Mission Shakti - India's ASAT Test Strategic Implications

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Abstract

Within a month of carrying out the Balakot air strikes deep within Pakistan, India carried out a successful anti-satellite (ASAT) test and sent a clear message of capability to its larger geopolitical neighbour China. Through this test, India joined an exclusive group of space-faring nations consisting of USA, Russia and China. Interestingly, the name 'Mission Shakti' links it to the other strategic capability India achieved with 'Operation Shakti' nuclear tests of 1998. It also once again confirmed India's ability to engage and destroy incoming enemy ballistic missiles. This is thus a strong military capability. Politically it showcases India's technological, industrial and military strength.

The Indian ASAT test used a long-range BMD interceptor under development for its Anti Ballistic Missile (ABM) capability. Dr G Satheesh Reddy, the Chairman of Defence Research and Development Organisation (DRDO) was the Chief Architect of the ASAT. The missile travelled at hypersonic speed, to a satellite 300 km away in space and achieved a direct hit. India intentionally targeted a satellite at lower altitude to reduce the effects of debris. However, the interceptor missile used in the ASAT test has the capability to neutralise satellites up to 1,000 km in space.

India has had the capability to carry out ASAT test since 2007 when China did its test, but there was no political will at that time. PM Modi gave clearance to conduct the test in 2016. As China catapults

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ahead with major achievements in space, India has to steadily evolve space programme while remaining committed to peaceful use of space.

Introduction

Within a month of India carrying out the Balakot air strikes, deep within Pakistan, in which it sent a punishing signal to the sponsors of terror, raised the strategic response threshold and called the Pakistani nuclear bluff, India carried out a successful anti-satellite (ASAT) test and sent a clear message of capability to its larger geopolitical neighbour China. Through this test India joined an exclusive group of space-faring nations consisting of USA, Russia and China.[1] In an address to the nation, Prime Minister Narendra Modi announced that through its missile test 'Mission Shakti' India had successfully tested an ASAT missile against a live satellite in low-Earth orbit on 27 March 2019. Interestingly, the name 'Mission Shakti' links it to the other strategic capability India achieved with 'Operation Shakti' nuclear tests of 1998. India, which has long struggled in its defence indigenisation and procurements, would now have the ability to destroy and disrupt enemy communications by knocking down enemy satellites if such an occasion arises. It also once again confirmed India's ability to engage and destroy incoming enemy ballistic missiles. This is thus a strong military capability. Politically it showcases India's technological, industrial and military strength. However, diplomatically, New Delhi was quick to clarify that they were not engaged in an arms race and that India stood by peaceful exploitation of weapons free Space.[2] China had conducted a similar test 12 year earlier in 2007.[3] The US Missile Defence Agency (MDA) undertook an interception of a dysfunctional satellite in low-Earth orbit in February 2008[4], the agency used the ballistic missile defence (BMD) interceptor, the Standard Missile-3 (SM-3), fired from Aegis-class destroyer deployed in the Pacific Ocean. The US had acquired ASAT capability as part of its Strategic Defence Initiative (SDI) in 1985. The successful flight test of Russia's direct ascent ASAT missile PL-19 Nudol, took place on 18 November 2015.[5]

The Test

The Indian ASAT test used a long-range BMD interceptor under development for its Anti Ballistic Missile (ABM) capability. The

Chinese ASAT test in January 2007 had also used a reconfigured DF 21-C or DF-25, the same which the Chinese used as mid-course interceptor for its first BMD test in January 2010. Dr G Satheesh Reddy, the Chairman of Defence Research and Development Organisation (DRDO) was the Chief Architect of the ASAT and led the entire launch operations.[6] The missile travelled at hypersonic speed to a satellite 300 km away in space and achieved a direct hit on the satellite in orbit. The Indian ASAT test is believed to have destroyed either the DRDO Microsat-R or Microsat-TD, according to some sources. The Microsat-R weighs 740 kg and is in a 268 km by 289 km orbit. The Microsat-TD weighs 130 kg and is in a 327 km by 368 km orbit. Both are classified as Earth-observation satellites. Microsat-R had been launched on 24 January 2019 this year and the Microsat-TD a year before that. The target for the test was most likely Microsat-R.[7] Low Earth Orbit (LEO) is the zone in space where a majority of man-made objects are. India intentionally targeted a satellite at lower altitude to reduce the effects of debris. However, the interceptor missile used in the ASAT test has the capability to neutralise satellites up to 1,000 km in space. "We don't need any more tests at this orbit now"[8], Dr Reddy said, though he did not rule out the option of conducting more tests in the future. He also clarified that an earlier failed test done on 12 February was not an ASAT test, but a ballistic missile that was used to take out an electronic target. It was a measure for national security without contravention of any international law. International concerns of the test leaving small pieces of debris in space were allayed by Indian scientists, and the Pentagon also confirmed that the 250-270 pieces of debris in low earth orbit would be of no risk to the International Space Station (ISS) as its orbit was nearly 100 km higher than the destroyed satellite.[9] The scientists had simulated the test to gauge the trajectory of debris and it was concluded that a direct head-on collision between the interceptor missile and the satellite would result in the least amount of debris. Also international agencies were tracking the debris and necessary notifications had been issued to all operators in space. International observers also complimented India for acting much more responsibly by doing a test on satellite much lower in orbit and the debris will clear of in a few months. On the other hand, China destroyed a Polar weather satellite at 865 km orbit in 2007 and Chinese satellite debris (647 pieces) was still orbiting in space.[10] Reddy clarified that a "mission

of such nature" could not have been kept a secret technically, and had to be made public. Almost all the technologies used for the ASAT test were indigenously developed with some 50 industries contributing components for the 13 metre missiles weighing 19 tonnes. The missile was described as a kinetic kill vehicle, which means it does not carry any explosives or other devices, and it 'kills' by smashing into the target satellite and shatters it using its kinetic energy.

The Timing of the Test

India has had the capability to carry out the ASAT test since 2007 when China did its test, says the former Indian Space Research Organisation (ISRO) Chairman G Madhavan Nair, but there was no political will at the time to demonstrate it.[11] The PM had taken the initiative and he had the political will. Clearance to conduct the test was received in 2016 when the programme to develop the interceptor missile began in earnest, Reddy said. There were others who thought the event was timed for pre-election political reasons. However, the election commission of India confirmed that the model code of conduct for elections had not been violated by the test or the announcement. There was urgency for testing also because on a future date there could be an international treaty for ban on ASAT testing. USA has confirmed that they were aware of such a test, but Pentagon denied that they had launched an aircraft from its base Diego Garcia in Indian Ocean to spy the launch.[12] The US Air Force Missile Warning System at Buckley Air Force Base had detected and confirmed the hit and breakup of the satellite.

The ASAT-BMD Linkages

Up to an altitude of close to 200 km, one could intercept missiles both, within the Earth's atmosphere (endo atmosphere) and beyond (exo atmosphere). The intention in both ASAT and BMD is to take on military targets operating in or transiting through the space. If destroyed just before atmospheric re-entry, it would ensure that space assets in low-Earth orbit are not affected. In all tests, exo-atmospheric BMD type interceptor was used. Clear linkages can then be drawn that BMD and ASAT missions are similar in nature and intent. Targeting algorithms for ASAT and ballistic missile interception in outer space are usually different. In fact, the Indian ASAT test was done using the long-range

interceptor of the BMD programme (PDV). The test has been a breakthrough for the DRDO.

Evolution of Space Weapons

The United States and erstwhile Soviet Union began conceiving and developing anti-satellite weapons in early 1960s. They were in the form of directed-energy lasers to decapacitate; kamikaze satellites for hard-kill; and possible orbital nuclear weapons. They felt that very long range Inter-Continental Ballistic Missiles (ICBM) spend significant time in sub-orbital flight and was best intercepted in space. The US 'Nike-Zeus' programme envisaged firing Nike nuclear missiles against incoming ICBMs.[13] Project 'Defender' was to destroy Soviet ICBMs at launch with satellite weapon platforms that were to orbit over Russia. Both programmes were abandoned later. The 'Sentinel' and 'Safeguard' programmes were to use Anti-Ballistic Missiles (ABM) to shoot down incoming ICBMs. Initial plan was to use a nuclear tipped interceptor missile but as accuracy improved, hit-to-kill ABMs evolved. In 1983, US President Reagan proposed a space-based Strategic Defence Initiative (SDI) to protect the United States from attack by strategic nuclear missiles.

In the 1960s, Soviets developed a "co-orbital" system[14] that would approach the space target using radar guidance, and then explode shrapnel warhead close enough to kill it. Soviets also evolved a low-Earth orbit Fractional Orbital Bombardment System (FOBS)[15] for earth targets. It would de-orbit for the attack. The SALT II agreement of 1979 prohibited the deployment of FOBS systems. Polyus orbital weapons system was an anti-satellite weapon with nuclear space mines and a self-defence canon. Soviets also considered the space Shuttle as a single-orbit weapon that could manoeuvre to avoid existing anti-ballistic missile sites, and then bomb the target and land. The Soviets also experimented with large, ground-based ASAT lasers with a number of US spy-satellites reportedly being temporarily 'blinded', and used a modified MiG-31 as an ASAT launch platform. End of Cold War saw new players like China, Japan, European Union and India create own space systems. Spy satellites continue to perform C4ISR missions. Satellites are also used to provide early warning of missile launches, locate nuclear detonations, and detect preparations for otherwise clandestine or surprise nuclear tests. Early-warning satellites were used to detect tactical missile launches, in Operation Desert Storm.

Weaponisation of Space

Space weapons can be categorised as those that attack targets in space (anti-satellite); or attack targets on ground from space; or attack targets transiting through space (anti-ballistic missile). It is technically possible to position conventional or nuclear missile in space which could reach targets on the ground, but the same could be expensive and difficult to maintain and service. Also carrying heavy missiles would be a logistic nightmare and have only small advantage of saving time vis-á-vis aircraft and submarine launched weapons. The Russian ASAT research has reportedly been resumed under President Putin to counter renewed US strategic defence efforts post ABM Treaty. The National Aeronautics and Space Administration (NASA) space plane X-37, now with US Department of Defence is akin to a space version of Uninhabited Aerial Vehicle (UAV) and its employability is evolving. International space treaties limit or regulate positioning of weapons or conflicts in space. To date, there have been no human casualties resulting from conflict in space, nor has any ground target been successfully neutralised from orbit.

ASAT tests are normally extremely controversial and are considered to be contributing towards weaponisation of space, which is prohibited by the Outer Space Treaty of 1967. The US and Russia have also shot down their own defunct satellites on multiple occasions. China and India have been vociferous against the arms race in outer space, and have backed Russia on the Prevention of an Arms Race in Outer Space (PAROS)[16] and demanded a treaty banning weapons in outer space. ASAT and BMD tests by China confirmed that great powers cannot abstain from technological races where their rivals have a clear edge or can swing the strategic balance. Similarly, the Indian ASAT test followed a techno-strategic trajectory to catch-up with its immediate rival China. Satellites are used by countries for navigation, communications and also for guiding their missile weaponry. These ASAT tests defacto make one more act for weaponisation of space. The current Trump administration has been rather vocal about need to harness the space for military applications as also for basing missile interceptors in space. Even in 2008, US described its ASAT test as a part of the BMD system. This was more so because just a year earlier, the US had criticised the Chinese ASAT test as space weaponisation.

Similarly, both Russia and China had censured the US for the SM-3 test.

Research is on into directed energy weapons, including a nuclear-explosion powered X-ray laser. AGM-69 SRAM carried on a modified F-15 Eagle was successfully tested in September 1985 targeting a satellite orbiting at 555 km.[17] Russia has reportedly restarted development of a prototype laser system 'Sokol Exhelon'. Israel's Arrow 3 (Hetz 3) anti-ballistic missile, with exo-atmospheric interception capability, is in advanced stage of development. US National Missile Defence (NMD) programme has no weapon stations in space, but is designed to intercept incoming warheads at a very high altitude where the interceptor travels into space to achieve the intercept.

China Pulls Ahead in Space Capabilities

China enjoys a big lead over India, and is quickly trying to overtake Russia and catch up with USA. In January 2019, it became the first country to land a spacecraft on the far side of the moon. Its Space programme is run by the Chinese military. China continues to work closely on strategic technologies, including Hypersonic flight, Directed Energy Weapons (DEW) and MaRVs (Manoeuvrable re-entry vehicles). For years shrouded in secrecy, China's ambitious space programme is now well publicised. Lunar and Mars missions, a permanent space station, and ASAT are part of it. Increasing number of Chinese rockets have been launched in the past few years. China is working on hack-proof satellites. China plans a permanent space station 'Tiangong' by 2020 and a crewed expedition to the moon. 2020 is also the plan for Chinese Mars mission. China spends around $6 billion a year on its space programme, albeit still a fraction of American US$ 40 billion budget. It is preparing to launch new rocket designs.

In December 2015, China launched the Dark Matter Particle Explorer. It soon plans to launch the Hard X-ray Modulation Telescope to look for black holes. Twelve Chinese astronauts have now been into space, including Liu Yang who became the first Chinese woman in space. Chinese Satellite Aolong 1 (Roaming Dragon) has a robotic arm that can grab another satellite and guide it to burn up in Earth's atmosphere. Officially, it is to remove space debris from orbit but it could be used as a weapon, bringing down a rival's satellite. China continues to develop a formidable

arsenal of launch vehicles. Long March 7 in June 2017 was capable of lifting about 13 ton into low Earth orbit. Long March 5 has capability of lifting 25 ton into low Earth orbit, rivalling anything the Americans, Russians or Europeans currently have. Designs for a Long March 9 rocket are currently being studied. With the first launch for the Long March 9 due in 2025, China could very well be in a position to land astronauts on the moon by 2030.

Pakistan takes Chinese support for satellite launch. They have also joined the Chinese satellite navigation system Beidou. In January 2017, they tested the Abadeel, a development of the Shaheen-III with multiple independently targetable re-entry vehicles (MIRV). The intention of the system is to counteract the Indian Ballistic Missile Defence (BMD).

India's Space Programme

ISRO has come a long way since its first satellite Aryabhata was launched by Soviet Union in 1975. In 1980, Rohini became the first satellite to be placed in orbit by an Indian-made launch vehicle, SLV-3. ISRO subsequently developed the Polar Satellite Launch Vehicle (PSLV) and the Geosynchronous Satellite Launch Vehicle (GSLV) for placing satellites into geostationary orbits. Satellite navigation systems GAGAN and IRNSS were deployed. In January 2014, ISRO successfully used an indigenous cryogenic engine in GSLV-D5 launch of the GSAT-14. ISRO sent one lunar orbiter 'Chandrayaan-1' on 22 October 2008, and a Mars orbiter mission which successfully entered Mars orbit on 24 September 2014, making India the first nation to succeed on its first attempt. ISRO thus became the fourth space agency in the world as well as the first in Asia to successfully reach Mars orbit. India's Space programme, though overtly for peaceful exploitation of space, has military off-shoots. These include remote sensing satellites of IRS series with some having spatial resolution of one metre or below. There are others with panchromatic cameras, synthetic aperture radars, satellites providing scene-specific spot imagery for cartographic/military applications. On 15 February 2017, ISRO launched 104 satellites in a single rocket, PSLV C-37, and created a world record. ISRO launched its heaviest rocket, Geosynchronous Satellite Launch Vehicle-Mark III (GSLV-Mk III), on 5 June 2017 and placed a communications satellite GSAT-19 in orbit. With this launch, ISRO became capable of launching 4 ton

heavy satellites. India has launched 100 Indian satellites of various types as on 31 January 2018. As of November 2018, ISRO has launched 239 satellites for 28 foreign countries. India will send its first manned mission to space by December 2021 says ISRO chief Kailasavadivoo Sivan.

Indian Military Application Satellites

India today has 11 operational Indian Remote Sensing (IRS) satellites. All these are placed in polar sun-synchronous orbit and provide data in a variety of spatial, spectral and temporal resolutions. Though most are civil satellites, some have a spatial resolution of 1 metre or below which can be also used for military applications. India also commercially offers images with one metre resolution. Radar Imaging Satellite 2 (RISAT-2) has synthetic aperture radar (SAR) from Israel Aerospace Industries (IAI). It has a day-night, all-weather monitoring capability with one metre resolution. The CARTOSAT-2 carries a state-of-the-art panchromatic (PAN) camera that take black and white pictures of the earth in the visible region of the electromagnetic spectrum. The swath covered by these high resolution PAN cameras is 9.6 km and their spatial resolution is 80 centimetres. The satellite can be steered up to 45 degrees along as well as across the track. It is capable of providing scene-specific spot imagery. The data from the satellite is used for detailed mapping and Geographical Information System (GIS). CARTOSAT-2A is a dedicated satellite for the Indian Armed Forces. Because of high agility, it can be steered to facilitate imaging of any area more frequently. CARTOSAT-2B offers multiple spot scene imagery. With CARTOSAT-2E launched in June 2017, India now has 13 satellites with military applications. Most of these remote-sensing satellites are placed in the near-earth polar orbit. GSAT-6 is the second strategic satellite mainly for use by the armed forces for quality and secure communication. Indian Navy uses GSAT-7 for real-time communication among its warships, submarines, aircraft and land systems. GSAT-7A an advanced military communications satellite exclusively for the Indian Air Force (IAF) was launched in December 2018.[18] It will enhance network-centric warfare capabilities by interlinking with IAF ground radar network and Airborne Early Warning and Control (AEW&C) aircraft. GSAT-7A will also be used by Indian Army Aviation Corps.

Integrated Space Cell and Aerospace Command

The Integrated Space Cell was formed in June 2010 as the nodal agency within the Government of India which oversees security of its space based military and civilian hardware systems. The Cell is jointly operated by the three Armed Forces, Department of Space, and ISRO. It functions under the Integrated Defence Staff Headquarters of Ministry of Defence. USA has a Tri-Service US Strategic Command which oversees space assets. Russia fused all space and some air defence components and merged with the Russian Air Force to form the Russian Aerospace Forces. China's People's Liberation Army Strategic Support Force was created to gain regional advantages in the astronautic war, space war, network war and electromagnetic space war and ensure smooth operations. Indian Air Force (IAF) had outlined the Defence Space Vision 2020 to harness satellite resources to significantly boost India's defence preparedness. The Indian tri-service Space agency, as a prelude to a full-fledged Space Command will soon be set up at Bangalore. It will be headed by an IAF officer. Finally the Space Command with requisite space expertise and authority can transform the space vision into tangible operational outcomes.

India's Anti-Satellite Ability and Implications

The Government of India stated that the test was done "to verify the capability to safeguard our space assets." Today's test does not violate any international law or treaty. We will only use modern technology for the security and welfare of 130 crore Indians. A strong India is necessary for the security of this region. Our strategic goal is "to ensure peace and not create an environment for war," the Prime Minister said. It clearly means that if someone threatens Indian assets, their assets could be targeted. The capability is a deterrent against a potential rival, like China. It means India now has the option of shooting down the satellites of any country in the event of conflict. That could have vast military implications, especially for the use of spy satellites or even navigation satellites of a particular country.

Indian ballistic defence programme is a multi-layered system consisting of two interceptor missiles, the Prithvi Air Defence (PAD) missile for high altitude, and the Advanced Air Defence (AAD) missile for lower altitude interception. It would be able to intercept

incoming missile launched 5,000 kilometres away. The 'Swordfish' radar for the BMD system currently has a range of 800 km. It is planned to upgrade to 1,500-2,000 km. Two new anti-ballistic missiles to intercept IRBMs are being developed to cover a range of up to 5,000 km. India is also planning a laser based weapon system to destroy a ballistic missile in its boost phase.

Way Ahead

Noted strategist Guilio Douhet had said, "Victory smiles upon those who anticipate the changes in the character of war not upon those who wait to adapt themselves after the changes occur".[19] India needs early warning satellites to monitor ICBM launches and even tactical airspace as an important military asset. Ground/space based lasers to disable enemy satellites or destroy/degrade attacking ICBM as part of ASAT capability.

There is also a need to develop Directed Energy Weapons. India one-day needs a permanent space station. The establishment of tri-services Space Command would be operational next step. Space is the future for all action and capabilities are the real force multiplier. Time to invest and prepare is now.

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