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“The opportunity to secure ourselves against defeat lies in our own hands, but the opportunity of defeating the enemy is provided by the enemy himself”.

- Sun Tzu

Contents

Opinions and Analysis

1. Three Years of Balakot Airstrike: Don't Get Complacent About Terror.
2. The Mysterious Case of the Missing Russian Air Force.

Air Power

3. IAF Withdraws From 'Cobra Warrior' Multilateral Air Exercise in UK.
4. Cheap and Nasty: Yemen's Home-Grown Drones Pose Challenge for UAE.
5. Chinese, Russian Warplanes Force Japan to Scramble its Fighters a Record 785 Times.
6. US Sanctions on Russia Won't Affect Indian Air Force Significantly, Says IAF Vice Chief.
7. The Role Of Turkish Drones in Ukraine's War.
8. Russia Slow to Win Ukraine's Airspace, Limiting War Gains.

Space

9. Russia Space Agency Head Says Satellite Hacking Would Justify War.
10. Russia Looks To China For Collaboration In Space But Faces Isolation Over Ukraine Invasion.
11. SpaceX Heeds Ukraine's Starlink SOS.
12. NRO Warns Satellite Operators Of Possible Russian Attacks.
13. Star Wars: The Outer Space Race To Kill Hypersonics.
14. Dozens Of SpaceX Internet Satellites Lost To Geomagnetic Storm.
15. China To Help Pakistan Build Space Centre, Satellites.

Global Aerospace Industry

16. S-400 Missile System Supply To India Will Not Be Impacted Due To Western Sanctions, Russia Says.
17. Russian Sanctions Throw South Korean Satellite Missions Into Uncertainty.
18. Rogozin Puts Poison-Pill Conditions On Oneweb Soyuz Launch.
19. Sanctions Could Hit Deliveries Of S-400, AK 203 And 11356 Frigates From Russia.
20. With Spain on board, final contracts imminent for Eurodrone program.

Indian Aerospace Industry

21. DRDO's Young Scientists To Develop New Cargo Drones For Himalayan Frontier.
22. Plan To Buy Predator Drones Put On Hold.
23. Taiwan Researchers Join ISRO In Satellite Launch Mission For First Time.
24. India is now home to more than 100 space startups.

Technology Development

25. Key Landing Test Will Push Reusable Vehicle RLV-TD Closer To Orbital Re-Entry Mission.
26. Nuclear Thermal Propulsion Is Key To Keeping Peace In Space.
27. China Tests New Engine, 'Likely To Power Hypersonic Aircraft'.

Opinions and Analysis

Three Years of Balakot Airstrike: Don't Get Complacent About Terror

Air Vice Marshal Anil Golani

Additional Director General, Centre for Air Power Studies | 25 February 2022

Source: Hindustan Times | <https://www.hindustantimes.com/opinion/three-years-balakot-airstrike-don-t-get-complacent-about-terror-101645774623800.html>



On February 26, 2019, 12 Mirage 2000 fighter aircraft took off from India and crossed the border to carry out a punitive strike on a Jaish-e-Mohammed (JeM) facility in the Khyber Pakhtunkhwa region of Pakistan. (PTI)

On February 26, 2019, 12 Mirage 2000 fighter aircraft took off from India and crossed the border to carry out a punitive strike on a Jaish-e-Mohammed (JeM) facility in the Khyber Pakhtunkhwa region of Pakistan. Code-named Operation Bandar, the attack was carried out in retaliation to the Pulwama terrorist attack that killed 40 Central Reserve Police Force soldiers. “In an intelligence-led operation in the early hours of today, India struck the biggest training camp of JeM in Balakot. In this operation a very large number of terrorists, trainers, senior commanders and groups of jihadis who were being trained for fidayeen action were eliminated,” the ministry of external affairs stated.

The Balakot strike was the first time that India carried out a bold manoeuvre, justifying it as a non-military pre-emptive action in the face of imminent danger. Credible intelligence, India said, indicated that more fidayeen attacks were

being planned. The Indian government’s intention was unequivocally conveyed to Pakistan and the world that it would no longer resort to dialogue with a nation that repeatedly failed to live up to its promises made in 2004 that Pakistan would not allow its territory for terrorism against India.

The world was in favour of India. Pakistan attempted to deny the damage, claiming that the attacks only destroyed some trees and that there was no loss of life. This plausible deniability, an oft-repeated tactic by Pakistan’s Inter-Services Public Relations, was once again in display, as it had been during the Kargil intrusion, which was initially blamed on militants and Kashmiri freedom fighters.

The jury is still out on the scale of casualties in Balakot, but enough water has flown under the bridge since then.

Pakistan is reeling under economic pressure with repeated requests for a bailout from the International Monetary Fund and World Bank; the nation continues to double its debt every five years. Inflation levels are at a record high, with a huge fiscal deficit. This precarious financial situation is bound to fuel disillusionment with the current government, which came to power with the promise of making a “Naya Pakistan”. Moreover, Pakistan’s honeymoon with the Taliban, which came to power in Afghanistan, after the exit of the United States, is getting sour by the day, with reports of repeated clashes along the Durand line. The illegal sale of arms seized from the departing American forces has given a fresh impetus to this business, which will only fuel further unrest in the region.

For China, whose much-touted “higher than the mountains and deeper than the seas” bond with Pakistan continues to prosper, the

US withdrawal from Afghanistan poses its own challenges. China needs to remain vigilant to the spread of terror and militancy with the increasing clout of the TIP and the TTP coupled with the Uyghur unrest in the Xinjiang region. These pose significant risks to Beijing's investments in the China-Pakistan Economic Corridor. Moreover, China's strategic alliance with Pakistan will be tested in the near future, with the perilous situation in the neighbourhood after the Taliban take-over of Afghanistan and the disillusionment within Pakistan with its deteriorating economic crisis.

Investments in relationships and policies, when done with vested and parochial interests will never pay dividends. Pakistan's policy of fomenting terrorism through its soil, China's alliance with Pakistan as a hedge against India, Pakistan's support to the Taliban for securing strategic depth and the American partnership with Pakistan to exert influence over Afghanistan have all ensured that the chickens have finally come home to roost.

After the Balakot strike, there has been a discernible downward trend in infiltration from across the border and terror attacks/incidents. India's diplomatic heft and its military capability with the induction of Rafale fighter aircraft with specialist stand-off precision weapons has only increased since then.

The last Fire Power Display (FPD), carried out by the Indian Air Force, took place two days after the Pulwama attack. This year's FPD is being carried out on March 7.

The lull in terror attacks must not make us

complacent. No. The powder must be kept dry and innovative options must be considered and debated because cold, calculative, and decisive actions, incorporating surprise and deception, will pay dividends and ensure that national security is not compromised.

The Mysterious Case of the Missing Russian Air Force

Justin Bronk | 28 February 2022

Source: RUSI | <https://rusi.org/explore-our-research/publications/commentary/mysterious-case-missing-russian-air-force>



Russian Su-34 aircraft pictured in 2017. Courtesy of Dmitry Terekhov / Wikimedia Commons / CC BY-SA 2.0

The Russian invasion of Ukraine began as expected in the early hours of 24 February: a large salvo of cruise and ballistic missiles destroyed

On the fifth day of the Russian invasion of Ukraine, one of many unanswered questions is why Russia has launched a military campaign at huge cost with maximalist objectives, and then declined to use the vast majority of its fixed wing combat aircraft.

the main ground-based early warning radars throughout Ukraine. The result was to effectively blind the Ukrainian Air Force (UkrAF), and in some cases also hinder aircraft movements by cratering runways and taxiways at its major airbases. Strikes also hit several Ukrainian long-range S-300P surface-to-air missile (SAM) batteries, which had limited mobility due to a long-term lack of spares. These initial stand-off strikes followed the pattern seen in many US-led interventions since the end of the Cold War. The

logical and widely anticipated next step, as seen in almost every military conflict since 1938, would have been for the Russian Aerospace Forces (VKS) to mount large-scale strike operations to destroy the UkrAF. With its early warning chain blinded and some runways cratered, the UkrAF was left vulnerable to raids by strike aircraft like the Su-34 with guided munitions, or even multirole Su-30 fighters with predominantly unguided munitions. If present in significant numbers, escorting Su-35 and Su-30 fighters would have overwhelmed the Ukrainian fighters, even if they did manage to take off for sorties conducted at very low altitudes with limited situational awareness. This did not happen.

Instead, the roughly 300 modern combat aircraft which the VKS have positioned within easy range of the main contact zones in northern, eastern and southern Ukraine appear to have largely stayed on the ground throughout the first four days of fighting. This has allowed the UkrAF to continue flying low-level defensive counter-air (DCA) and ground-attack sorties, and these appear to have had some successes in intercepting Russian attack helicopters. The fact that Ukrainian troops and civilians have been able to see (and rapidly mythologise) their own pilots continuing to fly sorties above major cities has also been a major morale-boosting factor that has helped solidify the extraordinary spirit of unified resistance shown across the country. The lack of Russian fixed wing fighter and strike aircraft sorties has also allowed Ukrainian SAM operators and troops with MANPADS such as the US-made Stinger missile to engage Russian helicopter gunships and transports with significantly less

risk of immediate retaliation. This in turn has contributed to the significant lack of success and heavy losses suffered during Russian air assault operations.

Furthermore, the almost total lack of Russian offensive counter-air (OCA) sweeps has been coupled with very poor coordination between Russian ground forces' movements and their own medium- and short-ranged air defence systems. Multiple Russian columns have been sent forward beyond the reach of their own air defence cover, and in others cases accompanying SAM batteries

The indiscriminate form of air attack that was standard practice for Russian and Syrian Air Force operations over Aleppo and Homs is unfortunately likely to be employed by the VKS over Ukraine in the coming days.

have been caught inactive in military traffic jams without making any apparent effort to provide situational awareness and defence against Ukrainian air assets. This has allowed the surviving Ukrainian Bayraktar TB-2 armed UAVs to operate

with considerable effectiveness in some areas, inflicting significant losses on Russian vehicle columns.

Possible Explanations

There are several factors that may be contributing to the lack of Russian ability to achieve and exploit air superiority, in spite of their huge advantages in aircraft numbers, equipment capability and enablers such as AWACS compared to the UkrAF. The first is the limited quantities of air-delivered precision-guided munitions (PGMs) available to most VKS fighter units. During combat operations over Syria, only the Su-34 fleet has regularly made use of PGMs, and even these specialist strike aircraft have regularly resorted to unguided bomb and rocket attacks. This not only indicates a very limited familiarity with PGMs among most Russian fighter crews,

but also reinforces the widely accepted theory that the Russian air-delivered PGM stockpile is very limited. Years of combat operations in Syria will have further depleted that stockpile, and may mean that the bulk of the 300 VKS fixed wing combat aircraft massed around Ukraine have only unguided bombs and rockets to draw on for ground-attack sorties. This, combined with the lack of targeting pods to spot and identify battlefield targets from a safe distance, means that the VKS fixed wing pilots' capacity to provide close air support for their forces is limited. As a result, the VKS leadership may be reluctant to commit the bulk of their potential striking power against Ukrainian troops before political approval is granted to employ unguided munitions to bombard Ukrainian-held urban areas. This indiscriminate form of air attack was standard practice for Russian and Syrian Air Force operations over Aleppo and Homs, and unfortunately is likely to be employed by the VKS over Ukraine in the coming days.

Lack of PGMs, however, is not a sufficient explanation for the overall lack of VKS fixed wing activity. The relatively modern avionics on most of their strike platforms mean that even unguided bombs and rockets should still have been sufficient to inflict major damage on Ukrainian aircraft in their airbases. The VKS also have around 80 modern and capable Su-35S air superiority and 110 multirole Su-30SM(2) fighters, which could conduct OCA and DCA sweeps. The inability to establish air superiority, therefore, cannot be purely explained by a lack of suitable PGMs.

Another potential explanation is that the VKS are not confident in their capacity to safely deconflict large-scale sorties with the activity

of Russian ground-based SAMs operated by the Ground Forces. Friendly-fire incidents by ground-based SAM units have been a problem for Western and Russian air forces alike in multiple conflicts since 1990. Running joint engagement zones in which combat aircraft and SAM systems can engage enemy forces simultaneously in a complex environment without friendly-fire incidents is hard; it requires close inter-service cooperation, excellent communications and regular training to master. So far, Russian forces have shown extremely poor coordination across the board, from basic logistics tasks, to coordination of airborne assaults with ground forces activity and arranging air defence cover for columns on the move. In this context, it might be the case that the decision was made to leave the task of denying the UkrAF the ability to operate to the ground-based SAM systems, with the explicit understanding that this would be instead of large-scale VKS air operations. However, once again, this is not a sufficient explanation in itself, since given the limited fighter and SAM assets available to Ukrainian forces at this stage, the VKS could still have conducted large-scale sorties against key targets at pre-arranged times, during which Russian SAMs could be instructed to hold their fire.

A final factor to consider is the relatively low number of flying hours that VKS pilots receive each year relative to most of their Western counterparts. While accurate numbers across each unit are hard to find, periodic Russian official statements suggest an average of 100–120 hours per year across the VKS as a whole. Fighter unit flying hours are likely to be lower than those for transport or helicopter units, so the real figure is

The VKS leadership may be hesitant to commit to large-scale combat operations which would show up the gap between external perceptions and the reality of their capabilities.

probably a little under 100. RAF and US Air Force fighter pilots often complain that they struggle to maintain multirole combat readiness with around 180–240 flying hours a year, access to modern high-fidelity simulators for additional training, and better cockpit ergonomics and weapon interfaces than their Russian counterparts. Therefore, it may be that despite an impressive modernisation programme that has seen the acquisition of around 350 new modern combat aircraft over the past decade, VKS pilots would struggle to effectively employ many of the theoretical capabilities of their aircraft in the complex and contested air environment of Ukraine. If this is the case, then the VKS leadership may be hesitant to commit to large-scale combat operations which would show up the gap between external perceptions and the reality of their capabilities.

However, it is important to remember that we are only five days into what could easily turn into a protracted campaign. The fact that there have only been a few confirmed sightings of Russian fixed wing sorties over Ukraine should not obscure the fact that the VKS fighter fleets remain a potentially highly destructive force, and one that could be unleashed against aerial and fixed ground targets at short notice over the coming days.

Air Power

IAF Withdraws From ‘Cobra Warrior’ Multilateral Air Exercise In UK

26 February 2022

Source: *IMR* | https://imrmedia.in/iaf-withdraws-from-cobra-warrior-multilateral-air-exercise-in-uk/?utm_medium=email&utm_source=getresponse&utm_content=Indian%20Military%20Review%20Newsletter%2028%20Feb%202022&utm_campaign=



LCA Tejas was slated to take part in Cobra Warrior exercise in UK

The Indian Air Force on Saturday (February 26) decided to pull out of a multilateral air exercise in the UK next month in view of the situation arising out of the crisis in Ukraine, officials said. The decision to not participate in the ‘Cobra Warrior’ exercise came just three days after the IAF announced that five Tejas light combat aircraft would be sent for the drills from March 6 to 27 at Waddington in the UK.

The IAF on Saturday morning tweeted that it has decided not to deploy its aircraft for exercise in the UK in “light of the recent events”. However, the tweet was deleted later.

Though there was no reason given why the tweet was deleted, officials said the decision to not participate in the exercise stands. “The IAF is not participating in the exercise ‘Cobra Warrior’,” said a senior official.

The pull-out came amid a deepening crisis in

Ukraine with Russian troops advancing on Kyiv and other key cities.

The decision also came hours after India abstained from voting on a UN Security Council resolution on the Russian military aggression against Ukraine.

Official sources said by abstaining from the resolution, India retained the option of reaching out to all relevant sides to find a middle ground and foster dialogue and diplomacy to resolve the crisis.

On 23 February, the IAF announced that it will participate in the 'Cobra Warrior' exercise with a fleet of five Tejas light combat aircraft (LCA).

Cheap And Nasty: Yemen's Home-Grown Drones Pose Challenge For UAE

29 January 2022

Source: Space War | https://www.spacewar.com/reports/Cheap_and_nasty_Yemens_home_grown_drones_pose_challenge_for_UAE_999.html



Domestically assembled drones that can fly hundreds of miles (kilometres) are proving a security headache for the United Arab Emirates after consecutive attacks by Yemen's rebel warriors.

The low-tech weapons, which use over-the-counter parts, were deployed in two attacks on

the wealthy Gulf state, a member of the Saudi-led coalition, the Iran-backed rebels said.

Three Asian oil workers died in a drone-and-missile assault on Abu Dhabi on January 17 and on Monday, US forces based in the city fired Patriot interceptors to help shoot down two ballistic missiles.

Drones were also used in the attack, the rebels said.

The attacks, in response to a series of rebel defeats by a UAE-trained militia, pit the Huthis' home-grown weaponry against the Emirates' billion-dollar missile defence capabilities.

The Sammad-3 drones -- named after the insurgents' former second-in-command Saleh al-Sammad, who was killed in a coalition air raid in 2018 -- have a range of about 1,500 kilometres (930 miles), rebels and analysts say.

They have frequently targeted Saudi Arabia, which neighbours Yemen, killing and injuring civilians, and damaging infrastructure, including oil facilities and airports.

"The Emiratis and Saudis are finding it difficult to fend off these attacks," said James Rogers, an associate fellow at the London School of Economics.

"It is notoriously difficult to counter drone and missile attacks, especially when used in a 'swarm tactic' where multiple weapons are sent at once to overwhelm existing defences."

Experts stress the cost-effectiveness of a strategy also adopted by the Hamas movement in Gaza against Israel as well as Shiite militants targeting US forces in Iraq.

Drones have long been used by conventional forces, including the Americans in the assassination

of senior Iranian commander General Qassem Soleimani at Baghdad airport in 2020.

Missile defence

Rogers said the Huthis have been using attack drones and medium-range missiles "at low altitude and low speed so they are hard for conventional radar to detect".

Saudi Arabia and the United States have repeatedly accused Iran of supplying the Huthis with drones, missiles and other weapons, a charge Tehran denies.

The Shiite Huthi rebels say they manufacture the drones domestically, although analysts say they contain smuggled Iranian components.

"Many of the drones were locally made reproductions of state-designed military systems similar to those made by Iran," said Rogers, who has inspected captured Huthi drones.

"They were augmented with easily available commercial drone motors, wiring, control systems, and cameras. This ensures the Huthis can secure these cost-effective fighting methods, increasingly with less support from state military supplies."

The Samad-3, the Huthis' most advanced drone, can be fitted with 18 kilogrammes (40 pounds) of explosives, according to rebel media sources and analysts.

The Huthis' drones use GPS guidance and "fly autonomously along pre-programmed waypoints" towards their targets, Center for Strategic and International Studies (CSIS) experts wrote in a 2020 report.

The UAE signed a multi-billion dollar deal for the Theater High Altitude Area Defense (THAAD) missile protection system, built by US

firm Lockheed Martin, in 2011.

It also inked a \$3.5-billion missile defence contract with a South Korean firm last week.

As for Saudi Arabia, its US-made Patriot missile defence system -- which already appears to have a mixed record in intercepting launches from Yemen -- is not primarily designed to repel low-flying drones, experts say.

Saudi Arabia possesses 80 standalone air defence radars, but many of these are older systems dating back several decades.

The extension of the Huthis' air offensive to the UAE came after heavy losses on the ground in Shabwa province in the face of an offensive by Emirati-trained Giants Brigade fighters.

Chinese, Russian Warplanes Force Japan To Scramble Its Fighters A Record 785 Times

Julian Ryall | 26 January 2022

Source: *South China Morning Post* | https://www.scmp.com/week-asia/politics/article/3164803/chinese-russian-warplanes-force-japan-scramble-its-fighters?module=perpetual_scroll_0&pgtype=article&campaign=3164803



Japan Air Self-Defense Force fighters above Hyakuri air base in Omitama, Ibaraki prefecture. Photo: EPA

Air Self-Defence Force fighters scrambled to intercept foreign aircraft approaching Japanese airspace a record number of times between April and December last year, with the vast majority of the incidents involving Chinese warplanes testing Japan's air defences around the islands of Okinawa.

Japanese air units are operating under regulations that have been revised in recent years to raise the threshold for interception flights, a military analyst told the *South China Morning Post*, meaning that if anything the increase in flights probing Japan's air defences is even more pronounced than the latest figures indicate.

According to the defence ministry, ASDF fighters were scrambled to intercept 785 inbound flights in the latter nine months of 2021, the highest figure for the same period in the last five

years. The total exceeded the 725 incidents in the whole of the 2020-2021 financial year.

Japanese fighters were ordered to meet Chinese aircraft 571 times during the nine-month period, up 240 incidents from the previous year and accounting for more than 70 per cent of the cases.

Interceptions of Russian aircraft accounted for the majority of the other cases, with 199 incidents. That figure, however, was down by seven from the previous year.

Garren Mulloy, a professor of international relations at Daito Bunka University and an authority on defence matters, said the growing number of cases appeared to be a continuation of the "incremental" increases that had been reported in southwest Japan in the last decade or so, coinciding with a dispute between Tokyo and Beijing over uninhabited islands in the East China Sea.

In tandem with Chinese coastguard ships, Chinese aircraft have tested Japanese reactions around islands known in Japan as the Senkakus. Beijing claims sovereignty over the islands, which it refers to as the Diaoyus.

"This increase is pretty much in line with what we have seen before, but it is difficult to know from the data the number of situations in which they did not scramble units last year under the new policy for interceptions," he said.

In the past, Japanese fighters would be launched from Kadena Air Base, in Okinawa, as soon as radar detected Chinese aircraft taking off from military facilities in China's Fujian province. The ASDF needed to respond rapidly as the flight time to the Senkaku Islands was similar to the

Japanese fighters were ordered to meet Chinese aircraft 571 times in the last nine months of the year, up 240 incidents from the year before.

time it would take the Chinese to reach the area.

“But the Chinese military is now flying so frequently all along the coast that it was becoming impossible for the Japanese to respond to every take-off,” Mulloy said. “It would very quickly have exhausted the Japanese aircraft and their pilots.”

The new requirements for a scramble to be ordered require the foreign aircraft to actually approach Japan’s Air Defence Zone or airspace over the East China Sea, he said.

“This means the number of predictive scrambles has been reduced, which means that the increase we have seen in the last nine months were direct approaches to Japanese airspace rather than what might be termed ambient threats, so the increase in the overall number of flights detected would have been even higher,” he added.

Concern Over Coordinated Actions

Another growing concern in Tokyo is the increase in coordinated actions by the Chinese and Russian militaries, as was seen last year when warships of the two nations carried out joint exercises in the Sea of Japan and then completed a circumnavigation of the archipelago.

“That, to Tokyo, is very worrying as it is more difficult to assess the scale of the threat and Japanese fighters would have to scramble in two or even three directions to meet a series of threats,” Mulloy pointed out.

The release of the report on the increased approaches to Japanese airspace coincides with the announcement that Japan and the United

States are to deploy unmanned Reaper drones at an SDF base for the first time. Seven MQ-9 drones, produced by General Atomics Aeronautical Systems of the US, are to be stationed at the Maritime Self-Defence Force base at Kanoya, Kagoshima prefecture, within the coming weeks.

Around 100 US military personnel are to be deployed to initially operate and maintain the aircraft, which have undergone extensive testing at the hands of the Japanese coastguard. Those test flights, conducted last year in Aomori prefecture, have confirmed that the maritime variants of the drones are effective at identifying and tracking ships across vast expanses of ocean.

The coastguard, which also intends to use the aircraft for search-and-rescue missions, presently operates a fleet of 33 fixed-wing aircraft and 52 helicopters, meaning its equipment is stretched thin at a time of increasing demands, particularly in areas of southwest Japan.

In addition to new equipment, the Japanese government has announced that it will start work on developing Mageshima Island, off Kagoshima prefecture, as an SDF base that will also be available to US forces for drills. The uninhabited island was used as an airfield for Japanese air attacks against Allied forces invading Okinawa in the closing stages of World War II, but it will require a complete rebuild of the facilities.

The plan is for US fighter aircraft that are presently required to fly to Iwo Jima to carry out landing practices to conduct drills much closer to their land bases. Mageshima is also conveniently located far closer to Okinawa and can serve as a staging base in the event of a military emergency in southern Japan.

There were also 199 incidents involving Russian planes - a figure likely to add to Tokyo's concerns over coordinated actions by Moscow and Beijing.

US Sanctions On Russia Won't Affect Indian Air Force Significantly, Says IAF Vice Chief

2 March 2022

Source: *India Today* | <https://www.indiatoday.in/india/story/us-sanctions-on-russia-wont-affect-indian-air-force-significantly-says-iaf-vice-chief-1919946-2022-03-02>



Vice Chief Air Marshal Sandeep Singh stated that India's relations with both Russia and the United States have remained strong (File)

The Indian Air Force (IAF) will not be significantly impacted by the US sanctions on Russia and India's relations with both countries remain strong, Vice Chief Air Marshal Sandeep Singh said on Wednesday. However, the IAF will face difficulties for a month or two in getting spare parts for its defence equipment from Russia to India, he added.

About 70 per cent of Indian defence equipment is of Russian origin.

After Vladimir Putin started a military offensive against Ukraine on February 24, various western countries — including the US — have decided to block assets of four large Russian banks, impose export controls and sanction oligarchs close to the Russian president.

“We know the geopolitical situation is difficult [currently] Our relations with Russia will continue,” Singh said at a press briefing here.

He said that things are still unfolding

geopolitically.

“Our position is very strong and our relations with both the countries [Russia and the US] have remained (strong) and you have seen that,” he noted.

“We are evaluating the situation. There will be certain difficulties, there is no doubt about it. But I think it should not affect us too much. I am confident that it won't affect us significantly,” he added.

On the issue of supply of spare parts from Russia to India, he replied there is no doubt there will be difficulties for a month or two.

Singh said, “There are sanctions but we have gone through similar issues earlier and maybe, this would be more serious than that I think it will not affect us critically and I hope for it also.” The IAF is aiming for 100 per cent indigenisation of the spare parts and components, he noted.

“It will take time to reach the 100 per cent mark,” he mentioned.

Russia-Ukraine War Live

Singh said the defence ministry and the IAF itself have set a very aggressive timeline to reach the 100 per cent mark.

He said there is no doubt that in the coming years, the IAF will have majority of its systems indigenously designed and produced.

The final aim is that you have to be self-reliant, he added.

Three aircraft have departed to evacuate stranded citizens, the IAF vice chief said. “We can operate four aircraft per day to evacuate Indians,” he mentioned.

Singh stated the evacuation operations will run

round the clock till all Indians are brought back.

The IAF has experience of running various such evacuation programs — the most recent one was conducted in Afghanistan, he noted.

When asked how many military transport planes An-32 have been upgraded by Ukraine till now, Singh replied this aircraft fleet has been upgraded to a large extent.

“The upgrade of An-32 aircraft was affected before too when Ukraine was under pressure due to the Crimean issue in 2014 and 2015,” he noted.

After that, the IAF has significantly indigenised many of the spare parts that needed to be upgraded by Ukraine, he added.

The Role Of Turkish Drones In Ukraine's War

03 March 2022

Source: The News | <https://www.thenews.com.pk/print/938093-the-role-of-turkish-drones-in-ukraine-s-war>

The pride of Ankara, Turkish combat drones were quickly put into action by Ukraine following Russia's invasion. But while they have proved their worth in several recent conflicts -- from Syria to Libya to Nagorno-Karabakh -- the terrain this time is less favourable, experts say.

Kyiv has around 20 Bayraktar TB2 drones, built by the Turkish military. Relatively cheap and effective, President Recep Tayyip Erdogan has been their number one salesman, securing deals with around 15 countries around the world.

The Ukrainian ambassador in Ankara has regularly tweeted images of explosions attributed to the drones, targeting Russian columns and artillery, with accompanying phrases like: "#Bayraktar -- "Mashallah (God be praised)" and strings of joyous emojis.

"These TB2 strikes are, in comparison to ground combat, relatively small in number, but important for Ukrainian morale precisely because it shows Russia does not control the skies," said Aaron Stein, of the Foreign Policy Research Institute. But the positive assessment also rests on Russia's surprising reticence to use its full airpower.

"The Russian air campaign has baffled experts, including myself, who made the incorrect assumption that they would be far more active over Ukraine," said Stein. Russian air power will overwhelm Ukraine's drones "at some point in the near future," he predicted.

Several conflicts in recent years have offered a shop window for Turkey's drones. They were a determining factor in Nagorno-Karabakh in November 2020, giving Azerbaijan's forces the edge over Armenia in the disputed region.

In Libya a year earlier, they were crucial to repelling a protracted offensive by rebel commander, General Khalifa Haftar, against the government in Tripoli. Turkey has also deployed drones against Kurdish militants and government forces in Syria -- the latter backed by Russia. "Hardy, reliable, competitive," gushes a Western competitor, speaking on condition of anonymity.

"Turkey has reinvented the Kalashnikov of the 21st century," they added -- a reference to the AK-47 rifle created by the Soviet Union that flooded war zones around the world due to its ease of use and cheap price tag.

The TB2 is 6.5 metres long and half the weight of its US counterpart, the Reaper, carrying four laser-guided munitions. Its maker Baykar says it can fly for 27 hours, at up to 220 kilometres per hour, and is operational between 18,000 and 25,000 feet.

Meanwhile, a wounded Ukrainian soldier dropped his crutches to the Kyiv metro station floor and picked up his five-year-old son, first wiping tears from his shaking wife's face. The sweet smell of sweat from the bodies of sheltering Ukrainians permeated the damp, chilly air around them.

But Sergiy and Natalia Badylevych were oblivious to the cooking odours and the dozing

families spread out on the floor of what has become one of Kyiv's deepest and safest bomb shelters. They had been reunited for the first time since witnessing a Russian missile strike on Kyiv's TV tower on Tuesday evening.

Russia Slow To Win Ukraine's Airspace, Limiting War Gains

01 March 2022

Source: *The Economic Times* | https://economictimes.indiatimes.com/news/defence/russia-slow-to-win-ukraines-airspace-limiting-war-gains/articleshow/89919248.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst

A possible explanation for Russia's failure to do so is that President Vladimir Putin built his war strategy on an assumption that Ukrainian defenses would easily fold, allowing Russian forces to quickly capture Kyiv, the capital, and crush Ukrainian forces in the east and south without having to achieve air superiority.

In war, winning quick control of airspace is crucial. Russia's failure to do so in Ukraine, despite its vast military strength, has been a surprise and may help explain how Ukraine has so far prevented a rout. The standoff in the sky is among the Russian battle shortcomings, including logistical breakdowns, that have thrown Moscow off stride in its invasion.

Typically, an invading force would seek at the outset to destroy or at least paralyse the target country's air and missile defences because dominance of the skies allows ground forces to operate more effectively and with fewer losses. U.S. military officials had assumed that Russia would use its electronic warfare and cyber capabilities to blind and paralyse Ukraine's air defences and military communications.

A possible explanation for Russia's failure to

do so is that President Vladimir Putin built his war strategy on an assumption that Ukrainian defenses would easily fold, allowing Russian forces to quickly capture Kyiv, the capital, and crush Ukrainian forces in the east and south without having to achieve air superiority.

If that was the plan, it failed, although at this stage the conflict's overall trajectory still seems to favour the larger, better equipped invading force. The invasion is less than a week old, and Russia still hasn't committed to the battle the full force it had assembled on the border. A senior U.S. official said Monday that about one-quarter of the force hasn't crossed into Ukraine.

The official, who spoke on condition of anonymity to discuss internal military assessments, said Ukraine has retained a majority of its surface-to-air missile systems - used to shoot down aircraft - and a majority of its helicopters and airplanes. One reason they have yet to be destroyed, the official said, may be because Ukraine's air defences were not centrally located and may have been moved around the country.

It appears that Russian commanders have become frustrated by the pace of their battlefield gains and failure to win full air dominance, the official said. In response they may consider more aggressive, larger-scale attacks against Kyiv and to reduce the significant remaining Ukrainian air defenses.

When he announced his decision to attack on Feb. 24, Putin gave no timetable for completing what he called not a war but a "special military operation." By U.S. estimates he had assembled more than 150,000 troops on Ukraine's borders.

"We think that they're a few days behind where they expected to be" at this stage, Pentagon

press secretary John Kirby said Monday, five days into a war that is the largest in Europe since World War II. "It's clear, yes, the Russians have had their own challenges and they have met resistance we don't believe they fully expected."

Philip Breedlove, a retired Air Force general who commanded NATO forces in Europe from 2013 to 2016, said Russia did unleash substantial missile attacks on Ukrainian air defense sites and airfields in the first few days. And yet the Ukrainians have found creative ways to preserve their air and missile defences.

"I am pleasantly surprised that the air defense capability of Ukraine, even though diminished, has carried on as long as it has," Breedlove said. He added that Russia may yet bring more fighters and bombers into the conflict, even as Ukraine acquires Stinger missiles and other air defense weaponry from Western nations.

In Breedlove's view, the weaponry provided to Ukraine by the United States and many other countries in recent weeks, including Javelin anti-tank missiles, has given Kyiv an important boost. He recalled that when Western countries in 2014 began providing radars used to detect and pinpoint the origin of artillery and mortar attacks, some questioned whether the Ukrainians could make good use of them.

"It was not long after they had them and started working with them that they were teaching us new tactics, techniques and procedures on how to employ them," said Breedlove, who was NATO chief at the time.

"From what I read and see, the Ukrainians have done a pretty good job of inflicting costs on Russian airborne forces," he said.

More broadly, beyond failing to destroy or

ground the Ukrainian air force, the Russians as of Monday had not managed to capture any major Ukrainian city and were advancing far more slowly than planned, Pentagon officials have said in recent days.

Still there were signs of intensified conflict. Fighting raged in towns and cities scattered across the country. The strategic southern port city of Mariupol, on the Sea of Azov, was "hanging on," said Zelenskyy adviser Oleksiy Arestovich. An oil depot was reported bombed in the eastern city of Sumy.

Video from Ukraine's second-largest city, Kharkiv, showed residential areas being shelled, with apartment buildings shaken by repeated, powerful blasts.

"There are two basic ways you can describe the slowness of the Russian advance in Ukraine," said Loren Thompson, a defense analyst at the Lexington Institute, a Washington think tank. "One explanation is deliberate restraint. The other explanation is poor execution. We don't know enough to identify which is the more plausible explanation, but it's important to recognize the Russians have all sorts of options they have not yet brought to bear," including heavier use of cyberattacks against the Ukrainian command and control system and air defenses.

In its latest assessment, the Institute for the Study of War said Moscow has likely recognized that its initial approach failed and is moving additional combat power toward Ukraine.

"The tide of the war could change rapidly in Russia's favor if the Russian military has correctly identified its failings and addresses them promptly, given the overwhelming advantage in net combat power that Moscow enjoys," it said.

Space

Russia Space Agency Head Says Satellite Hacking Would Justify War

03 March 2022

Source: Reuters | <https://www.reuters.com/world/russia-space-agency-head-says-satellite-hacking-would-justify-war-report-2022-03-02/>



A Soyuz-2.1b rocket booster with a Fregat upper stage and satellites of British firm OneWeb is lifted to a launchpad at the Baikonur Cosmodrome, Kazakhstan March 2, 2022. Roscosmos/Handout via REUTERS

MOSCOW, March 2 (Reuters) - Russia will treat any hacking of its satellites as a justification for war, the head of the country's space agency was quoted as saying in a news report on Wednesday.

Roscosmos head Dmitry Rogozin denied media reports that Russian satellite control centres have already been hacked amid Moscow's invasion of Ukraine, while warning against any attempts to do so, Interfax news agency reported.

"Offlining the satellites of any country is actually a casus belli, a cause for war," Interfax quoted him as saying.

Rogozin also said his agency wanted British-based tech firm OneWeb to provide guarantees that its satellites are not going to be used against Russia, Interfax added.

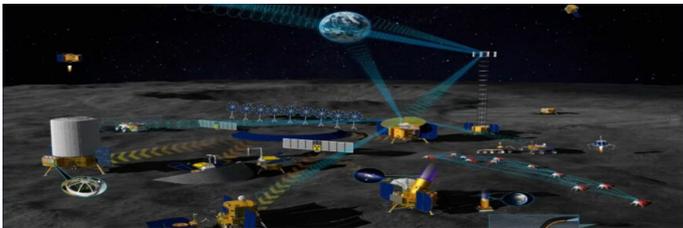
Without these, Rogozin said Russia will cancel the planned March 4 launch of 36 OneWeb

satellites from the Baikonur cosmodrome, which Russia rents from Kazakhstan, without compensating OneWeb, the Russian news agency reported.

Russia Looks To China For Collaboration In Space But Faces Isolation Over Ukraine Invasion

Jandrew Jones | 01 March 2021

Source: Space News | <https://spacenews.com/russia-looks-to-china-for-collaboration-in-space-but-faces-isolation-over-ukraine-invasion/>



A render depicting phase 3 of a planned joint China-Russia International Lunar Research Station (ILRS) in the 2030s.

Credit: CNSA

HELSINKI — Roscosmos is looking to China as a supplier of vital space industry components and a partner in missions following the invasion of Ukraine, but sanctions could still heavily impact any new plans.

Russian space agency head Dmitry Rogozin told Russian media Feb. 26 that sanctions imposed by Western countries would hit supplies of microelectronics necessary for spacecraft.

“With all our efforts to promote the Russian national microelectronic industry... it is impossible to produce everything,” Rogozin said, adding that, “We have excellent relations with China ... and we will solve these problems.”

Russia is understood to have turned to Chinese state-owned aerospace companies for alternatives following sanctions imposed in 2014

in response to the Russian annexation of Crimea. But the invasion of Ukraine is having far greater repercussions.

Reuters reported Feb. 27 that China so far does not seem to be helping Russia avoid sanctions. Chinese banks and other entities could face sanctions themselves and loss of access to the U.S. financial system by doing business with Russia, the report states.

China has been seen as trying to balance its response to the Ukrainian conflict. Beijing is urging restraint and has declined to describe Russia’s actions as an invasion, but appears to be careful to avoid being caught in the repercussions faced by Russia.

“China and Russia are comprehensive strategic partners of coordination. Our relationship features non-alliance, non-confrontation and non-targeting of any third party. China’s position on the Ukraine issue is consistent. We always decide on our position and policy based on the merits of the matter itself,” Chinese foreign ministry spokesperson Wang Wenbin said in a regular press conference Feb. 28, underlining that Moscow and Beijing were not allies.

“I think China increasingly finds itself in between a rock and a hard place,” says Matti Nojonen, a professor of Chinese culture and economy at the University of Lapland, noting that while Beijing has moved toward a closer relationship with Moscow, nearly the whole world community is turning against Russia.

“I think they [China] are very carefully monitoring now what they’re doing and what kind of reactions this has created. I think it must have surprised China how this united all the Western powers ... and now it turns out that even countries like Kazakhstan are turning and criticizing what

Putin did.” Nojonen told SpaceNews.

The U.S. State Department in January also imposed sanctions on subsidiaries of China’s main space contractors, the China Aerospace Science and Technology Corporation (CASC) and the China Aerospace Science and Industry Corporation (CASIC) under the Arms Export Control Act and the Export Administration Act.

Roscosmos says it is also looking for new partnerships following the breakdown in relations. Rogozin told the TASS news agency that he had instructed a team to initiate negotiations with Beijing on the coordination and mutual technical support of deep space missions.

Sino-Russian cooperation has grown in recent years, including agreements for cooperation on the Chinese Chang’e-6 and Chang’e-7 and Russian Luna 27 missions, a joint data center for lunar and deep space exploration and a proposed joint International Lunar Research Station (ILRS).

Question marks over the respective roles in the lunar base plan emerge however with an expected heavy impact of sanctions on Russian space activities. The ILRS roadmap envisions a series of launches in the early 2030s by new super heavy-lift launch vehicles to be developed separately by both Russia and China. The ILRS aims to establish a robotic research base, likely targeting the lunar south pole, according to a roadmpap released in June 2021.

Other missions could now see Chinese collaboration in place of American involvement. Rogozin said the Venera-D mission to Venus could no longer feature U.S. involvement. While discussions between American and Russian scientists on a potential role for NASA on mission, the project had experienced extensive delays.

While International Space Station operations remain normal, cooperation with Russia elsewhere has come to a swift end.

Roscosmos said in a pair of tweets Feb. 26, citing a statement by Rogozin, that the agency is suspending cooperation with European partners in organizing space launches from French Guiana.

The European Space Agency said Feb. 28 that it is “very unlikely” that its ExoMars mission will launch this September because of sanctions on Russia and the wider context of its invasion of Ukraine.

India meanwhile has so far refrained from criticizing Russia. In December the pair agreed to strengthen cooperation in the space sector, including human spaceflight programs and satellite navigation, as part of a wider set of agreements.

SpaceX Heeds Ukraine's Starlink SOS

Ukrainian Vice Priminister Mykhailo Fedorov.

Brian Berger | 28 February, 2022

Source: *Space News* | <https://spacenews.com/spacex-heeds-ukraines-starlink-sos/>



File photo of Starlink broadband satellite internet dish. Credit: SpaceX

China. WASHINGTON — SpaceX CEO Elon Musk said Saturday that he's sending Starlink terminals to Ukraine to help keep the embattled country connected to the outside world as Russia steps up its invasion.

Details of SpaceX's Starlink assistance remain under wraps. And while it's not clear how quickly the promised Starlink broadband terminals will be up and running inside Ukraine, SpaceX's response was another remarkable example of private companies and connected citizens pushing back on Russia's effort to subjugate its neighbor.

"I wish I could say more," Musk told SpaceNews. "But, yeah, I was thinking the same thing. Strange that SpaceX can do this."

As Russian forces were closing in on Kyiv on Saturday afternoon local time, Ukraine's minister for digital transformation called on Musk via Twitter to send Starlink terminals.

"@elonmusk, while you try to colonize Mars — Russia try to occupy Ukraine! While your rockets successfully land from space — Russian rockets attack Ukrainian civil people! We ask you to provide Ukraine with Starlink stations and to address sane Russians to stand [down]," tweeted



While Musk declined to talk about what transpired behind the scenes, just over 10 hours later — half past midnight in Kyiv — Musk publicly responded that help was on the way.

"Starlink service is now active in Ukraine. More terminals en route," Musk tweeted in reply to Fedorov.

Late Sunday, a senior Ukrainian space official told SpaceNews that Starlink terminals had not arrived but were on the way.

"I've heard from the minister himself that the first batch of terminals is coming. Not here yet. But this is not critical at all. No problems with connection for now in all regions of Ukraine," Volodymyr Usov, former chairman of the Ukrainian State Space Agency and co-founder of Kyiv-based Kurs Orbital, told SpaceNews via a messaging app.

Early Monday, Kyiv time, Usov said that telecommunications were still up and running inside Ukraine, easing the urgency for Starlink terminals. "We anticipated the disruption of our comms, but didn't happen," he said.

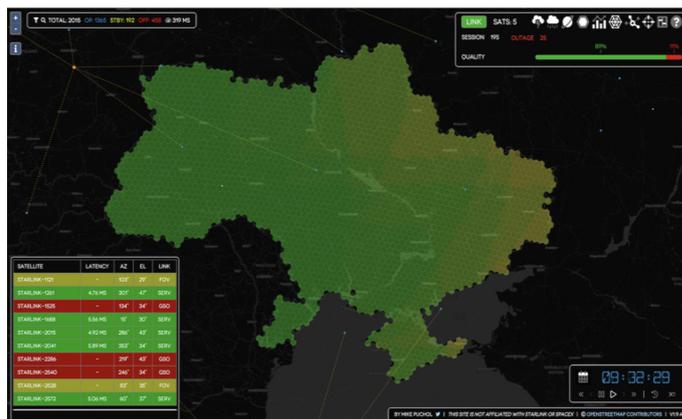
Nevertheless, he expressed gratitude for SpaceX’s quick response. “Thanks to Elon for his support and good outreach,” Usov said. “Starlink can prove to be useful, especially outside big cities.”

Shortly after 10 p.m. Monday, Kyiv, Fedorov tweeted that a truckload of Starlink terminals had arrived.

sophisticated signals-intelligence operation that would be necessary to distinguish friend from foe and combatants from noncombatants is largely theoretical at this point, at least for Ustov and his fellow Ukrainians.

“No concerns at all regarding location security,” Ustov said.

Making The Connection



A Starlink Coverage Tracker screenshot provided by Mike Puchol shows a color representation of potential coverage, with green representing areas better serviced by multiple satellites

Brian Weeden, a former U.S. Air Force officer and military space specialist at the Secure World Foundation think tank in Washington, said that Scott-Railton is correct that Starlink terminals are potentially targetable, but he doesn’t think they would rank as high-value targets.

“It is true that the Starlink ground terminals will be broadcasting, and thus potentially targetable using RF signal detection equipment. But I doubt they’d be that high of a priority for Russian targeting, so I think the odds of them being targeted is probably low,” Weeden said Monday by email. “A much bigger challenge would be Russian ground-based mobile jamming, which is sophisticated and can already deal with existing satellite signals such as GPS and satellite communications.”

Weeden said the near-term utility of sending

Uplink’s Downside?

Analyst John Scott-Railton, a senior researcher at the University of Toronto’s Citizen Lab who studies connectivity in conflict regions, warned over the weekend that Starlink uplinks could make Ukrainian combatants and noncombatants alike a target for Russian airstrikes.

“Good to see,” Scott-Railton tweeted Feb. 26. “But remember: if #Putin controls the air above #Ukraine, users’ uplink transmissions become beacons...for airstrikes.”

For a Russian invasion force that appears to be having trouble with core logistics, like keeping its armored vehicles fueled, the sort of

Starlink terminal to Ukraine could be limited by a lack of teleports covering Europe's largest country by area (after Russia).

"The other big challenge is the lack of operational teleports covering Ukraine, which are necessary to link end user requests to the Internet," Weeden said. "As far as I know, the only operational teleports covering Ukraine are in Poland, so I don't think the eastern part of Ukraine can actually use Starlink service."

Mike Puchol, the chief technologist of a Kenya-based wireless internet service provider who built and maintains a popular Starlink coverage tracker in his spare time, told SpaceNews that Ukraine appears to be fully covered, perhaps with less total Starlink capacity over Eastern Ukraine.

Puchol's tracker simulates the links between gateways, satellites, and user terminals based on SpaceX filings and other public sources of information.

"We know of three teleports, or gateways... one from regulatory filings in Poland, the second from photos in Turkey at a specific location, and the third from a construction company posting a photo in Lithuania," Puchol told SpaceNews. "The location of the latter is not accurately known, but has been placed on my tracker at the most probable location you would build one."

Puchol said the gateways in Poland, Turkey and Lithuania "can provide full service over all of Ukraine, with less simultaneous satellites covering the Eastern part of the country."

"[T]here could be additional gateways that we don't know of, as SpaceX doesn't make their locations public," Puchol said.

A Starlink user in Kyiv, he said, can expect their terminal to be serviced by one of five to

eight Starlink satellites at any given time."

Early Adopter

One of the first Starlink users in Ukraine, if not the first, is Oleg Kutkov, a Kyiv-based engineer with a master's degree in computer science from Kharkiv National Aerospace University.

Kutkov, a self-described hardware hacker, bought a Starlink terminal off eBay in December to tinker with in his home workshop. On Monday evening, Kyiv time, Kutkov got his Starlink connection up and running with a little tech support help via chat. "The initial registration address was in the U.S., and I couldn't change it to my Ukraine location," Kutkov said. "The SpaceX team helped me to solve this issue." Leaning the dish out his apartment window, Kutkov was able to get download speeds well over 100 Mbps, he said.

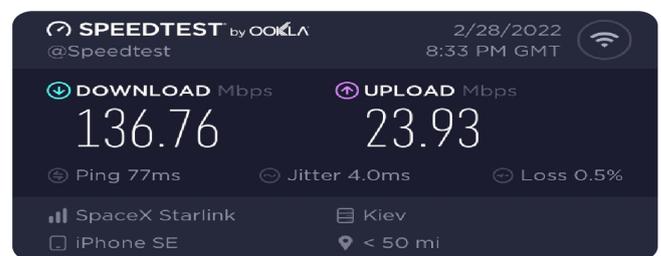


Oleg Kutkov
@olegkutkov

Success!
SpaceX Starlink is working in Kyiv, Ukraine!
The Dishy was placed just outside my window, even without adjustments.

Thanks, @SpaceX team, for your support :)

cc @FedorovMykhailo



2:13 am · 01 Mar 22 · Twitter Web App

4,801 Retweets 895 Quote Tweets 29.9K Likes

SpaceNews spoke with Kutkov on Tuesday via video teleconference. Since his apartment's fiber-optic internet connection is still working, he's taken his Starlink dish down for now.

Kutkov, who knows Puchol through their shared Starlink interests, told SpaceNews that Starlink satellite and teleport coverage appears to be adequate. “I believe that all of Ukraine territory should be covered. I also check satellite coverage,” he said. “Ukraine should be fine, at least northern Ukraine where there’s Kyiv and our major cities.”

Kutkov said he had not heard anything official about Ukraine’s plans for distributing the Starlink dishes or how many the country can expect to receive. “But I think they should distribute the terminals between military and government facilities. That would be most logical.”

Kutkov understands that any device that emits a strong enough radio-frequency or infrared signature can theoretically be used for military target identification. “I think it’s possible... I found transmission from the Dishy, its RF signal and the strength of the signals. Maybe it just transmits locally, but if [Russian military] used some sensitive receiver, maybe they could track the signal. Plus Dishy is hot, very hot, so there’s a lot of infrared radiation.”

For now, Kutkov said he is more concerned about the possibility of Kyiv’s power stations being taken out by airstrikes or artillery than Russia targeting anything with an RF or infrared signature.

Targeting combatants via Starlink uplink signals might be way down the list of near-term risks, However, Scott-Railton said Ukrainians should heed lessons from past conflicts.

“A well-resourced military tracks a massive variety of radio emissions during a war. Even if capabilities are not initially specced out for a novel new communications protocol, if the

transmission is interesting enough / the users worth killing, it will be worked on...”

To that end, he shared a link to a 2013 case study he wrote for the U.S. Naval War College.

Paul Hartman, Space Warfighting Division chief engineer at MITRE Air & Space Forces Center in Colorado Springs, Colorado, told SpaceNews that one way to keep Starlink terminals from becoming high-value targets is to send more. “The more Starlink terminals deployed to Ukraine, the harder it will be to take them all out.”

“Starlink uplinks can be used as target beacons, but it would be a game of attrition to knock them all out,” Hartman said. “In this case you are on the right side of the cost equation. It would cost the Russians much more to detect and knock out a Starlink terminal than it costs to produce and deploy them. The biggest issue is the collateral damage that could occur.”

NRO Warns Satellite Operators Of Possible Russian Attacks

Sandra Erwin | 23 February 2022

Source: *Space News* | <https://spacenews.com/nro-chief-warns-satellite-operators-to-secure-their-systems-as-ukraine-crisis-unfolds/>



National Reconnaissance Office Director Christopher Scolese speaks Feb. 23, 2022, at the National Security Space Association's Defense and Intelligence Space Conference.

Credit: NSSA

CHANTILLY, Va. — As the Ukraine crisis escalates, U.S. National Reconnaissance Office Director Christopher Scolese warned that Russia's military could target satellites to disrupt communications and GPS services.

"I think we're seeing pretty clearly that Russia is committed to doing what they want to do in Ukraine, and they want to win," Scolese said Feb. 23 at the National Security Space Association's Defense and Intelligence Space Conference.

"So I think it's fair to assume that, to the extent that they can, and to the extent that they feel it won't extend the conflict out of their control, that they will extend it into space," Scolese said.

The NRO operates U.S. government-owned spy satellites, but increasingly a lot of imagery and intelligence is collected and distributed by commercial satellite operators like Maxar, Planet, BlackSky, and others, so any attempt to disrupt the United States' ability to gather intelligence could impact private and public assets.

Scolese did not comment specifically on what actions the Russians might take, but he said it's easy to imagine based on past behavior. "They are already doing GPS jamming, as an example."

Scolese said both government and commercial satellites systems are potential targets. "I would tell everybody that the important thing is to go off and ensure that your systems are secure and that you're watching them very closely because we know that the Russians are effective cyber actors."

"And, again, it's hard to say how far their reach is going to go in order to achieve their objectives. But it's better to be prepared than surprised," he added.

For years, the U.S. military has worried that Russia and China will try to jam U.S. GPS and communications satellites during a conflict.

In addition to denying GPS through electronic jamming attacks, Russia could also target U.S. military GPS users with falsified PNT data, a technique known as spoofing. A GPS outage could wreak havoc across all military activities involving aircraft, ships, munitions, land vehicles and ground troops. "In an active military conflict, even brief denials and spoofing of PNT might make a difference if well-timed with other operations," said a RAND Corp. report.

Star Wars: The Outer Space Race To Kill Hypersonics

Gabriel Honrada | 31 January, 2022

Source: *Asis Times* | https://asiatimes.com/2022/01/star-wars-the-outer-space-race-to-kill-hypersonics/?mc_cid=222fd4cf73&mc_eid=00400db71d



The new Advanced Extremely High Frequency satellite will be used by the US Space Force. Photo: Lockheed Martin

The China, Russia and the United States are all revisiting space-based missile defense and anti-satellite weaponry concepts to counter rapidly developing and proliferating hypersonic missiles, a great power contest that promises to accelerate the militarization of outer space.

Space-based missile defenses add another layer to existing anti-missile defenses and would most likely focus on intercepting missiles during the early stages of their powered boost flight phase. This increases the chance of successful intercepts compared to mid-course and terminal intercepts where missiles could perform evasive maneuvers at hypersonic speeds.

Space-based defenses could target satellites that are critical links in hypersonic weapons' so-called kill chain, which are all the necessary things, people and processes involved in launching missiles and guiding them to their targets.

Armed satellites can also attack enemy satellites in several ways, including through physical attacks, directed energy or conventional weapons, electronic warfare, chemical sprays or

even direct collision.

This month, China's Shijian-21 satellite used a robotic arm to pull a dead Beidou satellite out of its normal geosynchronous orbit and into a distant graveyard orbit designated for satellites nearing the end of their operational lives.

In addition to Shijian-21, China's Tiangong Space Station, Beijing's answer to the International Space Station, features a robotic arm that has similar capabilities. As such, satellites equipped with robotic arms could also be designed to grab military satellites out of orbit, or even physically destroy them.

Military satellites can sport mounted weaponry to engage enemy satellites. The US has plans in 2023 to mount directed-energy weapons such as lasers and neutral particle beams on its military satellites.

While primarily intended for missile defense, these weapons can be used to destroy enemy satellites linked to an adversary's kill chain.

Military satellites can also be armed with conventional weaponry, with Russia successfully firing an autocannon mounted on its Salyut space station in 1975. Russia also had plans for a follow-on missile-armed Almaz space station but the concept was shelved in 1978.

Satellites themselves can be used as anti-satellite weapons via direct collision. Civilian satellites can be weaponized for this mode of attack, as they can be controlled by their operating country to crash into its adversary's satellites.

This also has the potential to turn outer space into a grey zone or hybrid warfare domain, wherein the distinction between state, non-state and civilian entities is blurred, alongside the employment of conventional and irregular

warfare. It also adds an element of plausible deniability to such operations.

In a possible demonstration of the privatization of grey zone warfare in space, last year the US may have intentionally staged a near-collision between one of its Starlink SpaceX satellites and China's Tiangong Space Station. While China mounted a formal diplomatic protest, the US did not respond.

Russia made similar maneuvers in 2014 when its Luch satellite came dangerously close to a US Intelsat satellite, which raised suspicions that Russia might be stealing data from the US satellite and rang alarms about collision risks.

Moreover, the development of 6G next-generation technology for military applications and hypersonic weapons has significantly increased the value of military satellites, which in turn makes them even more inviting targets.

In this direction, China has reportedly developed 6G technology that solves the communication blackout problem at hypersonic speeds. Hypersonic weapons face difficulties maintaining communication due to the hot, ionized gas that appears on their surface, which blocks electromagnetic waves during hypersonic flight.

Chinese scientists have reportedly developed a 6G laser device that generates a continuous beam of electromagnetic waves in the terahertz band, a frequency range that is also used for 6G technology. Ground tests have reportedly shown that the device can penetrate the plasma layer surrounding hypersonic weapons.

Such technology could be integrated in military satellites to provide reliable communications and relay targeting data to hypersonic weapons. Last

year, China launched the world's first 6G satellite with terahertz technology, while SpaceX has announced plans to upgrade its Starlink satellites with laser connectivity.

Both concepts may soon be adapted for military applications, especially for hypersonic weapons.

Dozens Of SpaceX Internet Satellites Lost To Geomagnetic Storm

09 February 2022

Source: Space Daily | https://www.spacedaily.com/reports/Dozens_of_SpaceX_internet_satellites_lost_to_geomagnetic_storm_999.html



Up to 40 SpaceX high-speed internet satellites have been knocked out of orbit by a geomagnetic storm shortly after launch, but pose little threat to Earth as they burn up in the atmosphere, the company said.

Geomagnetic storms are caused by ejections of the solar corona into space, resulting in disturbances to the Earth's upper atmosphere and increased drag on objects in low orbits.

The latest 49 satellites from the Starlink network launched from the Kennedy Space Center in Florida on February 3 and successfully assumed their initial orbit, with their nearest approach to the surface 130 miles (210 kilometers) high.

The company places them into this region to

carry out final checks before flying further into space.

On February 4, however, they were struck by the space weather event, Elon Musk's company said in a statement late Tuesday.

"These storms cause the atmosphere to warm and atmospheric density at our low deployment altitudes to increase. In fact, onboard GPS suggests the escalation speed and severity of the storm caused atmospheric drag to increase up to 50 percent higher than during previous launches," it said.

The Starlink team commanded the satellites into a safe mode, where they would fly edge-on -- like a sheet of paper -- to minimize drag as they sought shelter.

But despite the evasive maneuver, most were unable to raise their orbits, and as many as 40 "will reenter or already have reentered the Earth's atmosphere."

The company insisted they posed "zero collision risk" with other satellites and are designed to disintegrate upon re-entry, with no debris expected to hit the ground.

The UK Space Agency agreed in a blog post that there was "virtually no risk" since the satellites are built without any dense metallic components and should burn up entirely, but said it was monitoring closely. NASA has not yet commented.

Apart from increasing atmospheric drag, geomagnetic storms can wreak havoc with satellites' computer circuitry and thus cause them to fail, according to space industry analyst Seradata.

Whatever the exact cause, the loss could point

to a design weakness in Starlink satellites' ability to withstand such storms, Seradata's David Todd wrote in a post.

But it is not expected to impact the overall functioning of the Starlink "constellation."

SpaceX has launched more than 2,000 of the satellites since May 2019, with more than 1,500 currently operational, providing internet coverage across most of the planet.

The company currently has regulatory approval for 12,000 satellites, with plans to expand even further.

Astronomers have raised concerns about their impact on ground-based astronomy as they add to a congested environment in Low Earth Orbit (LEO).

There are approximately 4,000 active satellites in this space, which extends to 1,200 miles above the surface, as well as 15,000 pieces of debris like rocket bodies and defunct probes, according to the UK Space Agency.

China To Help Pakistan Build Space Centre, Satellites

Sutirtho Patranobis | 28 January, 2022

Source: *Hindustan Times* | <https://www.hindustantimes.com/world-news/china-to-help-pakistan-build-space-centre-satellites-101643376783649.html>



Chinese astronaut Zhai Zhigang stepping outside China's Tiangong space station in orbit around Earth on November 7, 2021. China will prioritise constructing a space centre and develop communication satellites for ally Pakistan over the next five years (AFP)

China will prioritise constructing a space centre and develop communication satellites for ally Pakistan over the next five years, according to a white paper on space published by the Chinese government on Friday.

While China and Pakistan have an agreement on space exploration, it's the first time that China has formally announced that it would help Islamabad to build a space centre, the Pakistan Space Centre, which is likely to build satellites.

While China and Pakistan have an agreement on space exploration, it's the first time that China has formally announced that it would help Islamabad to build a space centre, the Pakistan Space Centre, which is likely to build satellites.

The strategic allies have close economic and military ties with China recently supplying Pakistan with new warships.

The policy paper outlined China's plans in space for the period 2021-25, which included strengthening its governance and protecting "its space activities, assets and other interests" and to study plans to build "a near-earth object defence

system, and increase the capacity of near-earth object monitoring".

The white paper, titled "China's Space Program: A 2021 Perspective", was released by China's State Council Information Office.

Under "international cooperation", the paper highlighted its plans to help Pakistan in developing its space programme. "It (China) will give priority to developing communications satellites for Pakistan and to cooperating on the construction of the Pakistan Space Centre and Egypt's Space City," the policy paper said.

It did not share further details involving the space centre.

Pakistan announced in 2018 that it had plans to establish the Pakistan Space Centre (PSC) to lead the domestic development and manufacturing of satellites, according to a report by the state-owned Associated Press of Pakistan.

The PSC will have capability to carry out manufacturing, testing, system level assembly, integration, launch and operations of various types of satellites, the APP report was quoted as saying.

The Chinese policy paper mentioned that China has completed "in-orbit delivery of the Pakistan Remote-Sensing Satellite (PRSS-1)" besides delivering satellites for Venezuela, Sudan and Algeria in the last five years.

The PRSS 1 spacecraft was built in China by DFH Satellite Company, a subsidiary of the China Academy of Space Technology, for Pakistan's national space agency, SUPARCO or Space & Upper Atmosphere Research Commission.

The white paper added that China is also conducting satellite navigation cooperation with countries such as Pakistan, Saudi Arabia, Argentina, South Africa, Algeria, and Thailand.

In 2019, China and Pakistan had signed an agreement on space exploration during the visit of Pakistan Prime Minister Imran Khan to China for the 2nd Belt and Road Forum (BRF).

Available reports on the Space City in Egypt say it is for making satellites and space research.

As part of China's ambitious space programme, its under-construction space station, Tianhe, is expected to become operational in 2022.

Since 2003, China has launched six crewed missions and sent 11 astronauts into space.

In recent months, China has returned rock and soil samples to earth from the surface of the moon and landed a six-wheeled robot on Mars; it also landed a craft on the far side of the moon in 2019.

Once built, China's space station will be the only alternative to the two-decade-old, US-led International Space Station (ISS), which may be retired in 2024, Reuters had said in an earlier report.

The ISS - from which China is excluded - comprises Canada, Japan, the Russian Federation, the US, and 11 member states of the European Space Agency.

Global Aerospace Industry

S-400 Missile System Supply To India Will Not Be Impacted Due To Western Sanctions, Russia Says

03 March 2022

Source: *The Print* | <https://theprint.in/diplomacy/western-sanctions-wont-impact-s-400-missile-system-supply-to-india-russia-says/855891/>



File image of Russia's S-400 Triumph multi-layered air defence system | Photo: Sneesh Alex Philip | *ThePrint*

New Delhi: Russia on Wednesday said there will be no impact of the Western sanctions against it on the supply of S-400 missile systems to India.

At a media briefing, Russian Ambassador-designate Denis Alipov also referred to a bilateral mechanism to do business in national currencies.

“As regards the S-400 deal, be rest assured that it will not be impacted in any way. It is a 100 per cent surety.... As regards the overall trade and economic cooperation, we will see what will be the ultimate impact of those severe restrictions that are being imposed,” he said.

The Western countries have imposed severe sanctions on Russia in the last few days following its military invasion of Ukraine.

In October 2018, India had signed a USD 5 billion deal with Russia to buy five units of the S-400 air defence missile systems, despite a warning from the Trump administration that going ahead with the contract may invite US sanctions.

Russia has already started the supply of the missile systems.

To a question on the impact of the sanctions on bilateral trade, Alipov said it will largely depend on the readiness of the “Indian partners” to continue with the engagement.

“We have bilateral mechanisms and means of doing business in national currencies. Much will depend on the readiness of the Indian partners to continue the business because some of them are over-cautious as regards their exposure to the US and European markets,” he said.

Replying to a question on whether the Western sanctions and the conflict in Ukraine will impact the overall delivery of key defence equipment to India, Alipov said there are mechanisms in place to offset the impact of the restrictions.

“Russia has always risen from the ashes. It will rise again. Do not have any doubt about that. We have taken steps to secure ourselves,” he said.

“Our economy is stable and I believe we will withstand the pressure that we are experiencing and will experience in the future,” the Russian ambassador-designate added.

“As regards the bilateral trade in defence, we have the mechanism of cooperation and transactions independent of western mechanisms,” he said.

Russian Sanctions Throw South Korean Satellite Missions Into Uncertainty

Park Si-soo | 02 March 2022

Source: Space News | <https://spacenews.com/russian-sanctions-throw-south-korean-satellite-missions-into-uncertainty/>



South Korea's CAS500-2 remote sensing satellite is seen at the Korea Aerospace Research Institute's manufacturing facility. It's set to launch in the first half of this year on a Soyuz rocket from Baikonur Cosmodrome. But the launch is expected to be delayed due to sanctions on Russia. Credit: Korea Aerospace Research Institute

SEOUL, South Korea — South Korea, at least for now, is pushing forward with its planned launch of two satellites on Russian rockets this year. Still, it doesn't rule out the possibility that the missions could be delayed due to sanctions imposed on Russia for invading Ukraine.

South Korea's CAS500-2 remote sensing satellite is set to launch in the first half of this year on a Russian Soyuz rocket from Russia's Baikonur Cosmodrome in Kazakhstan. South Korea's KOMPSAT-6 multipurpose satellite, equipped with synthetic aperture radar (SAR), is due to launch in the second half of the year on a Russian Angara rocket from Plesetsk Cosmodrome in northern Russia. “For now, nothing has changed to the plan,” Korea Aerospace Research Institute spokesman Roh Hyung-il told SpaceNews. “We are taking a close look at how the situation unfolds because it could have a significant impact on our missions.” He admitted that it's “very likely” that the satellites won't be launched as planned.

The KARI spokesman said he “wishes

everything would be settled peacefully as soon as possible so that the missions would proceed as originally planned.” But if South Korea is put in a situation where it won’t be able to use Russian vehicles, he added, launching the satellites this year will be “impossible.”

If the international sanctions hitting Russia remain in place long-term, the restrictions would deal a “substantial blow” to South Korea’s space programs, Roh said. In collaboration with the private sector, South Korea’s government plans to develop and launch over 100 small satellites by 2031 to establish a national security monitoring system and test next-generation network communications. They include 40 SAR satellites that the defense ministry will develop for national security and 14 communications satellites that the science ministry will build to explore 6G technology.

“Some of them will go into space on homemade rockets and some on foreign vehicles,” he said. “If Russia is excluded from options available... it’s a big problem.”

Meanwhile, South Korea no longer depends on Russia when it comes to launch vehicle development. Russia played a key role in developing South Korea’s KSLV-1 rocket, which flew three times between August 2009 and January 2013 from Naro Space Center here. The rocket’s first stage was powered by an RD-151 engine developed by Russia’s NPO Energomash. Based on lessons from KSLV-1 development, South Korea set off in 2010 to develop a fully homemade satellite launcher, KSLV-2, which came to fruition in October last year. While the KSLV-2 reached space, it failed to put its dummy payload into orbit. A second KSLV-2 launch attempt is slated for June 15.

Rogozin Puts Poison-Pill Conditions On Oneweb Soyuz Launch

Jason Rainbow and Jeff Foust | 02 March 2022

Source: [Space News](https://spacenews.com/rogozin-puts-poison-pill-conditions-on-oneweb-soyuz-launch/) | <https://spacenews.com/rogozin-puts-poison-pill-conditions-on-oneweb-soyuz-launch/>



Russia issued an ultimatum on a March 4 launch for OneWeb after the Soyuz was rolled out to the launchpad.

Credit: Roscosmos

TAMPA, Fla. — This week’s Soyuz launch of a set of OneWeb satellites has been thrown into doubt after Russia made new demands on the company.

In tweets Wednesday, just after the Soyuz rocket carrying 36 satellites rolled out to the pad at the Russian-controlled Baikonur Cosmodrome in Kazakhstan, Roscosmos Director General Dmitry Rogozin said the launch would proceed only if the U.K.-based company met new conditions.

These include a guarantee its satellites would not be used for military purposes and that the British government divest its stake in the company — demands OneWeb is unlikely to accede to.

The Soyuz-2.1b rocket will be removed from the pad unless OneWeb guarantees by 1:30 p.m. Eastern Standard Time March 4 its satellites will not be used for military purposes, the Russian space agency tweeted March 2.

“There’s no negotiation on OneWeb: the UK Government is not selling its share,” U.K. Business Secretary Kwasi Kwarteng tweeted just

hours later.



“We are in touch with other shareholders to discuss next steps...”

OneWeb and the British government were already feeling pressure from members of parliament to call off the launch in order not to support Russian ventures.

Darren Jones, chair of the Business, Energy and Industrial Strategy Committee in Parliament, questioned the appropriateness of the upcoming mission in a March 1 letter to other government officials.

Jones has previously criticized the British government’s decision to invest \$500 million in OneWeb to help save the company from bankruptcy in 2020.

Indian conglomerate Bharti Global owns about a third of OneWeb and is its largest shareholder.

France-headquartered Arianespace has so far launched 428 of OneWeb’s planned 648-strong constellation, enabling the company to provide connectivity above 50 degrees North.

OneWeb had aimed to deploy the rest of the satellites before the end of August to expand its reach into more parts of Europe, Africa, Asia and other regions to provide global services.

Arianespace has performed 13 Soyuz missions for OneWeb to date across launch sites in Kazakhstan, Russia and French Guiana, where Arianespace launched OneWeb’s last batch of satellites Feb. 10.

Responding to European sanctions for Russia’s invasion of Ukraine, Russia’s space agency said Feb. 26 it is halting cooperation with Europe on Soyuz launches from French Guiana.

Neither OneWeb nor Arianespace have commented in recent days on the company’s latest launch.

Sanctions Could Hit Deliveries Of S-400, AK 203 And 11356 Frigates From Russia

15 February 2022

Source: IMR | https://imrmedia.in/sanctions-could-hit-deliveries-of-s-400-ak-203-and-11356-frigates-from-russia/?utm_medium=email&utm_source=getresponse&utm_content=Indian%20Military%20Review%20Newsletter%2028%20Feb%202022&utm_campaign=



Advanced Talwar-class frigates under construction at Kaliningrad shipyard in Russia

The conflict in Ukraine has cast a shadow on delivery of critical military systems in the pipeline from Russia, with the West looking at additional economic sanctions that can impact weapons trade. Besides spares and supplies for existing equipment, adverse sanctions could impact delivery of at least three systems, including the S-400 air defence system and Talwar class frigates. These are in advanced stages of delivery, with payments being made through European banking channels.

The trickiest, officials say, is the \$950-million contract for delivery of four advanced Talwar class frigates for the Indian Navy that was inked in 2018. The warships are designed to operate with a Ukrainian power plant, with no alternative option available.

India had to pull through a diplomatic coup of sorts in 2019 when it managed to convince Ukraine to supply engines for the first two ships

that are being made in Russia, despite the Crimea crisis. These Zorya Mashproekt RPC gas turbine engines have been delivered to the Kaliningrad shipyard and are being integrated on the warships.

Deals Under Threat

- Project 11356: \$950-m deal to supply four frigates to the Indian Navy
- Two being built in Russia. Gas turbine engines are Ukrainian
- S-400: Delivery of first regiment has taken place
- Prolonged crisis could impact future deliveries
- JV with Russia: Brahmos-Russian venture recently bagged export order from the Philippines JV for production of AK

Closure Of Any Project Unlikely

However, two additional ships are to be made at the Goa Shipyard with Russian assistance and power plants for them are yet to be delivered. There are concerns that uncertainty of supplies from Ukraine could adversely impact the project.

India has also received the first regiment of the S-400 air defence system from Russia but the delivery of four more is still hanging in the balance. There are no indications yet of any delay from the Russian side on the deliveries but a prolonged crisis in Ukraine is being seen as a matter of concern. In addition, US sanctions on India for the purchase under its CAATSA (Countering America's Adversaries Through Sanctions Act) regime is now a distinct possibility. Till now, India had avoided the sanctions that have been imposed on Turkey and China in the past.

The sanctions will not lead to the closure of any projects as India is determined to go ahead with its Russian partnership but they cause delays

in payments and procedural difficulties that take time to resolve. India and Russia have managed to evolve a process of payments for military systems that bypasses all US influenced banking controls. A significant part of these payments are being made through the Rupee-Rouble route.

Other Indian projects that can come under the scanner are the two joint ventures with Russia to manufacture missiles and assault rifles. The Brahmos project is jointly owned by the two nations and has recently won an export order to the Philippines, with more on the horizon. The other joint venture to produce Kalashnikov AK 203 assault rifles in India is yet to fully take off as production has not yet commenced in Amethi, where the factory has to be set up.

With Spain On Board, Final Contracts Imminent For Eurodrone Program

Vivienne Machi | 27 January 2022

Source: The Hindu | <https://www.thehindu.com/news/national/in-the-first-brahmos-missile-export-order-philippines-approves-374-mn-contract/article38272238.ece>



Companies are building the "Eurodrone," pictured here as a mockup at the 2018 Berlin Air Show, so it can operate immediately in the dense European airspace. Spain signed off on the effort in January 2022, paving the way for an industry contract. (Sebastian Sprenger/Staff)

STUTTGART, Germany – The Spanish government officially signed off on the Eurodrone program this week, giving the fourth and final government approval needed for Europe's preeminent unmanned aerial system to progress.

Madrid's council of ministers gave the UAS program the green light on Tuesday, Airbus Defence and Space CEO Michael Schoellhorn shared on Twitter that day.

Now that Spain, Germany, France, and Italy have all declared budgetary approval for Eurodrone, the program is entering its contractual phase, an Airbus spokesperson told Defense News on Thursday.

The four nations, their industry partners in the program, and the European intergovernmental Organization for Joint Armament Cooperation (OCCAR) will now get together to finalize the global contract, the spokesperson said.

France, Germany, and Italy had previously announced their budgetary approval, and this final nod from Spain “paves the way for contract signature on this key collaborative programme, which strengthens Europe’s strategic autonomy & sovereignty,” Schoellhorn wrote.

Airbus’ head of military aircraft Jean-Brice Dumont also weighed in on the decision, writing on Twitter: “Eurodrone will see the development and consolidation of key operational technologies and new digital-based design and manufacturing that will define the aerospace of the future. This is strategic autonomy at the service of our society.”

Airbus will announce the Eurodrone engine provider once this global contract is signed and completed, the spokesperson added. Two vendors are vying for the opportunity to supply at least 120 engines under the initial contract, which includes 60 dual-engine aircraft.

OCCAR is managing the Eurodrone program on behalf of the four European partners. Airbus is representing both Germany and Spain – although the company’s Munich-based headquarters is officially the prime contractor – while France’s Dassault Aviation and Italy’s Leonardo are also involved. Airbus previously revealed that final assembly of the aircraft will occur in Manching, Germany.

Airbus’ chief Eurodrone engineer Daniela Lohwasser said in November that a formal contract signing might take a couple of months to be finalized, once Spain gave the go-ahead.

Stakeholders expect more nations to sign onto the Eurodrone program once the formal contract is signed. The four current partners have ordered 20 systems, each comprising two ground stations and three aircraft. Germany has opted for seven systems, while Italy has committed to five, and

Spain and France will each buy four systems.

First flight for the medium-altitude, long-endurance (MALE) drone is currently targeted for 2025, with deliveries slated to begin in 2028.

The initial production contract is expected to cost around 7.1 billion euro (U.S. \$7.95 billion). In 2021, the program received a 100 million euro (U.S. \$118 million) grant from the European Union.

Indian Aerospace Industry

DRDO's Young Scientists To Develop New Cargo Drones For Himalayan Frontier

22 February 2022

Source: IMR | https://imrmedia.in/drdo-s-young-scientists-to-develop-new-cargo-drones-for-himalayan-frontier/?utm_medium=email&utm_source=getresponse&utm_content=Indian%20Military%20Review%20Newsletter%2028%20Feb%202022&utm_campaign=



Load-carrying octocopter drone

BENGALURU: Defence. Young scientists at the Defence Research and Development Organisation (DRDO) have been tasked to design and develop a new class of load-carrying unmanned aerial vehicle (UAV) that is capable of operating from high-altitude bases for undertaking logistic operations along the Himalayan frontier.

The 'high-altitude operating, vertical take-off and landing drone', driven by eight propellers, will have the ability to be launched from altitudes of up to 15,000 feet and the capacity to airlift up to 50 kg of cargo over a distance of 10 km.

The project is being undertaken by the DRDO Young Scientist Laboratories (DYSL), a recently formed group of five specialised research establishments where all scientists, including the directors, are required to be below 35 years of age.

Located at Bengaluru, Chennai, Hyderabad,

Kolkata and Mumbai, their core focus areas are artificial intelligence, cognitive technologies, smart materials, asymmetric technologies and quantum technologies, respectively.

In a request for proposal issued earlier this month seeking development partners, DYSL has defined its requirement for an octocopter (eight-engined UAV) with a carbon-composite airframe having a gross all-up weight, including payload, of less than 80 kg.

The octocopter is required to have a payload capability of 50 kg at mean sea level and above 20 kg at extreme altitude, and be able to operate at temperatures up to minus 20 degrees Celsius.

Artificial intelligence-based target tracking and accurate launching and landing, geo fence for operating within a defined geographical area, fully autonomous and semi-autonomous flight modes, GPS, real-time video telemeter and a failsafe system that enables the UAV to return to base in case of loss of radio link, low battery, etc, are other required features for the flying machine.

Cargo drones are being looked at as being force multipliers, according to DRDO scientists. Besides enabling faster and continuous supply to troops deployed at high-altitude areas and difficult-to-reach locations, they can be used for reconnaissance and mapping. In times ahead, they can also be modified for combat operations.

Urgent supplies of essential items such as rations, water, fuel, ammunition and medicines to forward posts in remote areas at present depends on helicopters, which is a costly affair, or ferried by porters and mules, which is time-consuming.

The use of UAVs for logistics in the mountains came into focus when the stand-off between India and China began along the Line of Actual Control

in 2020, with propaganda videos showing Chinese troops on the frontline being delivered freshly prepared hot food from base camps.

Last year, a Noida-based Indian firm had demonstrated a cargo hexacopter (six-engined), christened MR-20, for logistic operations in high-altitude areas. The Army is reportedly procuring 48 of these drones that can carry a load of up to 20 kg.

The defence forces have been using various types of imported and indigenous drones, both fixed wing as well as rotary wing, for surveillance and recce. Several projects are already under way in the country to develop new drones of different categories to meet various requirements, including armed UAVs for combat.

Plan To Buy Predator Drones Put On Hold

23 February 2022

Source: IMR | https://imrmedia.in/plan-to-buy-predator-drones-put-on-hold/?utm_medium=email&utm_source=getresponse&utm_content=Indian%20Military%20Review%20Newsletter%2028%20Feb%202022&utm_campaign=



Predator armed drone

India has put its plan to acquire 30 Predator armed drones from the US on the back burner, on account of its focus on indigenous development and manufacturing, as well as the prohibitive cost involved. HT learns that the Pentagon has been informed of the decision.

Although the Narendra Modi government on February 9 banned the import of drones, acquisition of unmanned aerial vehicles for defence and security purposes are exempt, but still require special and specific clearances. “As of now, the Predator deal is off,” said a top South Block official who asked not to be named.

Spearheaded by the Indian Navy, India was planning to acquire 30 Predator armed drones for use across services (10 each for the navy, air force and army) at the cost of at least \$3 billion from US-based General Atomics. The Indian Navy already has taken two surveillance Predators on lease from the US company and uses them for conducting reconnaissance of India’s maritime and land borders with China and Pakistan.

The decision to put the acquisition on hold was taken as India already has some capability in armed drones; it is currently upgrading the Israeli Heron drones. The Predator platform with armed payload, as in missiles and laser-guided bombs, costs nearly \$100 million apiece, but the platform has an endurance of nearly 27 hours.

The Indian Navy uses it for maritime domain awareness from Gulf of Aden to Sunda Straits in Indonesia.

While the Indian Defence Research and Development Organization (DRDO) is expected to unveil its medium altitude long endurance (MALE) drone latest by March, the country's national security planners are looking at futuristic high altitude pseudo satellite (HAPS) technology for surveillance and targeting capability.

India has already demonstrated its capacity and capability for the manufacture of swarm drones, as was showcased in the Beating Retreat ceremony this year.

Besides DRDO, private Indian companies are also involved in the development of drones that are cheaper to operate compared to the Predator and pack similar lethality.

While the Indian Navy and Army have significant use for the drones for domain awareness, the Indian Air Force was sceptical of Predators due to congested air space, and the presence of surface to air missiles and radars in Pakistan occupied Kashmir. The Air Force is in favour of purchasing more fighter aircraft.

Taiwan Researchers Join ISRO In Satellite Launch Mission For First Time

15 February 2022

Source: *Sino Daily* | https://www.sinodaily.com/reports/Taiwan_researchers_join_ISRO_in_satellite_launch_mission_for_first_time_999.html



File image of a PSLV launch.

The launch of the Earth Observation Satellite (EOS-04), scheduled for September 2021, was delayed due to the pandemic as engineers and scientists were working remotely. However, to make up for the delay, the Indian space agency has planned 19 missions, including a Moon landing, in 2022.

The Indian Space Research Organisation (ISRO) on Monday launched a satellite, INSPIRESat-1, jointly developed by a team of international researchers, including from Taiwan, using a PSLV-52 carrier rocket. This is the first time ISRO launched a satellite developed by a team of international researchers.

INSPIRESat-1, which stands for International Research and Teaching Satellite Project Satellite One, was developed by scientists from universities of the US, Taiwan, India, and Singapore.

The PSLV-C52 rocket also carries Earth Observation Satellite (EOS-04), student satellite INSPIRESat, and a spacecraft dubbed INSAT-2DT, the precursor of a joint India-Bhutan mission in the future.

The universities that took part in the launch are the University of Colorado's Laboratory for Atmospheric and Space Physics (LASP), the Indian Institute of Space Science and Technology (IIST), Taiwan's National Central University (NCU), and Singapore's Nanyang Technological University.

"Polar Satellite Launch Vehicle PSLV-C52 placed two small satellites, a student satellite (INSPIRESat-1) from Indian Institute of Space Science and Technology (IIST) in association with Laboratory of Atmospheric and Space Physics at the University of Colorado, Boulder and a technology demonstrator satellite (INS-2TD) from ISRO, which is a precursor to India-Bhutan Joint Satellite (INS-2B)", the space agency said in a statement.

The satellite will provide information on the Sun's corona and its impact on Earth's ionosphere.

Prime Minister Narendra Modi and Vice President M. Venkaiah Naidu congratulated the ISRO scientists on the successful launch.

ISRO Chairman S. Somanath also congratulated the ISRO team for the precision with which the mission was accomplished.

India's first launch in 6 months set to place radar imaging, baby satellites in orbit

Last year, the Indian Space Research Organisation (ISRO) managed only two launches, including the catastrophic failure of the ambitious Geo-Stationary Launch Vehicle, which failed to place a satellite in the desired orbit due

to a technical snag in the third cryogenic stage. ISRO has planned 19 missions, including a lunar mission, in 2022.

The countdown for the ISRO's first of 19 planned missions of 2022, PSLV-C52, with the imaging satellite EOS-04 onboard, has begun on Sunday.

The space agency said that the PSLV rocket would send a new earth observation satellite and two other baby satellites into space on Monday.

"The countdown process of 25 hours and 30 minutes leading to the launch commenced at 04:29 hours today, 13 February 2022," the statement read.

The 1,710 kg radar imaging satellite EOS-04 is designed to send high-quality images under all weather conditions from a sun-synchronous polar orbit of 529 km.

Designed by students from India, the US, Taiwan, and Singapore, a co-passenger, the small satellite INSPIRESat-1, will study the dynamics of the upper atmosphere.

The EOS-04 launch was scheduled for last September, but it was delayed as the coronavirus pandemic forced engineers and scientists to work remotely.

In 2020, the workflows of the space exploration agency had also been severely impacted due to the pandemic as the Bengaluru-headquartered, wholly state-owned agency completed only three launches: in January, November, and December.

A recent rescheduled plan shows 19 launches in 2022, including a moon landing mission in August, just over three years after its predecessor blasted off.

India Is Now Home To More Than 100 Space Startups

Shouvik Das | 31 January 2022

Source: *Tech Circle* | <https://www.techcircle.in/2022/01/31/india-is-now-home-to-more-than-100-space-startups>



Photo Credit: ISRO

The number of startups in the rapidly-growing Indian space sector has more than doubled over the past year, shows data from the Economic Survey 2022.

The total number of space startups in the country has crossed 100 with 47 space technology startups being established in the country in 2021, up from 21 in 2020. In 2019, there were only 11 new startups added in the space sector.

New policies from the Indian government in the space sector coupled with participation from the private sector have been the key factors behind the growth of space startups in the country, according to the Economic Survey 2022. “With these recently undertaken policy initiatives and private sector participations, the Indian space sector is expected to capture a larger share of the global space economy, which was close to \$447 billion in 2020. At present, India accounts for only about 2 per cent of the space economy, much behind the major players—the US and China,” the survey said.

The Survey acknowledged, though, that India still ranks far behind mature space economies

such as the US and China. It stated that as of now, India only accounts for 2 percent of the global space economy, which can grow steadily in the coming years as investments from private Indian corporations as well as foreign bodies come in.

In an interview on January 17, Lt Gen (Retd) Anil Kumar Bhatt, director general of the Indian Space Association (ISpA), an industry body, told Mint that through 2022 the Indian government is expected to introduce and expand three policies as part of its Space Activity Bill — Space Communication, Remote Sensing and Transfer of Technology.

Each of these policies were first introduced in 2020 and are directed at helping private companies offer communication services, satellite-based data and analytics services, and use resources owned or governed by the Indian government to build their own products and services, respectively.

The Bill, according to Bhatt, is also likely to lay down conditions for foreign direct investments (FDI) in the Indian space sector, which could help Indian startups attract foreign investments. Startups and experts in the space sector have often said that lack of funding is affecting their ability to match global competitors.

That said, this is expected to be a big year for Indian space startups. Private entities Skyroot Aerospace and Agnikul Cosmos are both slated to launch their first, indigenously developed rockets later this year. While Skyroot plans to host only one launch later this year of its Vikram-I rocket, Agnikul Cosmos is targeting at least two launches of its rocket— Agnibaan — by the end of this year.

“The numbers showcasing the growth in space startups is promising from an investor standpoint, and lays the groundwork for larger investments to finally come in this year. VCs in India will also follow this space closely, and may invest accordingly. A number of these startups are also at very early stages and offer repetitive services, so some of them will fail. Investors will look more carefully at India’s space startups and invest in businesses that are already maturing beyond the initial funding stages. The space communications and remote sensing categories are most likely to attract the highest investments,” said Chaitanya Giri, consultant, Research and Information System for Developing Countries (RIS).

Other startups in the space technology domain are also expected to make moves through 2022. Pixxel, a space satellite imaging and data analytics startup, may launch the first three of its 36 imaging satellites this year. Bengaluru-based Bellatrix Aerospace, on the other hand, is expected to launch its hall-effect thruster for small satellites aboard a European space mission in mid-2022.

Technology Development

Key Landing Test Will Push Reusable Vehicle RLV-TD Closer To Orbital Re-Entry Mission

Chethan Kumar | 15 February 2022

Source: *Times of India* | http://timesofindia.indiatimes.com/articleshow/89596282.cms?utm_source=contentofinterest&utm_medium=text&utm_campaign=cppst



ISRO's reusable launch vehicle-technology demonstrator

BENGALURU: Isro, which has been making quiet progress on the reusable launch vehicle-technology demonstrator (RLV-TD) is looking to carry out a key landing Experiment — RLV-LEX — in the next few months that will push it closer to an orbital re-entry experiment (ORE). The planned landing experiment will be carried out in Challakere in Chitradurga district, some 220km from Bengaluru.

Isro chairman S Somanath, while confirming that the agency has planned the RLV-LEX this year, said: “...We will be demonstrating one of the critical technologies — the approach and autonomous landing on a runway. This will happen in Challakere. We are preparing for the test and systems are being readied. We will soon make an announcement.”

In the LEX, the vehicle will be carried using a helicopter to an altitude of about 3km to 5 km and released at a distance of approximately 4km to 5km ahead of the runway with a horizontal

velocity. As per Isro, after the release, the RLV glides, navigates towards the runway and carries out a conventional autonomous landing with a landing gear.

S Unnikrishnan Nair, director, Vikram Sarabhai Space Centre (VSSC), said: “We are planning for the test in the next three to four months, the hardware is nearly ready. The RLV will be released from the helicopter under controlled conditions. It will have various control systems, including its own navigation and guidance control systems and aerodynamics sensors etc. This experiment will simulate the last 800m to 1km of the actual orbital mission.”

Pointing out how landing is among the most complex activities in any mission, Nair said the RLV-LEX would take the technology demonstration one step closer to the planned ORE.

“Once we successfully complete this mission and we have validated the software, landing gear and get data on how the aerodynamics sensors worked to manoeuvre the aircraft and bring it back to the intended spot on the runway and other critical technologies, we will be ready for the orbital re-entry experiment. For this the RLV will be scaled up,” Nair said.

As per Isro, in ORE, a wing body called Orbital Re-entry vehicle (ORV) will be taken to an orbit by an ascent vehicle derived from the existing GSLV and PSLV stages and stay in orbit for a stipulated period, re-enter and land in a runway autonomously with a landing gear.

“Before the RLV-LEX we’d done the RLV-TD HEX-01 (hypersonic experiment) mission in which we successfully validated autonomous navigation, guidance & control, reusable

thermal protection system and re-entry mission management. Once LEX is done, we’ll need to integrate both for the ORE,” Nair said.

Carried out on May 23, 2016, the RLV-TD HEX was a 770-second suborbital flight and designed to land on sea. The experimental mission saw the HS9 solid rocket booster carrying RLV-TD to a height of about 65km from where the vehicle began its descent followed by atmospheric re-entry at around Mach 5 (five times the speed of sound).

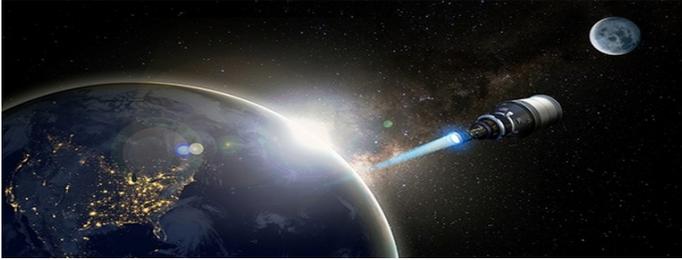
Isro, which has been working on this technology for more than a decade, decided to develop it primarily to address the cost and time issues. “The cost of access to space is the major deterrent in space exploration and space utilisation. A reusable launch vehicle is the unanimous solution to achieve low cost, reliable and on-demand space access,” Isro has said.

However, mastering this technology will provide multiple other benefits, including in development of different types of launch vehicles, space transportation and so on. While the ORE will be a major milestone, the RLV-TD is only a technology demonstrator and the development of an actual re-usable launch vehicle will take more time.

Nuclear Thermal Propulsion Is Key To Keeping Peace In Space

Alex Gilbert | 14 February 2022

Source: *The Space Review* | <https://www.thespacereview.com/article/4331/1>



DARPA is pursuing a nuclear thermal propulsion project called DRACO that could be ready for tests in cislunar space as soon as 2025. (credit: DARPA)

In mid-January, the Mitchell Institute released a landmark report on the “strategic mandate for nuclear propulsion” of US satellites and space-based assets to evade the growing threat from Russia and China’s anti-satellite weapons. The report’s analysis and conclusions are sound and timely, but nuclear thermal propulsion (NTP) has broader applicability in space, including commercial and “soft power” uses. The US should pursue a concerted, sustained whole-of-government approach to it. Beyond achieving a first-mover advantage, this will allow the US to develop norms and solidify rules of the road espoused by the UN last fall, rules aimed at preventing war in the heavens.

Nuclear Is Not New

As DARPA’s Michael Leahy said last month, the first challenge is to “get folks comfortable with this” by reminding them we’ve gone here before.

At the dawn of the space age, the US and Soviet Union employed nuclear energy

technologies as essential tools for exploration: radioisotope power sources used atomic decay to provide heat and electricity to spacecraft in Earth orbit and beyond. The major lunar exploration missions of both countries, Apollo and Lunokhod, relied on such radioisotopes for their scientific payloads. Both countries also tested nuclear thermal propulsion systems and space reactors, but space nuclear research ultimately stalled at the end of the Cold War.

That Has Changed

Today, security and economic imperatives have led to a renaissance of space nuclear systems in the US and Russia, and an emergent focus in China. In an October 2021 hearing before the House Subcommittee on Space and Aeronautics, NASA Senior Advisor for Finance and Budget

Today, security and economic imperatives have led to a renaissance of space nuclear systems in the US and Russia, and an emergent focus in China.

Bhavya Lal described the challenge: “strategic competitors including China are aggressively investing in a wide range of space technologies, including nuclear power and propulsion.”

NTP Delivers Soft And Hard Power In space

The US can achieve both soft and hard power with nuclear energy technologies, especially NTP, as the foundation of future American leadership in deep space exploration. Beyond the Apollo missions, many of NASA’s most iconic and inspiring missions were enabled by radioisotopes: Pioneer, Voyager, New Horizons, and the Mars rovers.

China knows this and has sought to emulate: in late 2020, China returned the first lunar samples in nearly 50 years from the Moon. Of note, Chinese lunar rovers used radioisotope

batteries supplied by Russia, a sign of growing collaboration in space technologies the US should not ignore.

China has identified space nuclear propulsion as a key element of its plan to become the pre-eminent spacepower by mid-century, specifically identifying the technology as a way to access and exploit space resources. Russia is pursuing several concepts, including a fission reactor to power an electronic warfare satellite (see “Ekipazh: Russia’s top-secret nuclear-powered satellite”, The Space Review, October 7, 2019) and a reactor to power an ion engine to create a space tug.

There is good news, however. Unlike terrestrial nuclear power, where the US is falling behind Russia and China in global trade, America has a slight head start on space nuclear technologies. In 2018, the tiny Kilopower intended for NASA operations was tested, the first novel domestic reactor designed, built, and operated in decades. The United States is pursuing two approaches to nuclear rockets, one military through DARPA and another civil through NASA. DARPA’s project, DRACO, is focused on developing capabilities to support maneuverability and responsiveness for operations as far away as the Moon.

Ultimately, space nuclear technology development provides optionality as the contours of competition in the space domain evolve.

The capabilities bring decisive advantages but vary by technology. Nuclear rockets greatly increase spacecraft maneuverability, advantages

for military spacecraft specifically in deep space. A basic nuclear rocket is feasible this decade; DARPA is targeting 2025 for a test launch. By contrast, the high efficiency but slower thrust of nuclear electric propulsion makes it ideal for slower-paced, economic logistics. However, the greater complexity of its subsystems make it a 2030s technology.

As described in a recent National Academies study, either type of nuclear propulsion may be needed for a crewed mission to Mars, exactly the type of mission that could cement US or Chinese soft power leadership. Meanwhile, fission reactors could be essential for early space mining. Focused on producing water for in-space refueling from the Moon, such mines are likely to be energy intensive but uniquely suited for fuel production for space nuclear systems.

NTP Is The Key To Space Leadership

Beyond technological advantage, the first nation to establish significant space nuclear capabilities can establish norms to guide global activities. The US is already taking leadership, avoiding the proliferation risks of highly enriched uranium by preferring high-assay low enriched uranium (HALEU). Technical and operational leadership breeds the influence to ensure future space norms reflect American nuclear energy priorities, like preventing proliferation, transparency of operations, and embracing safety as a guiding star.

To maintain space supremacy, the United States needs to build on its early leadership in

A basic nuclear rocket is feasible this decade; DARPA is targeting 2025 for a test launch.

Clear government demand for space nuclear systems can support the continued private sector investment necessary for a strong industrial base.

space nuclear technologies to harness them for military, scientific, and economic purposes. Bipartisan congressional funding and support the last several years has provided a start and must continue. The Biden Administration should build on the critical policy steps taken by the Trump Administration, which reformed launch authority to enable commercial missions for the first time and issuing Space Policy Directive-6, and recognize the unique value propositions of space nuclear technologies for meeting its policy goals. Not least of these would be creating early demand for HALEU and rebuilding domestic supply chains, which would help meet the administration's climate goals by supporting terrestrial nuclear energy.

Essential to any US pathway forward is a cohesive strategy that builds on America's competitive advantages. Clear government demand for space nuclear systems can support the continued private sector investment necessary for a strong industrial base. A portfolio approach to support nuclear thermal propulsion, nuclear electric propulsion, and fission power reactors can ensure technological diversity.

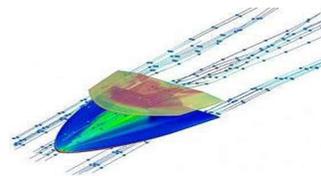
The hard reality is that great power competition now permeates the space domain: Russia and China increasingly see space nuclear technologies as tools to establish strategic and economic dominance. Congress has a significant opportunity to respond by further incentivizing NTP both in government and across industry. But beyond the technical challenges is a question of human will: the US has to accelerate a bipartisan focus on developing these capabilities for them to truly take off and solidify a peaceful path for human activities in outer space.

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China Tests New Engine, 'Likely To Power Hypersonic Aircraft'

26 January 2022

Source: Space Daily | https://www.spacedaily.com/reports/China_tests_new_engine_likely_to_power_hypersonic_aircraft_999.html



Stock illustration only

China on Monday conducted a test flight for a new engine that experts said could power China's future hypersonic aircraft and near-space plane.

The engine, developed by the Laboratory of Spray Combustion and Propulsion under School of Aerospace Engineering at Tsinghua University, successfully conducted a flight test on Monday morning, China Central Television (CCTV) reported.

A two-stage rocket booster was used to assist the test flight, CCTV said, noting that after the separation of the first stage, the second stage sent the engine to the predetermined height and velocity, and that was when the air inlet of the engine began to breathe in air very efficiently, and the fuel supply system began to spray vaporized jet fuel into the combustion chamber.

Then the ignition system started properly, the combustion chamber entered combustion status as planned, the engine worked in a stable manner and provided constant thrust, marking the complete success of the test flight, CCTV reported.

A computer-generated video shows that the second stage rocket booster did not separate from the engine, and it opened a parachute to land in a desert area, so it could be recovered.

The test gathered data on the effects caused by the parameter changes of the working environment to the operation characteristics of the engine's combustion chamber under real flight conditions, the report said.

It also thoroughly tested the engine's real work characteristics, validated the practicability of the technology and provided test data and accumulated experience to make this new technology into products, CCTV said.

This achievement will further enrich China's aerospace capabilities, and has strategic significance in new-type propulsion, the report said.

Huang Zhicheng, a senior expert on aerospace science and technology, told the Global Times on Monday that the experiment is about the engine's hypersonic flight.

Judging from the descriptions on how the engine worked, it is likely a scramjet engine, which is one of the key technologies to achieve hypersonic flight, experts said.

Wang Ya'nan, chief editor of Beijing-based Aerospace Knowledge magazine, told the Global Times on Monday that since the engine needed a two-stage rocket booster, it probably worked near space or in the upper edge of the atmosphere where air is very thin, with insufficient oxygen to support combustion.

Under such circumstances, airflow needs to be slowed down after it enters the inlet to blend it with the fuel, where fuel vaporization is a good

idea to apply as it can blend the fuel and air very well to guarantee stable and effective combustion, Wang explained, noting that this could be the breakthrough in the test.

Li Xiaoguang, an expert on intelligent unmanned systems at Qingdao University, told the Global Times that the CCTV report did not reveal the specifics of the engine, but it seems to be no more than one meter long according to the report, so its thrust would not be very high.

"If it is a scaled model test which aims to verify the theory, it means that there is still some way to go before the technology matures and becomes a real product," Li said.

When the technology becomes mature, it could see applications on hypersonic aircraft and near-space plane, Wang predicted.

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Commentary

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