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In the long run, the only safe and reliable foundation of national Air Power lies in commercial air development.

- P.R.C. Groves (Behind the Smoke Screen, 230)

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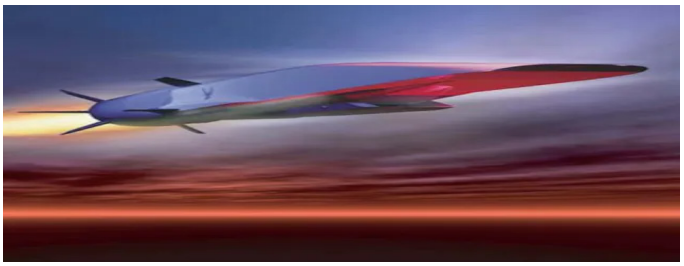
Opinions and Analysis

China Far Ahead in Hypersonic Platforms Research: Why India Needs to Step Up Fast

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

11 Jan 2023

Source: First Post | https://www.firstpost.com/opinion/china-far-ahead-in-hypersonic-platforms-research-why-india-needs-to-step-up-fast-11966732.html



Hypersonic missile. Inage courtesy US Air Force graphic

End March 2022, Russia became the first country to use a hypersonic missile against targets in Ukraine operationally and thus heralding a new era of warfare of very high-speed lethality. The Kh-47M2 Kinzhal hypersonic missile reportedly destroyed an ammunition warehouse. Hypersonic weapons or platforms fly at speeds in excess of Mach 5 or five times the speed of sound. These weapons not only enjoy the kinetic energy imparted by speed, but are also manoeuvrable, and thus making them a very lethal and unpredictable weapon.

China is clearly around 10 years ahead of India in development of hypersonic weapon systems.

To sustain hypersonic flight within the atmosphere was a challenge for mankind for long. It meant not only surmounting aero-thermal forces of air resistance but also sustaining such flight for a few minutes. The aerodynamic design had to allow manoeuvrability while maintaining a very high speed. These challenges have now been surmounted and many countries are pursuing such technologies and weapons. Since hypersonic weapons are not only disruptive technology but could carry a nuclear warhead, they could upset the current status quo of deterrence, increasing the risk of miscalculation. Hypersonic weapons have once again unlocked the offence-defence spiral risking arms race and strategic instability.

Hypersonic Weapon Types

There are two main categories of hypersonic weapons: hypersonic glide vehicles (HGV) and hypersonic cruise missiles (HCM). HGV is launched from a rocket, later it separates from the rocket and "glides" at speeds of at least Mach 5 toward its target. HCM is powered by air-breathing engines throughout the flight. HCMs use scramjet engines which are much more advanced ramjet engines that can handle supersonic airflow through the engine. The very high speeds give the defender shallow detection and interception time.

Unlike the ballistic missile which also travels at hypersonic speeds, the HCM/HGV manoeuvrability allows last-minute change of course and brings unpredictability about the intended target. While many nations are working toward space based detection sensors, the complexity remains. The United States, Russia and China have all developed hypersonic weapons. Others like India, the UK, France, Germany, Japan, and Australia are also developing hypersonic technology. Counters to hypersonic threat are already work in progress.

Russian and US Hypersonic Weapons Programmes

While both the US and Russia were working

on hypersonic weapons, Russia became the first to induct the HGV 'Avangard' and HCM 'Kinzhal' in 2018. In February 2019, Russia revealed 3M22 Tsirkon (Zircon) HCM, capable of both surface and underwater launch. Russia has already formed a hypersonic weapons regiment. The Kinzhal has been fired from MiG-31K fighter aircraft, and dedicated hypersonic weapons squadron is being formed.

The US has been developing hypersonic weapons under various military programmes. The United States Air Force (USAF) successfully tested its first prototype hypersonic missile, the AGM-183A Air-launched Rapid Response Weapon, or ARRW ("Arrow") HGV in December 2022, after three earlier failures. The Lockheed Martin-designed weapon is said to be based on previous test vehicles built by DARPA that reportedly had a maximum speed of Mach 20 (24,000 km/h). The US Long-Range Hypersonic Weapon (LRHW) is a medium-range surface-to-surface HGV planned for the US Army, with service induction in 2023. The US Navy (USN) intends to procure a ship/submarine-launched variant as part of the service's Intermediate-Range Conventional Prompt Strike (IRCPS) programme and induct by 2025.

Chinese Hypersonic Programme

In early 2000s, China had made a list of critical technologies, many disruptive and dual-use to pursue. Core teams for formed with research institutions, academia and industry. These got priority funding and goals spelt out. Hypersonic was one of these technologies. The tasks were further divided into three main technology areas of scramjet engine, combined propulsion system, and external vehicle design and aerodynamic force simulation. The funding increased considerably by around 2015.

The new generation high-speed flight vehicles need to fundamentally improve the guidance accuracy, reduce the weight, and ensure greater manoeuvrability. This set of requirements need new technologies and improved techniques, and direct lateral force control methods. China created hypersonic technology research institution clusters. These include Harbin Institute of Technology, National University of Defence Technology, Chinese Academy of Sciences, Northwestern Polytechnical University, Beihang University, Tianjin University, Dalian Maritime University, Nanjing University of Aeronautics and Astronautics, Peking University, Nanchang University, and Shanghai Jiaotong University.

Beijing is making a major investment in hypersonic missiles. They look at HGV/HCM as important element of its regional war-fighting strategy and also strategic deterrent. China already possesses one operational HGV, and are working on several others. China first successful tested its Starry Sky-2 (Xingkong-2) HCM in 2018. This has a range of 700-800 km and top speed of Mach 6. China successfully tested the DF-17, a road-mobile medium-range ballistic missile (MRBM) with a range of around 2,500 km designed to launch the DF-ZF HGV. The DF-ZF is reported to have a range of 1,600-2,400 km and high degrees of manoeuvrability and accuracy.

In 2019 China reportedly launched "more ballistic missiles for testing and training than the rest of the world combined." Some reports suggest that China is also considering deploying HGVs on DF-21 and DF-26 theatre-range ballistic missiles. China conducted two hypersonic tests in July and August 2021. The missile test in July reportedly circumnavigated the globe before

hitting its target, demonstrating China's ability to incorporate a glide vehicle into a Fractional Orbital Bombardment System (FOBS). China has also reportedly successfully tested a hypersonic unmanned aerial vehicle (UAV), presumably as a future intelligence, surveillance and reconnaissance (ISR) platform.

Other than funded research, China has also achieved many defence technologies because of US investments in China and access and transfer of technology by Chinese diaspora. All this happened because US businesses wanted access to huge Chinese market and the profits that come with it. This carried on for nearly four decades starting 1971. The US and the West has of late been trying to put curbs, and may be it is late. The next generation of Chinese hypersonic technology scientists are being trained domestically. While China is clearly collaborating with universities and scholars abroad, their international cooperation on hypersonic technologies now appears to be limited, and mostly stand-alone.

World's Biggest Hypersonic Wind Tunnel

The world's first wind tunnel capable of testing a full-sized hypersonic missile through the critical stages of flight has been operating in China and helped prevent expensive test stages and failures. The wind tunnel is large enough to house a full hypersonic missile and test various stages of flight including separation. Pentagon is still working on an equivalent wind tunnel, with a result many of their test had to be done in flight and some were failures. NASA's 8-foot high-temperature tunnel, though similar to the Chinese facility in size but could not simulate the booster separation. These wind-tunnels not only allow high wind speeds but also create more than 1,700 degrees Celsius. The JF-22, the world's most powerful hypersonic shock tunnel capable of simulating flight at Mach 30, will be completed in Beijing this year. The new facility will help China maintain a lead in hypersonic technology for decades to come, it is believed.

China's Hypersonic Operational Strategy

China currently insists that the hypersonic programme is for conventional weapons and for use against high value targets, treating them as the logical extension of cruise missiles. These capabilities will provide it enhanced multiple options to target US aircraft carriers and large ships and critical land targets as in Guam. The aim is to raise the costs for the US armed forces. Hypersonic systems would be part of the PLA's "anti-access/area denial (A2AD)". The situation could change when USA too deploys its similar weapons in larger numbers.

China could also use hypersonic weapons for striking military targets in US mainland in conventional prompt global strike role. The second role China may deploy these weapons would be for strategic deterrence. The HGV could have a nuclear payload and be launched aboard the new Chinese ICBM, the DF-41. This would give it global targeting ability including the US mainland. A nuclear-armed HGV could also piggyback on China's JL-2 submarine-launched ballistic missiles (SLBM) giving it greater reach and control while maximising their survivability.

Hypersonic Arms Race And Doctrinal Changes

Where are Russia, China and USA heading in this intense offense-defence hypersonic competition? As more hypersonic weapons are deployed, countries will have to develop active defence capability against such platforms. The nuclear deterrence stability and escalation

dynamics would have to be reworked. Would hypersonic weapons be an effective cost-imposing strategy? How expensive would it be to maintain large hypersonic weapons inventories would have to be assessed? Armed forces around the world would have to review doctrines to cater for speed, accuracy, surprise and shock that will come with the one seizing the initiative. Operational concepts would have to be reworked and war-gamed in exercises.

India's Hypersonic Developments

The DRDO's Hypersonic Technology Demonstrator Vehicle (HSTDV) is an unmanned scramjet demonstration aircraft for hypersonic speed flight. It is being developed as a carrier vehicle for hypersonic and long-range cruise missiles. It could even launch of small satellites at low cost. On 7 September 2020 the HSTDV scramjet was successfully tested. During the 23 seconds test, it reportedly attained Mach 6. The test flight validated many aspects that would serve as the building block for India's HCM. The BrahMos-2 will also be a hypersonic version and will probably fly at Mach 8, and have a range of 1,500 km. It is likely to enter the prototype stage by 2025. The missile is modelled on Russia's Zircon HCM.

India would thus become the fourth nation with hypersonic operational capabilities. The Philippines and Indonesia have shown interest for importing this missile. DRDO's Shaurya is a canister-launched hypersonic surface-to-surface tactical missile with a range up to 1,900 km and can carry a payload of up to 1,000 kg conventional or nuclear warhead. Sagarika K-15 missile is the under-water variant. But both these are ballistic missiles cannot be term as HGV/HCM.

Operational Implications of Chinese Hypersonic Weapons for India

China is clearly around 10 years ahead of India in HGV/HCM development. They are in a position to invest much greater funds for research and operational deployments. While the hypersonic platform can carry a nuclear warhead, that is beyond the scope of this tactical discussion. What are the type of targets against India which China may use hypersonic weapons? To target any land based targets, China can use a combination of conventionally armed ballistic missiles or air/ground/sea launched cruise missiles. These will be much cheaper. However in case a very well-defended and operationally critical target such as a political, or command and control centre, the hypersonic weapon may be used. Much more dividend would accrue in case the hypersonic weapon is used against a very high value target such as an aircraft carrier or large ship.

Hypersonic weapons would clearly score over others to target a large moving target. HGV/HCM would perform conventional precision-strike as next-generation anti-ship missiles that could penetrate the layered air defences even of a US carrier strike group. This is one type of target which the Chinese doctrine considers against the U.S. It could thus be huge threat to India's flotilla. Once the hypersonic weapons inventory becomes large, such targeting will have to be factored. Defences against HFV/HCM for high value targets would have to be strengthened.

Developing and building India's own hypersonic weapons stockpile would be important for deterrence and operational capability. Building air defence systems, including railgun or directed energy technologies to destroy incoming hypersonic weapon would be important. Such

technologies are not currently available even with the US Hypersonic weapons and flight are indeed game-changing technologies that India must push as a core national mission through a dedicated task-force and whole of nation approach. Time to act is now, lest India gets left behind.

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Air Power

Pantsir Air Defense Systems Appear on Moscow Rooftops

Joseph Trevithick | 19 Jan 2023

Source: The Drive | https://www.thedrive.com/the-war-zone/pantsir-air-defense-systems-appear-on-moscow-rooftops

A variant of Pantsir with the improved SOTS/RLM SOC radar. Vitaly Kuzmin

The Russian military appears to have emplaced Pantsir air defense systems on top of at least two different government buildings in Moscow, including the Ministry of Defense's headquarters. The official reason for the apparent deployments is unclear, but Ukrainian forces have demonstrated their ability to conduct strikes at extended ranges using various types of drones. There could be other explanations, including this just being part of an ostensible exercise of some kind.

Multiple pictures and videos reportedly showing the rooftop Pantsirs began to emerge on social media earlier today, but it is not immediately clear when exactly they were taken. In addition to the one on top of the headquarters of Russia's Defense Ministry, another looks to have been craned onto a building that is slightly closer to the city center and that Google Maps says belongs to the country's Ministry of Education.

It is unclear what specific versions of the Pantsir system are seen in the imagery, but they appear to be variants with the improved search

radar, referred to variously as SOTS or RLM SOC, on top. The radar, which is a rotating, mechanically-scanned array, is distinctive visually from earlier types used on Pantsir variants in that has two separate fixed-face antennas instead of just one.

Pantsir uses two radars, one to acquire targets and another to direct its command-guided missiles to intercept them. It is intended to primarily provide a point defense capability against various aerial threats, including fixed-wing aircraft, helicopters, drones, and cruise missiles. It also has at least some ability to engage artillery rockets, mortar rounds, and bombs.

Most variants of the system are also armed with a pair of twin-barrel 30mm cannons, but versions have been offered with missiles only. The system can be mounted on various wheeled and tracked chassis, and a navalized type for use as a close-in weapon system exists, as well.

The SOTS/RLM SOC radar is said to increase the range at which targets can be detected and how many targets can be tracked at once, and how accurately they can then be engaged. This was reportedly a product of lessons learned from the less-than-stellar performance of earlier Pantsir types in Syria, especially against drones.

This is, however, not the most advanced configuration of Pantsir that has been seen to date. A variant that uses a more advanced active electronically-scanned array (AESA) search radar emerged in 2019.

Without knowing more, it is hard to say exactly what kind of defensive coverage Pantsirs on top of the Ministry of Defense headquarters, and the other building tied to the Ministry of Education, might be able to provide. The systems would offer protection in a ring around these sites and would have better overall fields of fire thanks to their elevated positions.

It is possible that additional Pantsirs or other air defense assets may now be positioned in or around Moscow, too. This would all be in addition to the substantial air and missile defense capabilities already protecting Russia's capital.

The idea of positioning point defense systems like Pantsir around high-value and otherwise very sensitive locations as part of a larger integrated air defense network is certainly not unheard of. The U.S. military notably operates a number of Avenger air defense systems, which can engage various aerial threats with Stinger heat-seeking short-range surface-to-air missiles and .50 caliber M3P machine guns, in similar rooftop positions in Washington, D.C.

New air defenses on top of Russia's Ministry of Defense headquarters and another building likely point to concerns about Ukrainian strikes.

The Pantsir deployments could point to concerns about the potential for Ukrainian strikes targeting Moscow. Though the government in Ukraine is typically tight-lipped about the specifics, its forces have allegedly been responsible for a number of strikes inside Russia proper, including ones in December targeting an air base 300 miles from the border.

These strikes appear to have been conducted with various types of uncrewed aircraft drones, including Soviet-era jet-powered reconnaissance drones converted into weapons and commercially-available designs loaded with explosives.

In March 2022, shortly after Russia launched its all-out invasion of Ukraine, what appeared

to be a Ukrainian Tu-141 reconnaissance drone with a warhead installed notably crashed in the Croatian capital Zagreb. This city is, at closest, around 340 miles from Ukraine. The shortest distance between Moscow and the Russian-Ukrainian border is around 286 miles.

Representatives of Ukraine's state-run defense conglomerate Ukroboronprom claimed last week to have completed testing of a new strike drone design with a range of 1,000 kilometers (just over 620 miles). Reports about this system first emerged late last year.

Ukrainian operatives or anti-government partisans inside Russia could launch shorter-range armed drones, as well.

A demonstrated Ukrainian ability to hit targets deeper inside Russia, including in and around Moscow, could have significant operational implications. Destroying logistics, command and control, and other critical nodes within Russia proper could have very real impacts on battlefields in Ukraine. it could also force Russia's military to redeploy critical air and missile defense assets back inside its borders.

In addition, Ukrainian forces have appeared for months now to be looking for ways to retaliate more and more directly against Russia in response to strikes inside their country, in general. The Russian military has been striking targets across Ukraine for almost a year now and continues to do so. This includes indiscriminate strikes on the capital Kyiv and other cities since all-out fighting began nearly a year ago. Just this past weekend, dozens of Ukrainian civilians died and more were wounded when a Russian air-launched Kh-22 cruise missile struck an apartment building in the city of Dnipro.

All told, even a symbolic strike on a legitimate military target in Moscow, or somewhere nearby, could be a propaganda coup for the government in Kyiv. This, in turn, could prompt further criticism of how Russian President Vladimir Putin and his government are handling the war in Ukraine, which has already been building publicly.

In this context, it's interesting to note that, in December 2022, Yuri Knutov, the director of the Museum of Air Defense Forces, said during an interview on state television that gaps had emerged in Russia's domestic air defense networks due to the demands for those capabilities to support forces in Ukraine. Knutov further warned that this might open a door to a possible Ukrainian strike on Moscow.

The previous apparent Ukrainian drone strikes on targets inside Russia indicate that the country's air defense networks have already had difficulties in detecting and tracking uncrewed systems. Drones, by their nature, can be difficult to spot and intercept, and the Pantsirs in Moscow would offer an additional final line of defense against them and other aerial threats.

There is the possibility that the deployment of Pantsirs in Moscow might be part of a propaganda effort of some kind on the part of the Kremlin or an attempt to create some kind of pretext for escalation against Ukraine or its international partners. Today, a number of Western countries pledged to send even more military aid to the Ukrainian armed forces and dramatically increase the scope of that assistance.

The forthcoming aid packages, which have already prompted new vague threats of retaliation from Russia, will reportedly include Ground-Launched Small Diameter Bombs (GLSDB). GLSDB will significantly increase the range at

which Ukraine can reliably conduct precision strikes, as you can read more about here. GLSDBs, however, would not be able to reach Moscow from Ukrainian territory. The United States continues to decline requests to transfer Army Tactical Missile System (ATACMS) short-range ballistic missiles, which also do not have the range to hit the Russian capital from Ukraine.

Russia has, of course, also claimed, without evidence, in the past that the United States and other Western countries have been plotting direct attacks of various kinds against Russia in support of Ukraine. Earlier this month, Yevgeny Fedorov, a deputy of Russia's Duma, the country's parliament, made an entirely unsubstantiated allegation that the U.S. government was planning to strike Moscow and was the actor actually responsible for other previous strikes inside Russia.

The apparent installation of Pantsir air defense systems on top of government buildings in Russia's capital could turn out to just be temporary as part of an exercise or some other kind of military demonstration. In October 2022, Russia's Federal Protective Service, or FSO, conducted an ostensible drill in Moscow that also turned heads on social media and prompted initial speculation that a coup or counter-coup might be in progress.

It remains to be seen what, if anything, Russian officials have to say about the apparent deployment of the Pantsirs on top of buildings in Moscow. Whatever the official reasoning might turn out to be, it may still not inspire confidence in Russian air and missile defenses amid the growing threat of Ukrainian strikes inside the country.

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F-35 has Flown With its New Computer Backbone for the First Time

Emma Helfrich | 10 Jan 2023

Source: The Drive | https://www.thedrive.com/the-war-zone/f-35-has-flown-with-its-new-computer-backbone-for-the-first-time

Edwards AFB/USAF

An F-35 Lightning II has flown for the first time in the new Technology Refresh 3, or TR-3, configuration. TR-3 is intended to significantly upgrade the Lockheed Martin-built stealth fighter's core processor, memory unit, and associated avionics so the platform can better support all of the new capabilities slated to equip the type under the upcoming Block 4 modernization program, which we now know includes a brand new radar.

According to the F-35 Joint Program Office (JPO), a developmental test team from the 461st Flight Test Squadron (FTS) at Edwards Air Force Base, California, supported the test flight along with the F-35 Lightning II Integrated Test Force, which took place on Jan. 6. For the mission, U.S. Air Force experimental test pilot Maj. Ryan Luersen flew the F-35 with tail number AF-7, as a specially instrumented flight test aircraft and the first with TR-3 upgrades installed. AF-7 has been in Edwards' test fleet for years, but it is now helping to lead the charge with the new upgrade pathway.

In August of last year, the 'Deadly Jesters' of Edwards Air Force Base's 461st FTS and the F-35 Lightning II Integrated Test Force received

the first of what will eventually become a fleet of six enhanced F-35 testbed jets. According to the service, the rest of the batch will be delivered incrementally over the next few years and will be used to evaluate the F-35's new capabilities, weapons, and operating system tied to TR-3 and the related Block 4 initiative.

During the Jan. 6 test, Luersen performed what is known as a functional check flight profile meant to "verify aircraft airworthiness and system stability" of TR-3 aboard the F-35, explained the JPO. The overall flight lasted for 50 minutes above the Mojave Desert and saw the stealth jet reach heights of 35,000 feet and a velocity of just below the speed of sound. The test served as only the beginning of flight evaluations with TR-3, as the JPO added that developmental and operational tests will continue through 2023.

Known as Technology Refresh 3, the upgrade is critical to the F-35's future and the larger Block 4 modernization effort on the horizon.

"This is a significant achievement for the F-35 program," said Air Force Lt. Gen. Mike Schmidt, program executive officer for the F-35 JPO. "TR-3 is the F-35's critical computer processing electronics upgrade that will continue to provide all our pilots with the capability they need to be successful against any adversary. There is still a lot of work to do and I am confident that our industry partners and government team will get the job done."

At present, TR-3 is broadly known as the initiative that will revamp the F-35's core processor to achieve 25 times more computing power, its memory unit, and its panoramic cockpit display system. This would be an improvement over the jet's current computing system, TR-2, which has been deemed inadequate to support the powerful capabilities that Block 4 will bring to the F-35 platform, a number of which are software-based.

"Technology Refresh 3 modernizes the computational core of the F-35 air vehicle," said Air Force Lt. Col. Christopher Campbell, commander of the 461st FTS and director of the F-35 Integrated Test Force. "Therefore, new TR-3 hardware and software affect nearly every aircraft feature. Today's event was just the start of a comprehensive flight test campaign that will both verify and improve the safety, stability, and performance of the whole F-35 weapon system in this new configuration."

While some of these Block 4 upgrades remain confidential, others are known to include a new active electronically scanned array (AESA) radar designated as AN/APG-85, a major upgrade to the jet's Distributed Aperture System (DAS) and Electro-Optical Targeting System (EOTS), and the integration of a host of new weapons like the GBU-53/B StormBreaker precision-guided bomb. Although, it's worth noting that changes to the airframe or the jet's stealth coatings are also a possibility under Block 4, as well.

However, finally getting to the point where TR-3 could be tested in flight wasn't smooth sailing. The Government Accountability Office last year reported that complexities in the development of TR-3 increased the cost of the overall Block 4 modernization effort by $330 million in 2021 and contributed to program delays. In what was likely a response to this complication, the JPO in its announcement of the flight test said, "the TR-3 program has overcome technical complexity challenges with hardware and software, and is now on track to deliver capability."

All three variants of the F-35 will be subjected to this overhaul. The current goal is for TR-3 to roll out with new production Lot 15 through 17 F-35 deliveries, with Lockheed Martin hoping to begin delivering Lot 15 jets in mid-2023. But according to Air Force budget justification documents for Fiscal Year 2023, all F-35s from Lot 5 to Lot 14 are to be retrofitted with TR-3. The subsequent Block 4 upgrade package isn't slated to wrap until 2029, and if all goes as planned, this is projected to be introduced beginning with Lot 17 variants.

There are concerns in the United States and among other F-35 operators about the potential for Block 4 upgrades to be cost-prohibitive to integrate into older jets if that's the route Lockheed Martin and the JPO end up taking. To date, Lockheed Martin has delivered over 890 F-35s of all types to a variety of customers, and the price of upgrading even a portion of these older models to the TR-3 configuration with at least some Block 4 capabilities would likely be significant. Still, the capability that Block 4 brings, which you can read more about here, could very well be worth the price.

Lockheed Martin and the Pentagon recently finalized a gargantuan contract worth $30 billion to deliver up to 389 modernized fighter F-35 jets for the U.S. military and international customers. The order consists of 145 Lot 15s, 127 Lot 16s, and the option for 126 Lot 17s to be delivered to Finland, Belgium, and Poland. Canada also just closed on its own deal to procure 88 Block 4 F-35s that will replace its aging CF-18 Hornets, with the first deliveries are expected to take place in 2026.

It's safe to say that the F-35 will be undergoing quite an evolution over the next few years. The transformation will seek to boost the jet's overall survivability, lethality, reliability and utility as Lockheed Martin and the Pentagon work to better future-proof the aircraft so that it can confront high-end threats in the decades to come.

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Eight Lessons Air Forces are Learning From the War in Ukraine

Valius Venckunas | 08 Jan 2023

Source: Aerotime | https://www.aerotime.aero/articles/eight-lessons-air-forces-are-learning-from-the-war-in-ukraine

Photofex_AUT / Shutterstock.com

Ten and a half months have passed since Russia started its full-scale invasion of Ukraine. The resulting war became the most intense and large-scale conflict of recent decades, and the one that subverted many expectations on both sides.

Recently, there has been a multitude of reports and analyses, delving into various details of air campaigns waged by both Russia and Ukraine.

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6. Precision weapons must be manufactured in adequate quantities
7. Precision weapons must be cheaper
8. Drones have their place and time

Let's try to extract and sum up the observations the analysts have put forward. Some of their insights have already had an effect on defense spending, training and weapons development across the world. Others are yet to be acted upon, or perhaps will be discarded due to the rapidly changing situation.

1. Not All Wars are Fought by Air Power

Aviation is at the core of NATO military doctrine. Even before the start of the Cold War, the US and a lot of their allies tried to create quantitative and qualitative air power advantage and rely on it as the tip of the spear in their military campaigns.

During the early days of Russia's invasion of Ukraine, there was talk of the Russian army being primarily an artillery army. This feature was quick to reveal itself. When the frontlines stabilized, the then-advancing Russia started expending stupendous amounts of shells, effectively leveling entire cities before capturing them. Ukraine had no choice but to respond with its own massed, although more precise, artillery barrages.

Large-scale air raids, like the ones conducted by the US during the 1990-1991 Gulf War, were nowhere to be seen. This once again reminds us that overwhelming air power is not the only way to wage war, and this must be taken into account. Some military analysts called for efforts to reverse NATO's artillery "atrophy", others criticized such an approach as inefficient. Whichever side we take, there is little denying that the Ukraine war increased the awareness of a non-aviation-centric view of warfare.

2. Ground-Based Air Defenses are Important

During the Cold War, unable to respond to NATO's aviation advantage, the Soviet Union poured its resources into developing effective ground-based air defense (GBAD) systems. Decades later, some of those systems – such as the S-300 and the Buk – still form the backbone of both Russia's and Ukraine's air defenses.

They have been highly effective, creating a sort of mutual air superiority denial: neither Russian nor Ukrainian aircraft have had any success in breaking though these defenses since GBAD networks became established in March 2022.

The prominence of GBAD, and not only air power, has been reflected in both NATO's efforts to supply Ukraine with these systems and its members' calls for more anti-aircraft batteries on the alliance's Eastern flank.

However, doctrinal dependence on air power left NATO's air defense systems stretched thin. Defense representatives from both the US and European countries admitted that their capabilities are limited. Numerous countries – including NATO and non-NATO ones – announced that they were increasing their spending on new GBAD systems, citing lessons from Ukraine as a direct influence.

3. Sead/Dead Capabilities Should not be Taken for Granted

Suppression of Enemy Air Defenses (SEAD) and Destruction of Enemy Air Defenses (DEAD) are two parts of NATO's way of dealing with the enemy's anti-aircraft weaponry. They are complex and dangerous operations that target GBAD systems with special weapons and tactics.

Past wars, such as Operation Desert Storm, saw extensive SEAD/DEAD campaigns as a part of their opening act. Russia's invasion of Ukraine had nothing like this, suggesting that Russian Aerospace Forces (VKS) have only limited capabilities to target advanced air defenses. Ukraine had limited success at this task too, despite being supplied with US-made anti-radar missiles.

"The immediate lesson is that Russia's failure and Ukraine's inability to conduct successful suppression and/or destruction of enemy air defences (SEAD/DEAD) operations has crippled the battlefield effectiveness of both air forces. This is vital to understand because at present no Western air force other than the US Air Force has any serious SEAD/DEAD capability – despite, in many cases, having access to aircraft and weapons designed expressly for the task," a report by the Royal United Services Institute (RUSI), a prominent UK defense think-tank, states.

The French Air Force was the first to react to this and initiated the development of a version of the Dassault Rafale dedicated to SEAD/DEAD. Similar developments are expected in the future.

4. Large-Scale Aerial Missions are Difficult

NATO aerial training and combat often involves hundreds of aircraft working in coordination, at the same time performing various missions that include reconnaissance, air superiority, ground attack, and much more – with the support of aerial refueling and airborne mission management.

Russia did not conduct such missions in Ukraine, despite ostensibly having the capability. According to the abovementioned RUSI report, the main reason for that was Russia's inability to organize massed air refueling operations that require tanker availability, rigorous training of pilots, and high levels of coordination.

"The majority of their [Russian] fighter fleets do not have tanker support most of the time," Justin Bronk, combat aviation analyst at RUSI, said in an interview to the Geopolitics Decanted podcast. "It really helps to explain that lack of capability to sequence together large, complex strike packages, in the way the West does air power when it tries to push into contested airspace."

Bronk elaborated on this argument in an earlier article, highlighting the importance of large-scale exercises, such as the Red Flag, in maintaining the ability to conduct large-scale missions.

5. Combined Arms Warfare Should not be Taken for Granted

Combined arms warfighting is a strategy that emphasizes integrating all kinds of arms – such as infantry, armored units, artillery and air force – with each other and utilizing them so that weaknesses of any single arm are compensated by the strengths of the others.

It is the preferred way of fighting for most modern armies, and at least on paper, Russia demonstrated excellence at it during large military exercises organized in past years. When it came to demonstrating combined arms in Ukraine, the performance of Russian military was decidedly underwhelming.

"Instead of a single operational commander and clearinghouse headquarters, Russian forces have relied on a byzantine C2 [command and control] network that is unable to effectively combine arms at the joint force level or to synchronize operations, thus spurring sequential Russian operations that lack the synergistic benefits of combined arms," a report by AUSA, a

US-based military think-tank, says.

Many similar reports highlighted faltering communications between land and air forces as one of the main reasons for this failure. From the early days, when Russian tactical aviation failed to provide close air support to the invading force, to the Russian Air Force's inability to put up a fight during Ukrainian advances in the autumn, a lack of communication and coordination has been constantly on display.

Some reports argued that lack of training is at the core of that problem, as neither Russian ground nor air units had sufficient practice in executing combined arms maneuvers. Others blamed lack of necessary communications equipment. And others said that procedural problems – such as inflexible and ineffective ways of selecting and prioritizing targets – are at fault.

Whatever the case, the war showed that even armies who think they can effectively employ air power in combined arms operations may struggle when confronted with real world conditions.

6. Precision Weapons Must be Manufactured in Adequate Quantities

Just like the last lesson, this one is not exclusive to air forces. A lack of munitions production capacity arguably has an even bigger impact on artillery, as both Russia and Ukraine reportedly expend unsustainable quantities of shells, firing a year's production rate in a month.

But this problem is equally acute for Russian and Ukrainian air forces.

"The Russians have largely exhausted their supplies of precision-guided missiles and bombs. So as a result, they have turned to Iran and said 'could we buy some of your drones?' In my mind, this is the sign of Russia's weakness right now," Kurt Volker, a former US Ambassador to NATO and former US Special Representative for Ukraine explained in an interview to AeroTime.

Since then, Russia has tried to initiate domestic manufacturing of cruise missiles largely thanks to procuring electronics on the black market, latest reports claim. The struggle highlights the idea that many reports have explored since the start of the war: that modern armies, geared towards small-scale expeditionary wars, often struggle to keep up with a large-scale conflict when it comes to munitions expenditure.

7. Precision Weapons Must be Cheaper

The unsustainability of mass use of costly high-tech weapons, such as laser-guided missiles, has been highlighted for decades. Between Ukraine's use of the latest air defense systems against low-tech Iranian drones and Russia's expenditure of cruise missiles on tactical targets, the idea that precision weapons really ought to be cheaper becomes clear.

The alternative to that is reverting to unguided weapons, or so-called 'dumb bombs', that also see wide use in Ukraine, and are much less effective, as well as resulting in immense collateral damage.

Several initiatives to develop or produce cheaper precision weapons – and even deliver them to Ukraine – have been proposed. The Pentagon started evaluating production of the GLSDB, a ubiquitous GBU-39 bomb modified with a rocket motor. The UK included the development of a low-cost cruise missile into weapons production plans. The pitches of both cases cited the Ukraine war as a major influence.

8. Drones Have Their Place and Time

Heavy use of unmanned aerial vehicles has been a prominent feature of many armed conflicts in previous decades. The war in Ukraine ramped up this trend even further. From grainy footage of Bayraktar TB2 strikes to videos of DJI Mavics engaging in dogfights, drones have been in the spotlight since the start of the war.

Investments into unmanned technologies skyrocketed: Baykar admitted struggling to keep up with the inflow of orders for the TB2, while production of loitering munitions increased dramatically. Some analysts even predict that military purchases are going to become the main driver in the commercial drone market.

However, the fact that drones are important is a lesson that militaries learned decades ago. Russia's invasion of Ukraine supplemented that lesson with another one: it is important to use drones wisely.

According to Volker, Bayraktars were highly effective during the opening phase of the war, while GBAD networks were still not established – however, the effectiveness of these slow, low-cost machines has waned since then. Bronk agrees with that, and adds that Russia experienced the same struggle with their equally cheap Orlan drones that are only effective if the enemy's air defenses are not well set up – otherwise the service life of any conventional drone becomes very short.

It has long been understood that non-stealthy, non-autonomous drones have limited applicability on a battlefield where air defenses are active, and the war in Ukraine has illustrated that once again. Autonomy, attritability and other measures can mitigate that to some extent, analysts argue, but it should be noted that drones alone are not a magic technology that will change the way wars are fought.

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Drone Advances in Ukraine Could Bring New Age of Warfare

Frank Bajak and Hanna Arhirova | 05 Jan 2023

Source: C4isrnet | https://www.c4isrnet.com/battlefield-tech/2023/01/05/drone-advances-in-ukraine-could-bring-new-age-of-warfare/

Ukrainian soldiers launch a drone at Russian positions near Bakhmut, Ukraine, on Dec. 15, 2022. (Libkos/AP)

KYIV, Ukraine — Drone advances in Ukraine have accelerated a long-anticipated technology trend that could soon bring the world's first fully autonomous fighting robots to the battlefield, inaugurating a new age of warfare.

The longer the war lasts, the more likely it becomes that drones will be used to identify, select and attack targets without help from humans, according to military analysts, combatants and artificial intelligence researchers.

That would mark a revolution in military technology as profound as the introduction of the machine gun. Ukraine already has semi-autonomous attack drones and counter-drone weapons endowed with AI. Russia also claims to possess AI weaponry, though the claims are unproven. But there are no confirmed instances of a nation putting into combat robots that have killed entirely on their own.

Experts say it may be only a matter of time

before either Russia or Ukraine, or both, deploy them.

"Many states are developing this technology," said Zachary Kallenborn, a George Mason University weapons innovation analyst. "Clearly, it's not all that difficult."

The sense of inevitability extends to activists, who have tried for years to ban killer drones but now believe they must settle for trying to restrict the weapons' offensive use.

Ukraine's digital transformation minister, Mykhailo Fedorov, agrees that fully autonomous killer drones are "a logical and inevitable next step" in weapons development. He said Ukraine has been doing "a lot of R&D in this direction."

"I think that the potential for this is great in the next six months," Fedorov told The Associated Press in a recent interview.

Ukrainian Lt. Col. Yaroslav Honchar, co-founder of the combat drone innovation nonprofit Aerorozvidka, said in a recent interview near the front that human war fighters simply cannot process information and make decisions as quickly as machines.

Ukrainian military leaders currently prohibit the use of fully independent lethal weapons, although that could change, he said.

"We have not crossed this line yet – and I say 'yet' because I don't know what will happen in the future." said Honchar, whose group has spearheaded drone innovation in Ukraine, converting cheap commercial drones into lethal weapons.

Russia could obtain autonomous AI from Iran or elsewhere. The long-range Shahed-136 exploding drones supplied by Iran have crippled Ukrainian power plants and terrorized civilians but are not especially smart. Iran has other drones in its evolving arsenal that it says feature AI.

Without a great deal of trouble, Ukraine could make its semi-autonomous weaponized drones fully independent in order to better survive battlefield jamming, their Western manufacturers say.

Those drones include the U.S.-made Switchblade 600 and the Polish Warmate, which both currently require a human to choose targets over a live video feed. AI finishes the job. The drones, technically known as "loitering munitions," can hover for minutes over a target, awaiting a clean shot.

"The technology to achieve a fully autonomous mission with Switchblade pretty much exists today," said Wahid Nawabi, CEO of AeroVironment, its maker. That will require a policy change — to remove the human from the decision-making loop — that he estimates is three years away.

Drones can already recognize targets such as armored vehicles using cataloged images. But there is disagreement over whether the technology is reliable enough to ensure that the machines don't err and take the lives of noncombatants.

The AP asked the defense ministries of Ukraine and Russia if they have used autonomous weapons offensively – and whether they would agree not to use them if the other side similarly agreed. Neither responded.

If either side were to go on the attack with full AI, it might not even be a first.

An inconclusive U.N. report suggested that killer robots debuted in Libya's internecine conflict in 2020, when Turkish-made Kargu-2 drones in

full-automatic mode killed an unspecified number of combatants.

A spokesman for STM, the manufacturer, said the report was based on "speculative, unverified" information and "should not be taken seriously." He told the AP the Kargu-2 cannot attack a target until the operator tells it to do so.

Fully autonomous AI is already helping to defend Ukraine. Utah-based Fortem Technologies has supplied the Ukrainian military with drone-hunting systems that combine small radars and unmanned aerial vehicles, both powered by AI. The radars are designed to identify enemy drones, which the UAVs then disable by firing nets at them — all without human assistance.

The number of AI-endowed drones keeps growing. Israel has been exporting them for decades. Its radar-killing Harpy can hover over anti-aircraft radar for up to nine hours waiting for them to power up.

Other examples include Beijing's Blowfish-3 unmanned weaponized helicopter. Russia has been working on a nuclear-tipped underwater AI drone called the Poseidon. The Dutch are currently testing a ground robot with a .50-caliber machine gun.

Honchar believes Russia, whose attacks on Ukrainian civilians have shown little regard for international law, would have used killer autonomous drones by now if the Kremlin had them.

"I don't think they'd have any scruples," agreed Adam Bartosiewicz, vice president of WB Group, which makes the Warmate.

AI is a priority for Russia. President Vladimir Putin said in 2017 that whoever dominates that technology will rule the world. In a Dec. 21 speech, he expressed confidence in the Russian arms industry's ability to embed AI in war machines, stressing that "the most effective weapons systems are those that operate quickly and practically in an automatic mode."

Russian officials already claim their Lancet drone can operate with full autonomy.

"It's not going to be easy to know if and when Russia crosses that line," said Gregory C. Allen, former director of strategy and policy at the Pentagon's Joint Artificial Intelligence Center.

Switching a drone from remote piloting to full autonomy might not be perceptible. To date, drones able to work in both modes have performed better when piloted by a human, Allen said.

The technology is not especially complicated, said University of California-Berkeley professor Stuart Russell, a top AI researcher. In the mid-2010s, colleagues he polled agreed that graduate students could, in a single term, produce an autonomous drone "capable of finding and killing an individual, let's say, inside a building," he said.

An effort to lay international ground rules for military drones has so far been fruitless. Nine years of informal United Nations talks in Geneva made little headway, with major powers including the United States and Russia opposing a ban. The last session, in December, ended with no new round scheduled.

Washington policymakers say they won't agree to a ban because rivals developing drones cannot be trusted to use them ethically.

Toby Walsh, an Australian academic who, like Russell, campaigns against killer robots, hopes to achieve a consensus on some limits, including a ban on systems that use facial recognition and

other data to identify or attack individuals or categories of people.

"If we are not careful, they are going to proliferate much more easily than nuclear weapons," said Walsh, author of "Machines Behaving Badly." "If you can get a robot to kill one person, you can get it to kill a thousand."

Scientists also worry about AI weapons being repurposed by terrorists. In one feared scenario, the U.S. military spends hundreds of millions writing code to power killer drones. Then it gets stolen and copied, effectively giving terrorists the same weapon.

To date, the Pentagon has neither clearly defined "an AI-enabled autonomous weapon" nor authorized a single such weapon for use by U.S. troops, said Allen, the former Defense Department official. Any proposed system must be approved by the chairman of the Joint Chiefs of Staff and two undersecretaries.

That's not stopping the weapons from being developed across the U.S. Projects are underway at the Defense Advanced Research Projects Agency, military labs, academic institutions and in the private sector.

The Pentagon has emphasized using AI to augment human warriors. The Air Force is studying ways to pair pilots with drone wingmen. A booster of the idea, former Deputy Defense Secretary Robert O. Work, said in a report last month that it "would be crazy not to go to an autonomous system" once AI-enabled systems outperform humans — a threshold that he said was crossed in 2015, when computer vision eclipsed that of humans.

Humans have already been pushed out in some defensive systems. Israel's Iron Dome missile shield is authorized to open fire automatically, although it is said to be monitored by a person who can intervene if the system goes after the wrong target.

Multiple countries, and every branch of the U.S. military, are developing drones that can attack in deadly synchronized swarms, according to Kallenborn, the George Mason researcher.

So will future wars become a fight to the last drone?

That's what Putin predicted in a 2017 televised chat with engineering students: "When one party's drones are destroyed by drones of another, it will have no other choice but to surrender."

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IAF & JASDF Participate in Exercise 'Veer Guardian-2023' Amid Growing Defense Ties

Yuvraj Tyagi | 25 Jan 2023

Source: Republic World | https://www.republicworld.com/india-news/general-news/iaf-and-jasdf-participate-in-exercise-veer-guardian-2023-amid-growing-defense-ties-articleshow.html

Image: Twitter/@IAF_MCC

Russia In a bid to promote Air Defence cooperation and bonhomie between the Indian Air Force (IAF) and the Japan Air Self Defense Force (JASDF), the two air forces are participating in a joint Air Exercise called 'Veer Guardian-2023'. The exercise which began at Japan's Hyakuri

Air Base on 12 January 2023 involves an Indian contingent comprising one IL-78, two C-17 and four Su-30 MKI aircraft while JASDF has deployed four F-15 and four Mitsubishi F-2 combat jets. The exercise is set to culminate on 26 January.

Notably, the exercise is being held following the second 2+2 Foreign and Defence Ministerial meeting held on 8 September 2022 in Tokyo. Following the meeting, India and Japan agreed to enhance bilateral defence cooperation and step-up engagement in joint military exercises. Furthermore, the first fighter jet drills between the two nations signify increasing defence and security cooperation.

Ex Veer Guardian-2023 is the first exercise involving fighter jet drills between the two nations and signifies increasing defence and security cooperation.

Ex Veer Guardian-2023: Training Regimen

Amid multi-domain air combat missions in complex environments, the inaugural exercise included the conduct of various aerial combat drills between the Air Forces of the two nations. Exercise Veer Guardian-2023 aims to enable the two air forces to exchange best practices amid expert discussions sharing varied operational aspects. On January 11, crew rescue training was conducted as part of the exercise. Participants of the exercise practised opening a fighter aircraft's canopy in emergency situations and how to release the pilot's equipment in such cases.

As per a press release by the Indian Ministry of Defense, the exercise is set to fortify "the long-standing bond of friendship and enhance the avenues of defence cooperation between the two Air Forces."

On Tuesday, Chief of Staff JASDF, General Shunji Izutsu and AOC-in-C Western Air Command, Air Marshal PM Sinha, interacted with the personnel participating in the exercise and appreciated the professionalism exhibited by them during the exercise's conduct. Additionally, Air Marshal Sinha was familiarized with Japan's F2 'Viper Zero' fighter, while Gen Izutsu was acquainted with the Su-30 MKI of the Indian Air Force.

Furthermore, as part of the joint air exercise, pilots from the two nations switched cockpits to gain flying experience in fighters of each other's respective nations. The exercise also includes cultural exchange programmes between the participating contingents of the two nations. Signifying increasing bonhomie between the two nations, the JASDF installed a deflector (rectifier plate) for the engine test run of India's Su-30 MKI at the Hyakuri Air Base.

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Space

Oman is Building the Middle East's First Spaceport

Sarwat Nasir | 18 Jan 2023

Source: The National News | https://www.thenationalnews.com/gulf-news/oman/2023/01/18/oman-is-building-the-middle-easts-first-spaceport/

The Port of Duqm in Oman officially opened in February, 2022. Photo: Port of Duqm

Oman plans to build the Middle East's first space rocket launch centre this year.

Located in the port town of Duqm, the Etlaq Space Launch Complex, a project by the National Aerospace Services Company, could see its first rocket launch early next year.

However, it will take three years to fully complete the centre.

"We have two main goals with the Duqm launch land: to build a launch centre for commercial, professional and educational rocket users to assemble, test and launch from," Nascom said.

"The launch centre will be globally accessible for expanding rocket companies, and locally available for educational research programmes."

Private space companies, such as Virgin Galactic and Blue Origin, have eyed the Middle East, especially the Emirates, for spaceports. But nothing has materialised, even though the UAE's space strategy includes setting up a launch pad for space tourism flights.

Oman's plans could give a significant boost to the region's space programmes, as private companies and government agencies could use the pad for orbital launches.

First Suborbital Launch From Oman

Nascom also hopes to build the first Omani suborbital rocket that would be launched from the complex.

"The rockets will inspire the youth to pursue science and technology and will set a standard for future generations to achieve and surpass," the company said.

It plans to develop rockets with hybrid-solid engines.

"The solid fuel which we have been testing is much safer and environmentally friendly than the fuels used in liquid engines," Nascom said.

"The scale of rocket we are developing is comparable to the suborbital rockets which are launched by universities and colleges in the USA, which measure between 3 to 6 metres in length."

It will serve scientists, researchers and those interested in doing experiments in the space sector, artificial intelligence and advanced technology.

Why Duqm?

The port's equatorial positioning makes it an ideal spot for launches, as the rocket can take advantage of the Earth's rotational speeds.

"Internationally verified studies have identified that Wilayat Al-Duqm's equatorial positioning places it in the top 5 most efficient rocket launch latitudes in the world," Nascom said.

"Considering the data, and our own site

analysis, we acknowledge the location as an important national asset for Oman which must be developed.

"A national asset as such will continue to increase in importance over the next two decades as global industries look for solutions in space."

The Duqm Port opened in February as part of Oman's efforts to diversify its economy and expand its infrastructure.

It was developed in partnership with the Belgium's Port of Antwerp and received major investment from China.

Oman's space ambitions

Oman has big plans in space.

It plans to build a space research centre for simulation missions and science experiments in the Duqm district's Artificial Intelligence Zone.

The project is called the Space Settlement Centre.

Bahiya Al Shuaibi, chief executive officer of Oman's Global Space and Technology Company, said the centre would help scientists carry out research.

"The project aims to simulate a space environment to study the behaviour of astronauts before joining the actual astronaut flights," she said.

"It will serve scientists, researchers and those interested in doing experiments in the space sector, artificial intelligence and advanced technology."

Oman space programme has had a shaky start.

Its first satellite, Aman, was destroyed earlier this year during a failed Virgin Orbit launch.

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Virgin Orbit Blames Launch Failure on Upper Stage Anomaly

Jeff Foust | 12 Jan 2023

Source: Space News | https://spacenews.com/virgin-orbit-blames-launch-failure-on-upper-stage-anomaly/

Virgin Orbit said an anomaly during the first burn of its upper stage caused the engine to shut down prematurely on the Jan. 9 "Start Me Up" mission from England's Spaceport Cornwall. Credit: Virgin Orbit

SEATTLE — Virgin Orbit says its first LauncherOne mission from the United Kingdom failed to reach orbit Jan. 9 when an anomaly caused a premature shutdown of the rocket's upper stage.

In a Jan. 12 statement, Virgin Orbit provided a few new details about the failed "Start Me Up" mission from England's Spaceport Cornwall, which attempted to place nine satellites into orbit. The failure was the first for LauncherOne since an inaugural demonstration mission in 2020.

According to the company, the initial phases of the launch, including the rocket's deployment from its Boeing 747 aircraft and first stage burn, went as planned. The rocket's second stage then separated and ignited its NewtonFour engine, followed by payload fairing separation.

"Later in the mission, at an altitude of approximately 180 km, the upper stage experienced an anomaly. This anomaly prematurely ended the first burn of the upper stage," the company stated.

The company did not disclose additional details about the anomaly.

Observers had speculated that some sort of issue with the upper stage caused the failure, although issues with the telemetry displayed during the launch webcast, such as spurious data, made it difficult to narrow down the nature of the problem or its timing. The company did not explain why it initially announced during the launch that the upper stage had reached orbit, a claim it retracted nearly a half-hour later.

Virgin Orbit has started a formal investigation led by Chad Foerster, its chief engineer and vice president of technology, and Jim Sponnick, a former vice president of Atlas and Delta programs at United Launch Alliance. The company did not estimate how long that investigation will take.

"Upon identifying the anomaly, our team immediately moved into a pre-planned investigation mode," Dan Hart, chief executive of Virgin Orbit, said in the statement. Given the company's experience with the vehicle and "ample telemetry data" from the flight, "I am confident that root cause and corrective actions will be determined in an efficient and timely manner."

Virgin Orbit said LauncherOne's return to flight will take place from Mojave Air and Space Port in California, which had hosted all five previous missions before this launch. The rocket for that mission is going through final integration and checkout.

The company said it expects to return to Spaceport Cornwall for future launches, "and is in active discussions with key government and commercial stakeholders in the U.K. to start planning mission opportunities for as soon as later this year." Hart, at a Jan. 8 pre-launch briefing, offered a similar timeline but with caveats. "I'm not sure that will happen, but it's not out of the question," he said then of a second LauncherOne mission from Cornwall before the end of the year.

A swift and successful return to flight is critical for Virgin Orbit, which was losing a significant amount of money even before the failure as it struggled to increase its launch rate. The company ended its fiscal third quarter with $71 million in cash and negative free cash flow of $52.5 million, although the company has since raised $45 million in two separate tranches from Virgin Group and its investment arm.

Shares in Virgin Orbit fell 14% on the Nasdaq exchange Jan. 10, the first day after the failure, but rebounded slightly Jan. 11. The company's shares are still trading near its low since going public a little more than a year ago in a SPAC merger..

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China's New 'Super 6G Tech' Can Penetrate Hypersonic Missile Shield, Boost Country's Near-Space Defense

Sakshi Tiwari | 29 Jan 2023

Source: Eurasian Time | https://eurasiantimes.com/chinas-new-super-6g-tech-can-penetrate-hypersonic-missile-shield/?amp

Artist rendering of a hypersonic missile

Now, going even further, Chinese researchers have declared that they developed a device that far outpaces any previous claims about the 6G technology.

They also claim to have demonstrated that a hypersonic weapon could communicate and locate targets using 6G technology, overcoming some of the blackout issues that occur at speeds of five times the speed of sound or faster, reported SCMP.

Not too long ago, China claimed that it had created a 6G technology that was about a hundred times faster than 5G. This assertion seemed too good to be true at the time, given only a handful of countries have begun to use 5G now.

According to the team led by Professor Yao Jianquan, one of China's top laser scientists, the achievement has ramifications for the effectiveness of weapons and defense systems, and might lead to "major improvement in China's near-space defense."

On January 25, their experiment paper was published in the Journal of the National University of Defense Technology.

With electromagnetic waves, a Tianjin research team claimed to have "completely penetrated" the signal-blocking plasma shield surrounding a hypersonic missile.

Earlier this month, reports emerged claiming that Chinese researchers had achieved a world-record wireless transmission speed of 206.25 gigabits per second. This could indicate that, once it arrives, 6G technology would be up to 100 times faster than 5G, or the fifth-generation wireless mobile network, which is still being rolled out in most parts of the world.

Further, the latest claims come at a time when the United States, China's arch-rival, has been struggling with testing 5G due to interference with aviation as both use the same band. The US also does not have an operational hypersonic weapon as three successive tests in the past had resulted in a failure.

On the other hand, China has been making rapid strides in its hypersonic program which has been a rather unsettling precedent for the West as well as China's disenchanted neighbors. If these assertions are true, China could have reached a major milestone in both hypersonic as well as 6G tech programs.

Laser Technology For Hypersonic Weapons

When heated, ionized gas forms on the surface of a hypersonic weapon and blocks electromagnetic signals due to which the weapon has trouble communicating with the outside world.

Since ground-based radar cannot identify and lock on to a hypersonic target behind a plasma

shelter, the problem is referred to as the "black barrier."

Yao and his colleagues at Tianjin University's School of Precision Instruments and Optoelectronics Engineering have invented a laser system that can emit a continuous beam of electromagnetic waves in the terahertz spectrum, which is needed for 6G next-communication technology.

According to their research, ground experiment findings revealed that these terahertz waves may easily enter and exit the plasma created by a hypersonic weapon at 10 times the speed of sound or even faster "as if the black barrier does not exist."

The technology has been extensively researched for military uses, such as radar for detecting stealth aircraft or high-speed communication in space. However, employing 6G on a hypersonic weapon is more difficult.

Previous research has discovered that terahertz transmissions in the lower frequency range, which are routinely used for communication, can degrade when traveling through plasma. Higher frequency waves can pass through the barrier more easily, but they can't go very far in the atmosphere, said SCMP.

According to researchers from Northwestern Polytechnical University and Shanghai Aerospace Control Technology Institute, a hypersonic weapon traveling at Mach 5 in the atmosphere can achieve an effective communication range of up to 60 kilometers (37 miles) with a 5-watt transceiver operating at a high frequency of 2 THz.

This range "can ensure normal communication for flight control and detection through the black barrier", they said in a paper published in the domestic peer-reviewed journal Flight Control and Detection in November.

Yao's team created a terahertz gadget that operated at a slightly higher frequency of 2.5 Thz. In an open area, they underestimated the range of their technology.

Going by these assertions, while these claims sound too good to be true, this might not be an impossible feat to achieve given that 6G has already been tested for military application in space and for radars to see if this can help detect stealth aircraft. The hypersonic missile on a 6G range could still be years away given that as of now, it has just been published.

The 6G Race Between US And China

Even before the 5G battle is settled, China and the US have begun a race to exploit 6G technology. According to SpaceX creator Elon Musk, the Starlink communication satellite network will be upgraded with terahertz technology in the future, increasing the download speed to 10 Gbps at a ground terminal, thanks to financing from the US military. At the moment, Starlink's download speed is around 100 Mbps.

In 2020, China claimed to have launched the world's first 6G terahertz satellite to conduct high-speed communication experiments in space, as previously reported by Popular Mechanics. Chinese scientists have since carried out 6G data transmission trials on the ground, achieving speeds of several hundred terabytes per second.

Because of technical obstacles, several industry analysts predict that the commercialization of 6G will take a decade. In fact, the rollout of 5G is not complete in the world yet. Some countries have just started to, or are yet to start the testing of 5G

equipment.

Interestingly, the US has sanctioned Chinese telecommunication firm Huawei, which has since been banned from participating in 5G trials in various countries. The telecom giant has been accused of having links with the Chinese military.

According to scientists involved in the Chinese 6G projects, Beijing is developing compact terahertz antennas with synthesized aperture radar technology – high-speed processors that can handle a large data flow without overheating – and high-altitude base stations over the Tibetan plateau to integrate future 6G networks in space and on the ground.

It is believed that whoever patents the 6G first would probably lead what could be called an ultra-high-speed communication race.

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Space Debris: Is the USA Serious About Solving the Problem?

Group Captain Dr Ajey Lele

Source: Taza Khabar News | https://taazakhabarnews.com/space-debris-is-the-usa-serious-about-solving-the-problem/

Is the United States (US) moving towards space unilateralism? The answer could be both, yes and no. Recently for the first time, the United Nations (UN) panel formally adopted a resolution calling for a ban on destructive anti-satellite (ASAT) missile tests.

The ASAT testing resolution was championed by the US. The US looks to be very keen that various states should undertake a voluntary moratorium on ASAT testing as a first step to curbing an arms race in space. The best option available to push for this agenda was the UN route and that is what the US has taken.

The basic limitation of such resolutions is that they are voluntary and legally not binding. However, the advantage of such mechanisms is that at least they identify the problem correctly and start working towards developing global consensus on the issue.

The basic problem in regard to the conduct of ASAT tests is that they end up creating space debris, which is detrimental to the health of operational satellites. There have been some instances in the recent past of space debris impacting the health of space systems. There are various reasons for the formation of space debris. The manmade reasons for the formation of space debris include mainly defunct satellites. Such

satellites, which are well past their designed life keep on rotating in space as debris. At times, they hit each other and defragmentation happens to owe to the collision. This adds more amount of debris in the space.

Furthermore, mostly the last stage of various rocket systems, which deliver satellites into space remains there as debris. Also, there could be some missing tools in space, which could have been dropped accidentally by Astronauts during spacewalks.

In addition, there is debris owing to the ASAT tests conducted by China (2007) and Russia (2021). Obviously, there is a requirement for a multilateral/UN-supported effort to stop any more addition to this debris, particularly by the conduct of the ASAT test.

Presently, there are approximately 8,000 metric tons of space debris, which include at least 900,000 individual pieces of space debris that are possibly harmful to the health of satellites. It is also important to remove/reduce the existing space debris so that outer space becomes cleaner and safe for satellite operations.

In recent times, there has been a sharp increase in the number of space launches, particularly in the low earth orbit (LEO) owing to the formation of various constellations for providing satellite-based internet facilities. Such satellites have a limited lifespan (3 to 5 years) and are expected to remain in space as debris after the end of their life. Hence, there is an urgent need to invest in technologies and establish mechanisms to eradicate space debris.

Today, every country in the world is not in a position to develop technologies for debris removal. At present, some state-sponsored and private agencies are working towards developing such technologies. However, such technologies could be easily tweaked for military purposes. Hence, any debris removal activity should happen under a global watchdog. For this purpose, a specific mechanism needs to be established under the aegis of the UN. Unfortunately, the US is taking a different position in this regard.

On December 09, 2022, the US senate unanimously passed the Space junk bill. It is known as the Orbital Sustainability (ORBITS) Act, which is a bill to establish a first-of-its-kind demonstration program to reduce the amount of space junk in outer space. Right now, no specific funding has been earmarked for this program and some more technicalities are required to be completed before it is sent to the President for signature. It appears that in near future various procedural requirements would be fulfilled without any hindrances since the bill has been passed unanimously.

The ORBITS Act expects NASA to start a program towards developing technologies capable of safely carrying out successful Active Debris Remediation (ADR) missions. There would be a push given to private industry to collaborate with NASA in these efforts. They are first expected to establish a demonstration program and also partner with other states to address debris in orbit that belongs to them. The bill expects NASA to publish a list of dangerous debris, which require immediate attention. However, there is no clarity that how NASA should quantify this risk.

It is not clear why is USA on one hand pushing

for a mechanism to stop ASAT tests which end up creating space debris, while on another hand it wants to go solo when it comes to the physical removal of debris. This raises suspicion about the actual intent of the US toward ensuring global space security.

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Global Aerospace Industry

Australia to Spend $2 Billion on 40 U.S. Black Hawk Choppers

28 Jan 2023

Source: Army Technology | https://asia.nikkei.com/Politics/International-relations/Indo-Pacific/Australia-to-spend-2-billion-on-40-U.S.-Black-Hawk-choppers

The Lockheed Martin UH-60M Black Hawks will replace the Australian Army's fleet of MRH-90 Taipan helicopters. © Reuters

SYDNEY (Reuters) -- Australia confirmed on Wednesday it would buy 40 Black Hawk military helicopters from the United States for an estimated 2.8 billion Australian dollars ($1.96 billion), finalizing a sale signed off by the U.S. State Department last August.

The Lockheed Martin Corp UH-60M Black Hawks will replace the Army's fleet of MRH-90 Taipan choppers, which have been plagued for years by maintenance issues. Delivery of the new helicopters will begin this year.

"We've just not got the flying hours out of the Taipan that we would need," Defence Minister Richard Marles told ABC news on Wednesday. "We're confident that we can get that from the Black Hawks. It's a platform we're familiar with."

Australia has been boosting its defense spending over the past few years as China looks to step up its presence in the Indo-Pacific region.

A 2021 decision to ditch French-made submarines for nuclear submarines to be built by the United States and Britain sparked a bitter diplomatic dispute with France.

Marles said he had spoken with his French counterpart several times and was confident the U.S. helicopter deal "won't interrupt" the renewed relationship with France. The Taipans are made by Airbus AIR.PA, partly owned by France.

Australian industry will be involved in logistics, warehousing, engineering as well as the helicopter's global supply chain, said the Defence Department in a statement.

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Djibouti Inks $1bn Deal with Hong Kong Company to Build Rocket Launch Site

12 Jan 2023

Source: North Africa Post | https://northafricapost.com/64319-djibouti-inks-1bn-deal-with-hong-kong-company-to-build-rocket-launch-site.html

Djibouti has inked a preliminary technological cooperation agreement with Chinese multinational Hong Kong Aerospace Technology to build a $1bn satellite and rocket launch site which could see the launch of the first Africa-made satellite from the African continent.

The deal with the Hong Kong-based company, which was signed by Djibouti's President Ismail Omar Guelleh, includes the construction of port infrastructure and highways in the northern Obock region to ensure the reliable routing of aerospace materials coming from China. The construction works could be completed as early as 2027 and infrastructure will be handed over to Djibouti upon the completion of a 30-year co-management contract with Hong Kong Aerospace Technology, the president said. "I am delighted to see our country involved in this promising technological and energy development project," said Guelleh.

The Chinese multinational firm says it is Hong Kong's first commercial aerospace enterprise focusing on satellite network engineering and precise satellite manufacturing. Hong Kong Aero Tech owns five technical centers and manufacturing bases, including a satellite manufacturing centre

and a centre for satellite data. Located relatively close to the equator, Djibouti is an attractive destination for the launch of satellites which can take advantage of the Earth's rotational speed, ensuring savings on the amount of fuel required to get rockets into space. In 2022, African nations allocated a total of $534.9m for the operation of their respective space programs, and 13 African nations have manufactured a total of 48 satellites.

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India, France to Sign Deal for Rafale-M Fighters in March During Macron's Visit to New Delhi

Sakshi Tiwari | 06 Jan 2023

Source: Eurasian Time | https://eurasiantimes.com/india-france-to-sign-deal-for-rafale-m-fighters-in-march/?amp

Image: Rafale-M Fighters

According to a report published on January 4 in the French publication La Tribune, a contract for over 26 Rafale Marine fighters could be signed during French President Emmanuel Macron's visit to New Delhi in March 2023. The exact dates of the Presidential visit have not been announced yet.

The report speculated that the Indian side was likely working on the formalities for signing an agreement in March 2023, as the year marks the 25th anniversary of the strategic partnership between the two countries.

However, no such communication has been released by the Indian government or the Indian Navy.

In December 2021, the former French Defense Minister Florence Parly told the media that Dassault Aviation could bag an order for "26 to 57 Rafale in Navy version." However, a deal may now be signed for 26 Rafale Marine fighter jets instead of 57.

To supplement its dwindling and ailing fleet of carrier-based MiG-29K fighters, the Indian Navy evaluated the French Dassault Aviation's Rafale-M and the US-based Boeing F/A-18 Super Hornet earlier this year. The tests involving both aircraft were conducted at a shore-based test facility in Goa, India, a few months apart.

After the trials, the Indian Navy submitted an exhaustive report on Rafale and Super Hornets to the Defense Ministry to make a final decision on the procurement, according to reports in The Times of India. As per the report, French Rafale-M is "more suitable in meeting the operational requirements and criteria" than the Super Hornets.

Earlier, military experts had said that the wings of the Rafale-M could not be folded, making it take up more space on the aircraft carrier's deck. In contrast, F/18 Super Hornet somewhat enjoyed an advantage with its folding wing mechanism.

However, several other features of the Rafale Marine were factored into the report, which favored the Dassault aircraft. The 26 jets the Navy intends to purchase are merely a stop-gap solution until the nation develops and manufactures its twin-engine deck-based fighter (TEDBF).

The Navy is considering importing deck-based fighters as a temporary solution because

TEDBF won't be ready for another ten years, and the MiG-29K aircraft have faced many technical problems, requiring replacement.

A report in another local French publication clarified that the remaining aircraft would not be supplied by the United States but by the Indian manufacturer Hindustan Aeronautics Ltd.

According to speculations, the Indian Navy will acquire the HAL Tejas Mark-2 multi-mission aircraft, which is expected to be operational between 2024 and 2026. EurAsian Times could not independently verify these claims.

Tejas Mark-2 For Indian Navy?

The LCA Mark 2 multirole fighter jet is a more potent version of the indigenous LCA Tejas fighter aircraft. Being developed by the Aeronautical Development Agency's Tejas Mk-2, a 4.5th generation fighter is anticipated to be the most advanced Tejas derivative created and produced domestically.

The Indian Navy's quest to acquire a carrier-based fighter jet for its indigenous aircraft carrier INS Vikrant is nearing conclusion after months of rigorous evaluations. As per speculations, the Dassault Rafale is expected to win this tightly-fought contest against Boeing Super Hornets.

The aircraft will be equipped with a more powerful engine, the American GE-414, stronger radar, better avionics and electronics, and the ability to transport additional weaponry.

The Mk2 variant of Tejas will be armed with weapons like the Scalp, Crystal Maze, and Spice-2000. Further, it will be equipped with locally produced Astra Mark 1 and Mark 2 missiles for air-to-air conflict. The 'Made in India' Uttam AESA radar will direct the Tejas Mk-2.

However, despite its stellar and promising performance, the Tejas Mk-2 is not a carrier-based fighter jet. It will be inducted into the Indian Air Force as a replacement for the aging Mirage-2000 and Jaguars. In a nutshell, it will be operated as an air-to-ground attack aircraft.

The carrier-based aircraft the country is pining for is the HAL Twin Engine Deck-Based Fighter (TEDBF). According to the Indian Navy Chief Admiral R. Hari Kumar, the service is putting together a draft cabinet note for the design and development of the TEDBF, which India intends to operate from its aircraft carriers.

TEDBF's initial prototype should be completed by 2026, and production could start sometime around 2032. The Navy collaborates with the Defense Research Development Organization (DRDO) and Aeronautical Development Agency for the TEDBF Project.

Previously, Aerospace analyst Girish Linganna had explained to EurAsian Times that the TEDBF could be viewed as the successor of the Naval variant of the indigenous Tejas jet. Tejas is a light combat aircraft with a single engine. But the Indian Navy has concluded that it needs a twin-engine plane to take over the role of the MiG-29K.

The expert further stated that the TEDBF fighter is a twin-engine canard derivative of the Tejas fighter jet that is carrier-based and multirole. HAL and the Aeronautical Development Agency (ADA), an autonomous agency under India's Ministry of Defense, are working on it together.

Drawing a preliminary conclusion from the above arguments, it is unlikely that the Indian Navy would be interested in the Tejas Mk-2, which does not qualify as a carrier-based aircraft.

However, the TEDBF seems to be on track and could be inducted into the Indian Navy for operations aboard the carriers in the next ten years.

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Indian Aerospace Industry

Army to Get First Apache Attack Helicopter in February 2024

Dinakar Peri | 19 Jan 2023

Source: The Hindu | https://www.thehindu.com/news/national/army-to-get-first-apache-attack-helicopter-in-february-2024/article66408969.ece

First fuselage for Indian Army's six AH-64E Apache attack helicopter contract rolls out of Tata Advanced Systems Limited and aircraft manufacturer Boeing. | Photo Credit: Twitter: Dinakar Peri/@dperi84

A The first fuselage for the Indian Army's contract for six AH-64E Apache attack helicopters has rolled out of the Tata Boeing Aerospace Limited (TBAL) facility in Hyderabad, the Joint Venture between Tata Advanced Systems Limited and aircraft manufacturer Boeing. The first Apache is scheduled to be delivered to the Army in February 2024 and training of Army Aviation pilots and technicians has commenced in the U.S. last December, according to a defence official.

The first fuselage for the Army's Apaches, manufactured by TBAL in Hyderabad, to be sent for final assembly in the U.S.

The first fuselage -- which is the main body of an aircraft -- was formally handed over to the Director General of Army Aviation Lt. Gen. A.K. Suri before it was dispatched by TBAL to Arizona in the U.S. for final assembly, one official said on Thursday.

The first Apache will be delivered to the Army in February 2024 and delivery of all six would be completed within three months by April 2024, a defence official said, adding that four pilots and seven technical persons are undergoing training in the U.S. to prepare for the induction.

TBAL's 14,000 sq.m. facility is the sole source supplier for Apache fuselages globally, and also produces complex aero-structures for Boeing 737 and 777 models, Boeing said in a statement. The joint venture employs over 900 engineers and technicians and uses cutting-edge robotics, automation and advanced aerospace concepts in its manufacturing processes.

Attack helicopters inducted recently

Army Aviation, which has so far operated only utility helicopters, inducted its first dedicated attack helicopter recently with the indigenous Light Combat Helicopter (LCH). As reported earlier by The Hindu, the first LCH squadron was moved to Missamari, Assam in the eastern sector near the Line of Actual Control last November.

The Cabinet Committee had given its sanction for the procurement of 39 AH-64 Apache attack helicopters from the U.S. Following this, the Indian Air Force had procured 22 Apaches under a deal signed in September 2015, following which the government decided that any further Apache procurements would go to the Army.

In line with this, India signed a deal for six more Apaches, for the Army, at a cost of around $800 million in February 2020. There has been a

slight delay in the deliveries of the Apaches due to the COVID-19 pandemic.

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India to Modernize Sukhoi Su-30MKI Fighter Fleet With $4 Billion Program

Valius Venckunas | 26 Jan 2023

Source: Aero Time| https://www.aerotime.aero/articles/india-to-modernize-sukhoi-su-30mki-fighter-fleet-with-4-billion-program

Venkat Mangudi / Wikipedia

Hindustan Aeronautics Limited (HAL) is going to request $4 billion from the Indian Ministry of Defense to upgrade the country's fleet of Sukhoi Su-30MKI fighter jets, Indian media reports.

The upgrade – dubbed Super Sukhoi – has been announced in 2021. However, it has been hanging in the balance since the start of Russia's full-scale invasion of Ukraine.

A revamped upgrade program is now expected to be approved by the Indian government, several Indian news websites report.

Earlier reports suggest that the program was reoriented towards wider employment of domestic aerospace companies.

New Electronics

The upgrades mostly concern the jets' avionics and sensor systems. Notably, the slotted planar array radar, which dates back to the 1980s, is bound to be replaced by a Uttam MK3 active electronically scanned array (AESA) radar, manufactured by HAL.

The radar is to be complimented by a new domestically-manufactured infrared search and track (IRST) system, although its advantages over the original OLS-30 system remain unannounced.

A modernized cockpit with new displays is also going to be installed, in addition to a new digital flight control computer (DFCC).

The weaponry is also to be upgraded with the ability to carry an expanded range of domestically-manufactured air-to-air missiles, cruise missiles and sensor pods.

150 out of 260 Su-30MKIs operated by the Indian Air Force' are expected to undergo the upgrade program, which is planned to start in 2024 and deliver the first upgraded aircraft by 2025.

India's Most Numerous Jet

The Su-30MKI is a fourth-generation fighter jet designed as an India-specific variant of the Sukhoi Su-30, a further development of the Soviet-era Su-27.

50 of India's Su-30MKIs have been manufactured in Russia, while the rest were built by HAL under license.

Since deliveries ended in 2018, the Su-30MKI remained Indian Air Force's most numerous combat aircraft, serving alongside smaller fleets of Mirage 2000s, MiG-29s and MiG-21s.

In 2019, India started receiving its most modern aircraft yet, the Dassault Rafale. Production of the Su-30MKI was stopped, and plans to upgrade the aircraft to make it competitive against 4.5

generation jets, such as China's Shenyang J-16 started.

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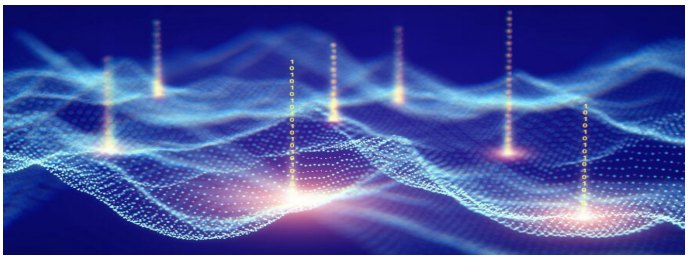
Technology Development

Thales Alenia Space Leading Another ESA Push to Develop Quantum Comms

Jason Rainbow | 24 Jan 2023

Source: Space News | https://spacenews.com/thales-leading-another-esa-push-to-develop-quantum-communications/



Quantum communications graphic. Credit: Airbus

TAMPA, Fla. — Thales Alenia Space has signed a contract to develop quantum technologies in another push by the European Space Agency (ESA) to use the behavior of subatomic particles to make communications more secure.

The European satellite maker said Jan. 23 it is leading a consortium called TeQuantS, which aims to develop technologies needed to demonstrate quantum communication links from space in three years.

By using the entanglement properties of photons, these links are intended to be more secure than conventional networks because any attempt to intercept them would change their state.

Terrestrial quantum communication networks using fiber optic cables are limited to about 150 kilometers, according to Thales, and satellites are better suited for using these capabilities over longer distances.

According to Chinese state media, the Micius satellite China launched in 2016 was the first quantum-enabled spacecraft.

NASA and startups including Singapore's SpeQtral are also exploring space-based quantum capabilities to protect communications from increasingly sophisticated cyberattacks, such as by quantum computers.

The overall contract ESA awarded TeQuantS is worth around 10 million euros ($11 million), said Mathias Vanden Bossche, director of research, technology and product policy at Thales Alenia Space.

That covers a first phase lasting 12 months, Bossche told SpaceNews via email, to start technology qualifications that could lead to a potential demonstration in 2026.

It is part of ESA's multi-pronged approach to advance quantum communications technology, notably under a framework called EuroQCI (European Quantum Communication Infrastructure.)

Two groups have secured contracts under the EuroQCI framework to study quantum communication architectures: One led by Airbus and another by German telco Deutsche Telekom.

EuroQCI covers many projects ranging from ground to space segments. The main objective is to define the overall architecture of quantum-based networks and set up terrestrial test beds.

TeQuantS is focusing on technology developments for the space segment, Bossche said, and targets a wider scope than EuroQCI.

And unlike an ESA project led by satellite operator SES aiming to develop a satellite to test the distribution of quantum encryption keys for

cryptography, he said TeQuantS will also study ways to connect quantum computers and quantum sensors in a multipurpose network.

While quantum key distribution (QKD) is important for security, he said generic networks will need to be able to support the many applications and greater performance promised by quantum information networking

"These generic networks are the real at-stake and challenge of quantum communications," Bossche added.

"Overall, the Thales Alenia Space project is the first project that addresses quantum information networks in space."

The TeQuantS consortium comprises Airbus, seven smaller firms and startups, and two research laboratories.

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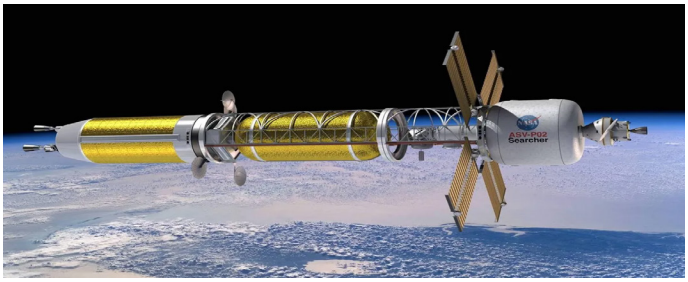
NASA Nuclear Propulsion Concept Could Reach Mars in Just 45 Days

Chris Young | 18 Jan 2023

Source: Interesting Engineering | https://interestingengineering.com/innovation/nasa-nuclear-propulsion-concept-mars-45-days



A concept image of a NASA nuclear rocket.

NASA selected a nuclear propulsion concept for Phase I development as part of its Innovative Advanced Concepts (NIAC) program for 2023.

The Nuclear Thermal and Nuclear Electric Propulsion (NTP/NEP) concept is a new class of bimodal nuclear propulsion system that uses a "wave rotor topping cycle," as per a NASA blog post.

The scientist behind the proposal, Prof. Ryan Gosse from the University of Florida, believes it could reduce travel time to Mars to a mere 45 days. If the technology does work as planned, it could drastically reduce travel times to Mars and make missions to the red planet innumerably safer for humans.

Is Nuclear Propulsion the Future of Human Spaceflight?

The new proposal, titled "Bimodal NTP/NEP with a Wave Rotor Topping Cycle," is one of 14 selected by the NIAC for Phase I development. It received a grant to the tune of $12,500 to research and develop the technology required.

NASA has a long history of considering nuclear propulsion for spacecraft, according to Universe Today. This includes the Nuclear Engine for Rocket Vehicle Application (NERVA) concept, which was successfully tested but then defunded around the same time the Apollo Era came to a close in 1973.

More recently, NASA also tested nuclear propulsion concept technologies with Project Prometheus in the early 2000s. Private firm Ad Astra, meanwhile, which is run by former NASA astronaut Franklin R. Chang Díaz, completed a record 88-hour high-power endurance test of its Vasimr VX-200SS plasma rocket at 80 kW in 2021. Ad Astra claims its nuclear rocket technology could eventually take humans to Mars at speeds of 123,000 mph (197,950 km/h).

NASA's New Nuclear Propulsion Concept

NASA's new NIAC grant recipient leverages two of the key concepts behind nuclear propulsion.

Nuclear-Thermal Propulsion (NTP) utilizes a nuclear reactor to heat liquid hydrogen propellant so that it is converted into plasma and channeled through a nozzle to generate thrust.

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Commentary

1. Next Gen Aero Engines - https://airpowerasia.com/2023/01/15/next-gen-aero-engines/

Further Reading

1. DHS Report on Denver Jamming – More questions than answers - https://www.gpsworld.com/dhs-report-on-denver-jamming-more-questions-than-answers/
2. 'Retired' F-117 Nighthawks Will Fly for Another Decade - https://www.thedrive.com/the-war-zone/retired-f-117-nighthawks-may-fly-for-another-decade
3. F-35 Will Get New Radar Under Massive Upgrade Initiative - https://www.thedrive.com/the-war-zone/f-35-will-get-new-radar-under-massive-upgrade-initiative
4. UK space launch: Historic Cornwall rocket launch ends in failure - https://www.bbc.com/news/science-environment-64218883
5. Police UAV operator 'saturated' before collision with landing Cessna - https://www.flightglobal.com/safety/police-uav-operator-saturated-before-collision-with-landing-cessna/151800.article
6. Indian Aerospace Industry : On a High Growth Trajectory - https://www.mmindia.co.in/article/93/indian-aerospace-industry-on-a-high-growth-trajectory
7. Russia Swarms Ukraine With 'Moskitos' To Jam Its Communication; Could be Moscow's First EW Drone - https://eurasiantimes.com/miniature-irritant-power-packed-mosquito-bites-as-russias/
8. Losing The 'Thunder': Myanmar Grounds Its Pak-China Developed JF-17 Fighter Fleet Due To Technical Snags - https://eurasiantimes.com/myanmar-grounds-its-pakistan-china-developed-jf-17-fighter/

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

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

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