for L1 frequency and L5 frequency were secured from the United States Air Force and the United States Department of Defense in November 2001 and March 2005, respectively, to commence building an SBAS across Indian airspace.

The GPS information is received and analyzed at the 15 Indian Reference Stations (INRES) in Ahmedabad, Bengaluru, Bhubaneswar, Kolkata, Delhi, Dibrugarh, Gaya, Goa, Guwahati, Jaisalmer, Jammu, Nagpur, Porbandar, Port Blair, and Thiruvananthapuram.

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Technology Development

Airbus Zephyr stratospheric drone demos internet connectivity during test flight

Ben Sampson | 16 November 2021

Source: Aerospace Testing International | https://www.aerospacetestinginternational.com/news/drones-air-taxis/airbus-zephyr-stratospheric-drone-demos-internet-connectivity-during-test-flight.html

Airbus' Zephyr High Altitude Platform Station (HAPS) is a drone able to fly in the atmosphere for extended periods of time (Image: Airbus)

Airbus' Zephyr S high altitude drone has provided wireless broadband connectivity during an 18-day stratospheric flight test.

The test program, which was conducted in partnership with Japanese mobile network provider NTT Docomo, took place in the USA during the summer.

The solar-powered Zephyr-S, which is known as High Altitude Platform Station (HAPS), has a 25m wingspan and weighs 75kg (165lbs). The aircraft has been in development at Airbus since 2013, but the program was originally started by UK-based defence company QinetiQ in 2003.

Airbus has mooted several possible applications for the Zephyr, initially in the defence sector to

provide communications and surveillance but also in the commercial sector for disaster management and providing communications in unconnected regions.

During the stratospheric test flights, the Zephyr S carried a radio transmitter that provided a datalink at an altitude of approximately 20km (12 miles) to a receiving antenna on the ground.

The trial tested the stability of the connection between the Zephyr S HAPS and the ground antenna and how it was affected by factors such as weather conditions, differences in reception distance and the flight pattern of the HAPS aircraft. As a result, under three specific scenarios: clear, rainy and cloudy conditions, and in a multitude of flight patterns, data transmissions across various speeds were successfully demonstrated, up to a distance of 140km (87 miles).

Tests included various bandwidths to simulate direct-to-device service from the HAPS to end users using low, nominal and high throughput. The demonstration confirmed the viability of the 2GHz spectrum for HAPS-based services and also the use of a narrow (450MHz) band to provide connectivity in a range of up to 140km.

The measurement and analysis of the propagation of radio waves transmitted from Zephyr demonstrated the feasibility of stratospheric communications to devices such as smartphones. Airbus and NTT Docomo will now work to provide communication services to mountainous areas, remote islands, and maritime areas where radio waves are difficult to reach.

Takehiro Nakamura, general manager of Docomo's 6G-IOWN Promotion Department said, "DOCOMO believes that HAPS will be a promising solution for coverage expansion in 5G evolution and 6G.

"In this measurement experiment, we were able to demonstrate the effectiveness of HAPS, especially for direct communication to smartphones, through long-term propagation measurements using actual HAPS equipment. Based on these results, we would like to further study the practical application of HAPS in 5G evolution and 6G with Airbus."

The test data will be used to inform future LTE direct-to-device services that are expected to be provided via the Airbus Zephyr HAPS solution.

"Billions of people across the world suffer from poor or no connectivity. These tests show us the viability of the stratosphere to bridge this divide and provide direct to device connectivity via Zephyr without the need for base stations or extra infrastructure,"

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China tests hypersonic flight engine using rejected design developed in US

Kirill Kurevlev | 10 December 2021

Source: Sputnik News | https://sputniknews.com/20211210/china-tests-hypersonic-flight-engine-using-design-developed-in-us-but-rejected-over-costs---report-1091428668.html

A team of scientists has built and successfully tested a prototype based on a novel idea created more than two decades ago by an American space agency expert of Chinese descent.

A Chinese research team has built and tested a prototype hypersonic flight engine, capable of operating in Mach 4 to Mach 8 (4,900-9,800 kph) speed conditions, based on a design cooked up in NASA but later rejected due to high costs and unsolved technical problems, The South China Morning Post reported.

According to the report, while the majority of hypersonic aircraft have engines at the belly, a key feature of the experimental TSV X-plane is that it is powered by two separate engines on the sides.

The design was reportedly conceived by Ming Han Tang, a Chinese American who served as the lead engineer of NASA's hypersonic program in the late 1990s.

An interesting part of the design is that at lower speeds, the engines are able to operate as regular turbine jet engines, then they transition to a high-speed mode with no moving components when the aircraft accelerates to five times the speed of sound or higher.

NASA was ultimately unable to complete the now-defunct Boeing Manta X-47C project, as the dual-engine design's aerodynamics were too complex, and certain key problems remained unanswered, such as whether the engines could ignite after moving to hypersonic speed.

The US government reportedly canceled the program created to test Tang's design in the early 2000s due to technical challenges and costs.

According to the SCMP, the prototype research was taken up by a group of Nanjing University of Aeronautics and Astronautics scientists led by professor Tan Huijun, who have created a prototype machine featuring a pair of side-opening air inlets based on a declassified Tang scheme.

The team reportedly tested the prototype in a wind tunnel that could simulate flight conditions from Mach 4 to Mach 8 for several seconds. They discovered that the engines could start even in the most difficult of flight conditions, precisely as Tang expected.

In China, the design has reportedly gained much attention because "understanding its work mechanism can provide important guidance to hypersonic plane and engine development," according to Tan and colleagues in a paper

published in the Chinese peer-reviewed Journal of Propulsion Technology, per the outlet's translation.

However, according to Tan and his colleagues, Tang's design was reportedly not ideal. Strong turbulence could occur around several corners of the air inlet, compromising flying stability, the team stated based on computer simulation and experimental results. The plane's ability to rise steeply without choking its engines was similarly limited.

And more importantly, the Chinese researchers emphasized that even if the dual-engine architecture was viable with some advantages, as the ground experiment revealed, many difficult challenges remain.

China's hypersonic vehicles and weapons currently utilize a rocket to initiate flight. The rocket shuts down after reaching a high altitude and high speed, allowing the air-breathing engine to take over.

And by 2035, Chinese space officials reportedly hope to produce a jet that can transport ten passengers anywhere on Earth in an hour on a new generation of turbo jet engines that could reach the speed of up to Mach 4, replacing rockets in hypersonic flights.

Earlier this year, China successfully launched a rocket into space carrying a hypersonic glide vehicle that circled the globe before rushing towards its target, which US intelligence and military officials admitted was surprising for the US.

Commentary

1. Civil Aero Engines — Review Of Trends - https://www.sps-aviation.com/story/?id=3032&h=Civil-Aero-Engines-Review-of-Trends

Further Reading

1. Don't wait for a disaster: Industry-led space traffic management. - https://spacenews.com/mop-ed-dont-wait-for-a-disaster-industry-led-space-traffic-management/
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4. Higher Priority For MRO Activity Makes Sense - https://www.iadb.in/2021/11/10/higher-priority-for-mro-activity-makes-sense/
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7. Rocket industrial park put into operation in Wuhan - http://www.chinadaily.com.cn/a/202111/26/WS61a035ffa310cdd39bc77a75.html

8. Moscow accuses US of rehearsing nuclear strike against Russia - https://www.scmp.com/news/world/russia-central-asia/article/3157134/moscow-accuses-us-rehearsing-nuclear-strike-against

"In order to assure an adequate national defence, it is necessary - and sufficient - to be in a position in case of war to conquer the command of the air."

- Giulio Douhet

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