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India's Space Power: Revisiting the Anti-Satellite Test

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Against the backdrop of former U.S. president Ronald Reagan's Star Wars program, Satish Dhawan, a pioneer of the Indian space program, observed that time would tell whether Indian activities in space would remain exclusively civilian and pacifist.[1] Around three decades later, on March 27, 2019, Indian Prime Minister Narendra Modi surprised the world with his announcement that India had become the fourth country to conduct an anti-satellite (ASAT) missile test (after the United States, Russia, and China). The test on March 27 was preceded by an unsuccessful one in February; but that doesn't eclipse the significance of the exercise. Only three publicly recorded ASAT tests have been conducted since the end of the Cold War, and, arguably (the possession of latent capabilities notwithstanding), it is the actual testing of a technology that represents a salient transformation in a country's capabilities.

Dubbed "Mission Shakti" (shakti denotes "power" in Sanskrit), the test entailed launching a ballistic missile into outer space to destroy an Indian satellite located about 300 kilometers above the earth's surface, in low earth orbit (LEO)—which ranges between 80 kilometers and 2,400 kilometers above the earth's surface, depending on contrasting definitions. The direct-ascent missile destroyed the satellite kinetically, in under three minutes, by the sheer impact of the collision rather than a warhead-induced explosion. India reportedly adapted its missile defense interceptor, the Prithvi Defense Vehicle Mark-II, into an ASAT weapon, making it the third country to demonstrate the capability for a direct-ascent kinetic kill.[2] Though its technological antecedents have been engendered through the ballistic missile defense program since 2006, recent global and regional dynamics arguably catalyzed Mission Shakti. The ineluctable questions now revolve around the mission's intentions, impact, utility, and potential next steps.

BACKGROUND: CONTEXT AND CONCEPT

Historically, outer space has been the preserve of great powers, reflecting the bipolar power dynamics of the Cold War. However, in the twenty-first century, space activities now reflect ongoing global power

transitions (particularly the rise of China and India), while ideas and institutions regulating outer space are being increasingly contested. Modi's address on Mission Shakti underscored the strategic dimension of the exercise—which isn't insignificant for a country like India, often denounced for underestimating the role of hard power in international relations. While satellites in outer space enable a range of functions that influence strategic decisions—such as surveillance, reconnaissance, communication, navigation, targeting, and geodesy—the use of weapons in space marks a distinct transformation. Harnessing satellite-enabled features for military purposes entails militarization of outer space that is universal and routine; in contrast, using weapons in outer space (whether from ground, air, or space itself) denotes the weaponization of outer space—the latter being circumscribed by practice and precedent.

History testifies that the proliferation of ASAT systems correlate with great power competition. During the Cold War, the United States and the Soviet Union pioneered a wide array of ASAT systems, though Russian military space activities declined with the end of Cold War, leaving the United States as the space hegemon. It would not be impertinent to point out that the last ASAT test of the Cold War era was in 1985, with an air-launched missile from an F-15 plane by the United States—the last test of its kind until the Sino-U.S. competition reached the final frontier in 2007–2008. China conducted a direct-ascent kinetic kill ASAT test in 2007, and the United States responded with a similar exercise the following year. Russia hasn't conducted an actual kinetic kill ASAT test, but, in addition to the legacy of its Soviet-era ASAT program, it has multiple successful test flights of the dual-use Nudol anti-ballistic missile—which serves in an anti-satellite role—to its credit. Significantly, despite their substantial capabilities, the United States and Russia do not pose a direct security threat to India; unlike China.

INDIA'S SPACE POWER PLAY: DRIVERS AND PATHWAY

The clearest driver for Mission Shakti seems to be China, official platitudes to the contrary notwithstanding. Ascending in the global order, China joined the ASAT club in 2007, when a Chinese missile downed one of its satellites. It's widely acknowledged that this incident prompted the United States to conduct a reciprocal test, Operation Burnt Frost, in 2008. Inarguably, the Chinese ASAT test also raised India's security concerns and catalyzed the establishment of an Integrated Space Cell for space security in India. China and India have been perennial adversaries since the Sino-Indian border conflict of 1962 (which well predates the Asian century), and political, territorial, and strategic animosities continue to endure. The ascendancy of India and China in the global hierarchy of states has added a novel dimension to this trend. The Chinese ASAT test of 2007 was completely unexpected and, overnight, the extensive Indian satellite fleet that had been a critical part of the national infrastructure became highly vulnerable. Hosting the largest fleet of civilian communication satellites in the Asia Pacific region and the largest fleet of civilian remote-sensing satellites, the Indian space program is instrumental to providing key satellite-based functions, such as telemedicine, banking, resource mapping, and marine fishing. A few satellites also provide crucial strategic leverage to decisionmakers and security forces by facilitating satellite communication and imagery—primarily along the Indo-Pakistan border and in the Indian Ocean region.

Another factor driving India's ASAT testing could be the recent efforts, under the aegis of the United Nations, to establish an "international legally binding instrument on the prevention of an arms race in outer space." The Indian Ministry of External Affairs' press release on the March 2019 ASAT test made an

unambiguous reference to this: "India expects to play a role in the future in the drafting of international law on prevention of an arms race in outer space . . . in its capacity as a major space faring nation with proven space technology." The traditional Indian stance has been to uphold the peaceful use of outer space and oppose its weaponization. Incidentally, India's bittersweet experience with the global nuclear order demonstrates that international regimes reflect global power hierarchies and, in practice, manifest early-mover advantages. This is due to the fact that, often, countries that derive specific benefits from a development, technological or economic, seek to consolidate these benefits, and the ensuing arrangements evolve into regimes that typically suit their needs—by default or design. Ironically, India, the first country to espouse a ban on nuclear testing, witnessed the emergence of a global nuclear order that preserved the relative gains of the established nuclear powers through the Nuclear Non-Proliferation Treaty and related arrangements without concomitant steps for disarmament and, in India's view, to the detriment of its security. The lesson here is that the acquisition of strategic capability is not equivalent to the demonstration of that capability, and the role of Mission Shakti in terms of the latter cannot and should not be underestimated.

Acknowledgments of India's exemplary space program have been hitherto restricted to commercial and scientific achievements. For example, the Indian Space Research Organization (ISRO), established in 1969 and boasting of 102 spacecraft missions, has been primarily acknowledged for its societal applications of space technology. The exclusively civilian mandate of the ISRO rendered the ASAT program under the Defense Research and Development Organization (DRDO). Entrusted with a wide spectrum of military research across its network of fifty laboratories, the DRDO is the largest research organization in the country and has demonstrated varied levels of success. However, its missile program is noteworthy, with the ASAT missile appearing to have been adapted from a ballistic missile defense (BMD) interceptor, the Prithvi Delivery Vehicle Mark-II. The technological foundations of the anti-satellite test can be traced back over a decade, although the precise points of advancement during this period are subject to interpretation. Some believe that the Indian BMD program, established in late 2006, led to the development of a rudimentary framework for an ASAT missile, and that the successful testing of the Agni V intercontinental ballistic missile (ICBM) in 2012 then demonstrated the capacity to build the ASAT missile. With a range of over 5,000 kilometers, the Agni V flew 600 kilometers into space in a parabolic trajectory before reentering the atmosphere for impact. Following this test, the DRDO began publicly expressing its intention to develop anti-satellite weapons.

THE DETERRENCE MATRIX: BALLISTIC MISSILE DEFENSE AND THE ANTI-SATELLITE SYSTEM

A BMD system protects a country by destroying incoming missiles, and this strategic canopy provides a distinct advantage in the deterrence game. The system comprises sensors and radars that detect an incoming missile and destroy it with another missile—a process that is remarkably complex in application and which only a handful of countries have been successful in developing. The technology for conventional rockets and ballistic missiles are identical—the first intercontinental ballistic missile, the Soviet R-7 Semyorka, preceded the launch of the Soviet Union's Sputnik by less than six weeks and epitomized the parallel development of ballistic missiles and space rockets.

In principle, any country with the capability of launching a ballistic missile can also operate rockets and thereby target satellites. However, satellites are barely

a few meters in dimension and move at around eight kilometers per second, presenting the most significant technological challenge for targeting. A successful direct-ascent kinetic kill ASAT test by demonstrating extraordinary precision accrues benefits for a BMD system—making the March ASAT test extremely significant for India. Deterrence among nuclear-armed adversaries is premised on an unwillingness to risk the apocalyptic consequences of a nuclear strike, which ensures stability. However, as ballistic missiles are the primary vehicles for delivering nuclear warheads, the existence of BMD capabilities to destroy hostile missiles reconfigures the rules of deterrence. A ballistic missile travels into outer space at a speed several times that of sound, and then reenters the atmosphere to hit its target—consequently, the quest to block ballistic missiles usually involves developing systems to track missiles in outer space.

Anti-satellite is a generic term denoting a spectrum of measures or systems targeted at satellites. With no unanimity on how to classify or categorize them, ASAT systems come in many forms, including missiles, laser or energy waves, electromagnetic pulses, and even smaller satellites.[3] These systems can be activated from aerial platforms, or be based on the surface of the earth or in space. Depending on the nature of their effect on satellites, ASAT systems can conduct hard or soft kills, corresponding with their ability to inflict permanent or temporary damage. Satellites are essentially receiver-transmitter equipment in the orbit, which rest on a triad of three distinct systems—the satellite in space, the receiver, and the transmitter system based on the ground. Disrupting the signal transmission system of satellites—such as through cyber or conventional attacks on ground systems or the jamming of electronic signal frequencies—could also be considered a form of ASAT measures. The effects of ASAT systems can be limited (targeting of a specific satellite) or much broader. For example, a directed-energy weapon (DEW)—including lasers, particle beams, and microwaves—can target a satellite with surgical precision, while an electromagnetic pulse generated by a high-altitude nuclear explosion (in space or at a near-space altitude) could potentially destroy many satellites and even render an orbit useless through indiscriminate radiation.

MISSION SHAKTI: THE AFTERMATH

Ballistic missiles from earth, capable of conducting direct-ascent kinetic kills, represent the most common form of ASATs—the Chinese test in 2007, the U.S. test in 2008, and the Indian test in 2019 belong to this category. India's ASAT project appears to have been approved in 2016 and reached the critical phase (that is, the mission mode when the final preparations for launch are undertaken) after September 2018. Public opinion in India was largely positive, but the exercise caused some heartburn among opposing political parties—given that the test occurred propitiously close to the imminent 2019 general election. The ensuing domestic political discord was illustrative of government-opposition dynamics representing the effect of the exercise, rather than the cause. With the imminent general election, the political opposition was sensitive to the probability of any perceived electoral benefit to the ruling political dispensation. Overall, the insularity of space and military research and development projects from election cycles in India rules out domestic electoral attributes as being the primary driver of Mission Shakti. The correlation between techno-scientific accomplishments and electoral outcomes in India is a matter of conjecture.

While space may be infinite, in practice, only a tiny fraction of orbits are useful to satellites that rely on them for their trajectory. These orbits are becoming increasingly congested, not only by functional satellites but also by defunct satellites, rocket stages, and their fragments—all of which comprise space debris. The

location of the March 2019 target in the LEO (at about 300 kilometers) was purposely selected to avoid creating dangerous space debris. Space debris at this distance get dissipated as they drift toward the earth's atmosphere, but debris at a higher distance remain intact and pose a permanent hazard. The pollution in outer space due to space debris is a growing concern. The Chinese ASAT test in 2007 created the largest amount of space debris to date when it intercepted a defunct satellite at 865 kilometers. The U.S. test in 2008 minimized space debris by targeting a satellite at a much lower altitude of approximately 247 kilometers. The Indian exercise reportedly targeted a satellite at roughly 282 kilometers. Debates rage among independent experts about the level of threat from the debris caused by India's test, but several agreed that the bulk of debris would be disposed of—the larger pieces in a few weeks and the smaller ones in a matter of months. This is in sharp contrast to the debris created at higher altitudes, such as from the Chinese test, which take years, and even decades, to dissipate.

India's assertion of the positioning of the target, along with the exercise not violating any international law, may have played a hand in muting global criticism. China and Russia were guardedly neutral, and despite apprehensions from the chief of the U.S. National Aeronautics and Space Administration (NASA), the U.S. Department of State and the U.S. Department of Defence acknowledged, if not tacitly accepted, the Indian position on space debris. Technical studies have sometimes included contradictory evidence due to differing technical parameters, but regardless, arguments based exclusively on a techno-scientific prism overlook the fact that outer space is not merely an arena for scientific endeavors; it is subject to the political dynamics of the world.

Further, the lack of consensus among experts regarding the precise definitions and dimensions of space debris and their potential impact makes a linear and universally acceptable response to ASAT tests difficult. When contradictory technical assessments coincide with political maneuvering, the resolution requires an intelligent and broadly acceptable interpretation. The heart of the matter remains that a debris-free direct-ascent kinetic kill ASAT test is a myth. Hence, any evaluation should be driven by the quantity and the decaying timeline of the ensuing debris. For instance, Operation Burnt Frost was deemed responsible by minimizing the debris on both these counts, unlike the Chinese ASAT test. Hence, it could be strongly argued that the Indian exercise was not irresponsible, judged in its entirety.

Another strand of perspectives pertaining to the debris debate focuses on the progressively weakening norms on ASAT testing due to events like Mission Shakti. This, however, misses the broader point—the extant arrangements for governing space, set in the bipolar era of the last century, are being rendered increasingly irrelevant by the technological and political developments of the twenty-first century. Scientific innovation, the decreasing cost of access to space, and the emergence of new powers have led to an increased number of actors (both state and nonstate) in outer space. It is an established axiom—validated by credible research in game theory and international relations—that an increasing number of actors is positively correlated with declining prospects of cooperation; and outer space is no exception.

While countries agree, in principle, to uphold space as a common heritage of humanity, they differ on specifics and jostle for comparative advantages. Typically, the trend intensifies during periods of (great) power rivalry and power transitions. Thus, several proposals in the United Nations since the 1980s have languished due to disagreements among states. As the preeminent actor in space, the United States has often perceived

the proposals to be inimical to its interests; enactment of forthcoming proposals would have constrained the extensive U.S. military space program. Since the 2000s, alternative proposals by the European Union and a joint proposal by Russia and China seeking to ban the weaponization of outer space have floundered due to ambiguities surrounding precise definitions and the scope of space weapons. The latter formulation, for instance, leaves the scope open for weapons systems from the earth targeting satellites in space—and would provide direct advantages to China and Russia at the expense of the United States.

INDIA, ANTI-SATELLITE, AND OUTER SPACE: WHERE DO WE GO FROM HERE?

The ability to secure satellites in space, and deny the same to adversaries through ASAT tests, is central to projecting power in outer space. As iterated earlier, ASAT comprises a wide array of technological platforms and other types of ASAT systems are in various stages of development in India. Although India acknowledges that projects on directed energy weapons (both lasers and particle accelerators), for ASAT purposes, are in the research and development phase, it doesn't note when these might be successfully operationalized. Equally significant is the absence of a coherent policy or doctrine that establishes the framework for military space operations. Although no state has, so far, destroyed the satellites of another state, the presence of such a capability is considered to be the keystone of deterrence (because each state can destroy the other's satellites, both would refrain from pursuing such a course). It remains to be seen if India is opting for a minimalist deterrence posture in space or is seeking to proactively deny an adversary's use of space.

Significantly, outer space is integral to contemporary military operations in irreversible and multiple ways. Unsurprisingly, the ongoing revolution in military affairs put a premium on network-centric warfare—this implies synergy among soldiers, weapons, commanders, and support systems at all levels—which is achieved primarily through satellite communications and satellite navigation. ASAT capability becomes crucial herein, as states with this capability aim to secure their assets in space and, by the same token, deny their adversaries the same. However, the contrast between the former and the latter objectives denotes a substantial distinction in the scale and scope of ASAT systems, corresponding to minimalist and defensive counter-space capabilities to an expansive range of space weapons. Outer space is emerging as a distinct domain of military operations, as well as an extended arena of operations on earth; this calls for establishing a dedicated military force dealing exclusively with space.

In competing with the United States, China has targeted U.S. satellites through cyber and laser weapons and is rapidly building up its counter-space capabilities in various forms. Unlike other leading powers in space, China has been expanding the range of its ASAT missiles to go beyond LEO and is developing potential orbital weapons with dual-use space platforms. Beijing's drive toward space weapons is emphasized by its unfolding great power rivalry with the United States, and by the fact that space infrastructure is integral to U.S. power projection. If these indications are anything to go by, then this great power competition doesn't show any sign of abatement and is bound to affect the Indian security calculus.

In the evolving manifestation of military operations, satellites are playing a key role, as they expedite navigation, reconnaissance, communication, and targeting. Due to its destructive potential, an ASAT missile is arguably

a weapon of last resort—hence, possessing only an ASAT missile in its arsenal would leave Indian space assets vulnerable to Chinese military space capabilities. Essentially, a wide array of ASAT capabilities is required for strategic proportion and flexibility in counter-space operations. Hence, considering the Chinese threat, Mission Shakti is a necessary but hardly sufficient step for cosmic deterrence. While a Defense Space Agency for synchronizing diffuse military space activities has been approved—and is a welcome step forward from the insipid Integrated Space Cell—the last word on this is subject to requisite ideational and institutional progress on the topic through appropriate strategic doctrines and force structures, respectively.

CONCLUSION

Mission Shakti has propelled India into an elite quartet of countries with ASAT capabilities, establishing it as a major actor in space and improving its deterrence posture, though not without caveats. Military space activities are accelerating universally, while all the major powers in space—the United States, Russia, and China—are reorganizing their military space programs, securing their space assets, and developing further space weapons. India's security considerations are mostly driven by Pakistan and China—the nominal space capabilities of the former does not pose a threat to India, but the extensive capabilities of the latter precipitated Mission Shakti—which is representative of India's baby steps toward great power status.

With a steadily expanding fleet of satellites for both civilian and military purposes, the technological ability to secure these is a national imperative, as is the diplomatic ability to proactively shape the global governance of outer space with like-minded partners. Consequently, expanding offensive space capabilities, complemented by coherent policies at the global and national levels, are crucial to sustain this momentum. The next step should be to consolidate the gains from this exercise by demonstrating a resolute political will and forging a national consensus on the role of India in outer space in the coming era. India's external behavior is marked by three characteristic themes—a persistent great power aspiration, an overcompensation for the Pakistani threat, and an underestimation of China. While the ASAT test is not an exception to these trends, it does provide a kernel of hope for a new strategic trajectory for India.

ABOUT THE AUTHOR

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NOTES

1 Satish Dhawan, "Space and Foreign Policy" (KPS Menon Memorial Lecture delivered on October 1988 ,29 at Andhra Bhavan, New Delhi). http://dspace.rri.res.in/bitstream/1988/1/5428/2289_KPS20%Menon20%Memorial20%Lecture.pdf

2 Russia is yet to test this type of ASAT, although it has an extensive range and legacy of research and development and testing of ASAT and energy weapons since the Soviet era, while in recent times, its Nudol ballistic missile interceptors are capable of ASAT missions.

3 Shounak Set, "Outer Space and Warfare: A Study of Trends And Transformations" (unpublished dissertation, Diplomacy and Disarmament Division, Jawaharlal Nehru University, New Delhi, 2006).

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