

India's Missile Defence Programme: Threat Perceptions and Technological Evolution

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India's Missile Defence Programme: Threat Perceptions and Technological Evolution

Today, the anti-ballistic missile defence is a major shield system available to nations worldwide to guard them against any nuclear weapon attack. India has been exploring various missile defence options and it has achieved excellent progress in its own indigenous missile defence shield. This was aptly demonstrated, when on 06 March 2009, India's Defence Research and Development Organisation (DRDO) successfully conducted its third test to improvise its missile defence system by intercepting an incoming missile threat. The Indian missile defence programme is the result of indigenous scientific research and consistent endeavour and resolve in the field of ballistic missile defence. The progress made in this field has not been easy, and in the past, research and study in the missile defence area was stalled by limited access to advanced interception technologies and the slow pace of indigenisation on numerous occasions. It was further constrained by political and financial factors. India is now developing lower- and upper-tier systems for air and missile defence applications and is also aspiring for longer range exo-atmospheric interception capability. While continuing to depend on its own indigenous scientific and research progress, India is seeking international collaboration with countries like Israel, Russia, the United States and different nations in Europe to get the best support in missile defence technology.

This paper focuses on the compulsions and threat perceptions that make India's missile defence programme so pertinent for its protection against nuclear attack. Despite its indigenous advancement in missile defence, India is not capable of meeting the immediate threat from nuclear attacks. This delay has resulted in the need for acquisitions of missile defence from the leading international players in the respective systems. Considering the above, this paper reviews the missile defence and interception technology which

is available at the international level and looks into India's missile defence programme and its possible collaboration with international players namely Israel, Russia and the United States, in terms of both acquisition of technical know-how and ready-made systems. Further, it analyses the changing Indian policy on missile defence programme amidst positive developments in Indo-US relations that took place in the post-Cold War period, mainly during the Bush regime.

This paper proposes that along with the structural factors such as the changed international scenario after the Cold War, India's rapidly growing economy, which has the potential to compete with China, the concurrent growth of India's military capability that could contribute to the strategic stability in the Asian region and the growing threat of Islamic terrorism, has resulted in new convergences in geo-political and geo-economic interests between the US and India. This strategic convergence could be seen in many aspects of a bilateral relationship, be it in economic, political, nuclear energy or defence sectors. But the growing threat of weapons of mass destruction (WMD) and threat from nuclear weapons going into the hands of rouge states and states with poor nuclear non-proliferation records has been guiding Indo-US courtship in the missile defence arena. In the coming years, missile defence will emerge as one of the more important components of the Indo-US bilateral relationship.

India's Threat Perception and Need for Missile Defence System

India's own indigenous missile defence shield originates from its threat perception from China and Pakistan. Pakistan, with its various short- and medium-range missiles, has the capability to hit major targets in India; and China, with its huge arsenal of solid-fuelled missiles, is the most potent threat to India. The Chinese upper hand in force level and its intermediate-range ballistic missiles (IRBM) and medium-range ballistic missiles (MRBM) that can reach India's farthest corners increases India's anxiety.¹ Despite the indigenous development of systems such as Akash and Trishul, and the planned acquisition of foreign air defence and limited-range theatre defence systems, it is clear that these systems would not be adequate to address all conceivable threats. As a result, the requirement for comparatively longer range interception technologies to tackle a large gamut of faster missiles in

the neighborhood pushed India's search for systems beyond the realm of indigenous programmes and friendly imports. Although Akash and Trishul projects were part of the Integrated Guided Missile Development Programme (IGMDP) launched in 1983, substantive planning to construct a missile defence shield seemingly began in the 1990s, after reports of Pakistan's deployment of Chinese missiles and a global momentum in favour of missile defences. Since then, India has been pursuing various options, including deliberations with friendly countries, to explore the best available systems to build a Ballistic Missile Defence (BMD) network.²

But India's recent urgency in missile defence programme could be seen in the context of threats arising from Pakistan's nuclear arsenals. The Bhartiya Janta Party (BJP)-led National Democratic Alliance (NDA) government was apprehensive that India would be the main target in case of Pakistan's nuclear arsenal falling into unsafe hands. India also feels that any future India-Pakistan war would not remain purely conventional and that Pakistan would not mind flaunting its nuclear arsenal to defeat India's conventional capability.³ India's strategic thinkers perceive that Islamabad might have an edge in missile capability that prompts them to pursue a proxy war in Kashmir.⁴ Also, Pakistani proliferation of nuclear and missile technologies by the A Q Khan network and Islamabad's volatile nuclear stance⁵ necessitated India's search for a countervailing strategy and a credible and deterring missile defence capability. In addition, recent revelations, confirmed during a Senate hearing by Admiral Michael Mullen, Chairman of the Joint Chiefs of Staff, in May 2009 about Pakistan increasing its nuclear weapons⁶ amid continued concern about the security of Pakistan's nuclear arsenal, further necessitates the urgency of India's missile defence programme. Missile defence would, therefore, offer an added guarantee and shield that could assist India in defusing nuclear blackmail by Pakistan without deflating its own nuclear stand of 'no first use'.

Origin of India's Missile Defence Programme

Since the beginning of the 1990s, India has been facing the danger of ballistic missile attacks from Pakistan against which it has fought multiple wars in the past. Introduced in light of the ballistic missile threat from Pakistan and China, India's missile defence programme began in 1995. Responding to Pakistan's procurement of the M-9 and M-11 ballistic missiles from China,

the Indian government bought six batteries of Russian S-300 surface-to-air missiles (SAMs) in August 1995 to protect New Delhi and other cities. With Pakistan's testing of nuclear weapons and missile delivery systems, and heightened tensions during the Kargil conflict, including the possibility of a full-scale nuclear war in 1999, the progress of acquiring Anti-Ballistic Missile (ABM) system intensified.

India already had its own nuclear deterrence in place; the Prithvi missile was ready, and the Agni was being tested. Unlike the high-pitched promises that accompanied the Trishul and Akash anti-aircraft missiles, the ABM programme was kept clandestine, even from close watchers of the DRDO. But Pakistan was considered unpredictable and, in 1996, the Ministry of Defence (MoD) asked its scientific advisor APJ Abdul Kalam whether India could quickly develop protection against an incoming Pakistani ballistic missile. Kalam, who was already overseeing the IGMDF, began feasibility studies on an ABM programme as well. DRDO's first challenge was to develop a radar that could pick up enemy ballistic missiles being launched from 300 km away. The longest range Indian radar at that time was Rajendra, with a range of 60 km, and there simply was no time to develop a long-range radar from scratch. The only option left with them was foreign collaboration.

The first country that DRDO approached was Russia. However, the conditions in Russia – with defence research and development (R&D) at an all time low – made the DRDO look elsewhere. The option that attracted the DRDO scientists was the Israeli ABM programme – the Arrow-I based upon the long-range Green Pine radar. A delegation was sent to Israel, but in vain. India could not acquire the Israeli system because the Green Pine radar incorporated American technology and it was turned down. But India was successful when Israel agreed to collaborate in building a long range tracking radar (LRTR). India and Israel have jointly developed the LRTR, which bears target acquisition and fire control radar for Prithvi Air Defence (PAD) Missile System. The LRTR has the capability to detect multiple targets.

Also needed for the system was a guidance radar to track incoming enemy missiles. The Electronics and Radar Development Establishment (a DRDO laboratory) developed that radar in collaboration with a French company, Thales. With the radar problems solved, government sanction was obtained in 1998 to develop an ABM system. But the project remained a secret because

an ABM system is controversial. Besides, that year, India's nuclear tests had resulted in international sanctions. India was collaborating with these two countries, but the international climate was not favourable for India. In the wake of nuclear defiance by its atomic test in 1998, India faced severe sanctions and if it had publicised its ABM programme, the collaborations could have been terminated or interrupted. They had to be kept low profile. Though the radars were a collaborative effort, the interceptor missiles were developed entirely by the DRDO. So were the mission control centre and the launch control centre, which are the nerve centres of the system.⁷

Present Status of India's Anti-Ballistic Missile Defence Programme

The Indian Ballistic Missile Defence Programme, an initiative to develop and deploy a multi-layered ballistic missile defence system, is a two-tiered system consisting of two interceptor missiles, namely Prithvi Air Defence (PAD) missile for high altitude interception, and the Advanced Air Defence (AAD) missile for lower altitude interception. The two-tiered shield will be able to intercept any incoming missile launched 5,000 km away.

The PAD was tested in November 2006, followed by AAD in December 2007. With the test of the PAD missile, India became the fourth country to have successfully developed an ABM system, after the United States, Russia and Israel.⁸ The December 2007 test was conducted by DRDO with two missiles – a modified Prithvi missile fired from Chandipur-on-Sea to simulate an incoming enemy missile and an AAD interceptor missile fired from the Wheeler Island in Bay of Bengal to defend against and destroy the hostile missile. This ABM system was apparently a modified version of the indigenously designed and developed Akash medium-range SAM based on the foundation technologies, manpower, expertise, experience and infrastructure developed during the Akash SAM project that formed part of the IGMDP started in the early 1980s.⁹

On 06 March 2009, India again conducted a successful test of its BMD system on its eastern coast, in Orissa. The target used was a ship-launched Dhanush missile which followed the trajectory of a missile with a range of 1,500 km. The target was tracked by Swordfish (LRTR) radar and destroyed by a PAD missile at 75 km altitude.

The ABM defence system comprises integration of LRTR, fire control radar, mobile communications terminal and mobile launcher-fired interceptor missiles, which make it technologically complex. These tests are a significant step forward in establishing a credible missile defence system, capable of detecting, intercepting and destroying medium- and long-range ballistic missiles.¹⁰

At present, the Indian army has already acquired missiles which carry conventional warheads but can be fired from mobile launchers. India has also built an array of nuclear-capable missiles, and is likely to test-fire IRBMs and inter-continental ballistic missiles (ICBMs) by 2010-11. Two new anti-ballistic missiles that can intercept IRBMs/ICBMs are being developed. These high speed missiles (AD-1 and AD-2) will be able to intercept ballistic missiles with a range of 5,000 km.¹¹ These new missiles will be similar to the Theatre High Altitude Area Defence System (THAAD) missile deployed by the US. These missiles will travel at hypersonic speeds and will require radars with scan capability of over 1,500 km to successfully intercept the target.¹² The Agni-V will have an ICBM range in excess of 5,000 km. Although not fully operational, the shorter range Agni-I and Agni-II ballistic missiles are being introduced into India's arsenal. An Agni-III with a 1.5-tonne payload capacity and a range of 3,500 kilometres – enabling it to strike targets deep inside China – has been tested successfully thrice.

Looking at missile threats from the hostile neighbourhood, India is eyeing an effective BMD system, with an overlapping network of early-warning sensors, command posts and anti-missile land- and sea-based missile batteries. Having tested its anti-missile defence system thrice, India is giving thrust on fully developing a two-tier BMD system, capable of tracking and destroying incoming hostile missiles both inside (endo) and outside (exo) the earth's atmosphere.

According to DRDO, the BMD system capable of taking on a 2,000 km-range missile will be available for deployment by 2011-12. The Phase-II, in turn, will be geared towards tackling threats from missiles up to 5,000 km. However, interception of an enemy missile demands high levels of exactness and accuracy in terms of detection, tracking and point-kill capabilities and a number of tests will be required to finetune the system. To that level, the Indian ABM tests, so far, are successful manifestations of its scientific research and technological advancement in this field.

Indian scientists are developing a laser based weapon system as part of the BMD to intercept and destroy missiles soon after they are launched towards the country. According to DRDO's air defence programme director V K Saraswat, it is ideal to destroy a ballistic missile carrying nuclear or conventional warhead in its boost phase. Saraswat informs that it is an involved process and not just about producing lasers. Many systems like the surveillance and tracking systems need to be put together for such a system to work. It will take another 10-15 years for the premier defence research institute to make it usable on the ground.¹³

However, the actual space and role for missile defence in India's security calculations continues to be a hypothetical construct, owing to divergent perceptions on actual threats, ambiguity on choosing between indigenously developed and foreign systems, and lack of clarity on suitable architectures that can serve India's purpose with minimal consequences for regional stability. There are sections in India which are cynical about the largely unproven BMD technologies and the massive costs involved in developing or acquiring such systems. Nonetheless, there is greater acceptance in the country on the need to invest in affordable interception capabilities, be it through the indigenous route or through other sources of technology assimilation.¹⁴

With both China and Pakistan fielding a wide variety of nuclear-capable ballistic missiles, BMD capabilities have become a crucial necessity and the Indian ABM programme has reached a level where it can't be affected by any international sanctions. DRDO has acquired a degree of self-confidence, which allows it to acknowledge the role played by other countries. International collaboration is no longer taboo.

US Missile Defence: Technological Evolution

The first time National Missile Defence Shield came into existence was during the Reagan presidency in 1983. The Reagan administration proposed the Strategic Defence Initiative (SDI), a military research programme for developing an ABM defence system, and vigorously sought acceptance of SDI by the US Congress and its North Atlantic Treaty Organisation (NATO) allies. It was described as the system that would protect the United States from a nuclear attack. The SDI system was initially intended to offer a layered defence employing advanced weapons technologies, a number of which were

only in the R & D stage.¹⁵ It aimed at intercepting incoming missiles in mid-course, high above the earth. The concept of SDI marked a sharp break with the nuclear strategy that had been followed since the development of the armaments race. This strategy was based on the concept of deterrence through the threat of retaliation. More specifically, the SDI system would have contravened the ABM Treaty of 1972. For this reason and others, the SDI proposal was attacked as a further escalation of the arms race and was considered impractical.

After that, it resurfaced during the Clinton administration, when threats started emanating from states such as North Korea and Iran, which began flaunting their missile capabilities. But due to factors such as the disintegration of the Soviet Union in 1991, the signing of START I and START II treaties, the SDI received less budgetary support from the administration. But it was President George W Bush who took the firm initiative and drafted the comprehensive outline of missile defence system in 2001. The 9/11 attacks further intensified Bush's tenacity. In 2002, the Bush administration withdrew from the ABM Treaty so that it could pursue more vigorous testing of a missile defence programme. The same year, the Ballistic Missile Defense Organisation (BMDO) was renamed the Missile Defence Agency (MDA), but the efforts continued to draw criticism from scientists as also other nations. President Bush set the broader contours of this scientific re-embodiment through a strong structural design that conceived of intercepting and destroying enemy projectiles at various stages of flight.

The whole range of military strategy and associated systems to shield an entire country against incoming missiles are presently under development in the United States. These interception systems represent a new coating of baseline technologies, which when positioned in a multi-layered structural design, would be able to intercept missiles by missiles or possibly by lasers. They could be intercepted near the launch point (boost phase), during flight through space (mid-course phase), or during atmospheric descent (terminal phase). Conventional thinking propounds that defensive mechanisms would be positioned at the 'theatre' to be protected. The layered system redefines this thinking by seeking to destroy the weapon 'farther out', thereby preempting not just the enemy missile but also any potential damage to the protected area. The Terminal Phase, or the theatre defence segment, is

currently the phase that can boast of total technological maturity in the US inventory. There are three notable US systems developed for this phase—the Patriot Advanced Capability-3 (PAC-3), the Arrow-2 ABM, and the THAAD system.

PAC-3 missile programme, a stepped up version of the first generation Patriot air defence system used in the first Gulf War, will provide essential advantage in battle space, accuracy, and kill potential. It has a 15-km-plus range at Mach 5 speed and is viewed as ideal for air defence against slower, low-flying missiles and other air-breathing threats.¹⁶ The Arrow-2 is the other terminal phase interceptor that is currently operationalised. It is the first missile developed by Israel and United States that was specifically designed and built to intercept and destroy ballistic missiles on a national level.¹⁷ The two-stage solid-fuel system enables it with a 90 km plus range to operate in the upper layers of the endo-atmosphere. The main attraction of this system is Elta's Green Pine radar that can detect and track targets at a distance of over 500 km. Although PAC-3 and Arrow operate inside the earth's atmosphere, the THAAD missile system, an easily transportable defensive weapon system to protect against hostile incoming threats such as tactical and theatre ballistic missiles at ranges of 200 km and at altitudes up to 150 km, provides an extended theatre defence capability to intercept missiles in the threshold of endo- and exo-atmosphere which would reduce post-kill damage.¹⁸ Another terminal phase missile known as Medium Extended Air Defence System (MEADS), is being developed in coordination with Germany and Italy.¹⁹

Countries such as Israel, Japan, and South Korea are already fielding the PAC-3. India has also acquired PAC-3 and is aiming at Arrow II Missile system as part of its comprehensive missile defence shield. Arrow II is a defence against short and medium-range missiles, the kinds that Pakistan possesses. Another Terminal phase THAAD missile could be very useful and suitable for India's extended endo-atmospheric interception applications. The mid-course phase of a ballistic missile trajectory, an important and difficult phase of the US BMD, allows the longest window of opportunity to intercept an incoming missile for up to 20 minutes. This is the point where the missile stops thrusting, to follow a more predictable glide path. The mid-course interceptor and a variety of radars and other sensors have

a longer time to track and engage the target, as compared to boost and terminal interceptors. Also, more than one interceptor could be launched to ensure a successful hit. The Midcourse Defence Segment has ground- and sea-based elements.²⁰ The MDS has two primary segments – Ground Based Midcourse Defence (GBMD) and Aegis Ballistic Missile Defence (Aegis BMD).

The GBMDS became fully successful with two interceptions in September 2006 and September 2007. GBMDS had to face many rounds of developmental failure. The MDS has put major stakes on the GBMDS as it could be the primary mid-course interceptor that is being fielded in Alaska and Vandenberg as also for its East European BMD deployments in Poland and the Czech Republic. Presently, the only operational mid-course interception system is the Aegis BMD.²¹ Also referred to as the Sea-Based Midcourse or Navy Theatre Wide (NTW), this sea-based system is intended to intercept short to medium range hostile missiles in the ascent and descent phase of midcourse flight. With exo-atmospheric interception and deployment flexibility, the Aegis has the dual functionality of being a first-tier interceptor on the high seas as well as that of a forward-deployed early warning system, if at all the first interception opportunity is lost.²²

Intercepting a missile in its boost phase is the ideal solution. The boost phase is the part of a missile flight path from launch until it stops accelerating under its own power. Typically, the boost phase ends at altitudes of 300 miles or less, and within the first 3 to 5 minutes of flight. During this phase, the rocket climbs against the earth's gravity. This technological advancement can defend a large area of the globe and prevent mid-course decoys from being deployed by destroying the missile early in its flight. Of the boost phase defences, the Airborne Laser (ABL) is the most mature. Development in the boost phase missile defence has two elements, namely the ABL with directed energy systems using high power lasers, and a kinetic energy interceptor, which is a three-stage, high-energy mobile interceptor meant to destroy missiles in boost or (early ascent) mid-course phases. Boost phase elements will be integrated into an overall BMD operational concept. Sensors developed in this segment will have multi-mission capabilities intended to provide critical tracking data for ballistic missiles in all phases of flight.²³

Apart from these baseline BMD technologies, there are subsidiary systems in the US inventory that can be categorised as augmented air defence systems with point and area defence applications. The most noteworthy among them are the Sky Shield and the Skyguard. The Sky Shield 35 uses a unique 35-mm Advanced Hit Efficiency and Destruction (AHEAD) shell that ejects sub-projectiles on the path of the incoming target, especially aircraft and short-range missiles. Another system of this variety is the HAWK ADS—supposedly the world’s most advanced all-weather, medium-altitude air defence system in service since the 1960s.²⁴

These systems would hold interest for India as cheaper utilities for its lower-tier air and limited-TMD applications. The concept New Delhi has to pick up from this technological spectrum is the diversity of interception capabilities that could be considered for acquisition when the Indian BMD architecture is designed. Although many of the high-end interception technologies mentioned above are still maturing, it should be noted that Indian defence forces are already considering some of these augmented air defence systems for their extended point and area defence applications.²⁵

Indo-US Missile Defence Cooperation

When the SDI missile defence system was first introduced in 1983 by the Reagan administration, it received criticism from India on the grounds of SDI being against the norms of disarmament and perhaps leading to another nuclear race. However, when it again resurfaced during the Bush administration, India was one of the first countries to endorse it. After a conversation between National Security Adviser Condoleezza Rice and Minister of External Affairs (MEA) Jaswant Singh, the Indian Foreign Ministry lauded President Bush’s new framework for “seeking to transform the strategic parameters on which the Cold War security architecture was built.”²⁶ This endorsement by the Vajpayee government provoked controversy both within the country and abroad. In India, some strategic analysts questioned the government’s action on the ground of “an over-hasty endorsement” of Bush’s plans while others complimented the government’s decision.²⁷

The Vajpayee government’s decision to endorse the Bush National Missile Defence (NMD) programme was to save India’s strategic nuclear autonomy, which it had sought so persistently at Pokhran and certainly designed to have

security from its hostile neighbour. A nuclear first strike would be more difficult, if not impossible, under an NMD regime. President Bush's statement that the NMD was aimed at "states for which terror and blackmail are a way of life" led to hopes that Pakistan would fall under this rubric. Pakistan has been ranting the world over with the argument that Kashmir is a "nuclear flashpoint", internationalising the issue and thus seeking international intervention. Analysts have been stressing the point that the NMD regime once in operation would neutralise the offensive capacity of Islamabad and New Delhi's other adversary, Beijing.

Commenting on the Chinese stand on the NMD, one of India's premier strategic analysts K Subrahmanyam opined that Beijing's reaction to the NMD should be India's primary concern. Officials point out that China is a signatory to the nuclear non-proliferation treaty (NPT). Article 6 of that treaty commits its signatories to reduce their nuclear arsenals. But Beijing has done the opposite. It has increased its arsenal both in terms of quantity and quality. Analysts note that the Bush proposal echoed earlier Russian calls for weapons cuts and de-alerting. Beijing alone resists the trend. The NMD also exposed inconsistency in China's nuclear posture. Beijing publicly claims to embrace a no-first use policy. Missile defence only matters if a country wields weapons, not if it scabbards them. Therefore, the NMD should not have aroused such strong criticism from Beijing. Interestingly, China is not averse to theatre missile defence systems – missile defence systems that cover small regions – in Europe. On the other hand, it opposes vehemently such systems in Asia. Many pointed out that if China is pursuing double standards, then the NMD becomes more vital.

Under Next Steps in Strategic Partnership (NSSP), the US began debate on the missile defence programme. The initial talks saw the State Department less than enthusiastic about such cooperation. The non-proliferation bureaucracy was concerned about the impact of missile defence sales to India on Indo-Pak nuclear stability. Opposition to comprehensive Indo-US cooperation on missile defence in the US, the issue of nuclear stability and probable reaction from China tried to dampen this missile defence programme. The Pentagon, however, was determined to broaden the base of the talks on missile defence with India and agreed to give briefings first on Patriot II and later on more advanced Patriot III systems. When the United Progressive Alliance (UPA)-

led by Congress came to power after NDA, at the political level, enthusiasm dwindled, but missile defence cooperation under NSSP continued.²⁸

At the macro level, Indian Prime Minister Manmohan Singh kept the pace of this evolving Indo-US relationship rolling. The historic Indo-US nuclear deal²⁹ meant to serve the energy security interest of India was signed in July 2005. Although it aims at nuclear energy cooperation between two nations, the fact is that its purpose goes beyond. The Indo-US nuclear deal is focused on the issues such as energy security, nuclear safety cooperation, and integrating India into the global nuclear regime so as to address India's desire for renewed access to safeguarded nuclear fuel and advanced nuclear reactors. Also, it underpins the ongoing defence cooperation with the US, in which missile defence is emerging as an important component.

India and the United States have been deeply engaged in all aspects of a bilateral relationship³⁰ and exploring the possibility of bilateral cooperation on missile defence. According to Secretary of Defence, Robert Gates, "We're beginning to talk about conducting a joint analysis on what India's needs would be in the realm of missile defence, and where co-operation might help advance that."³¹ Gates' announcement came in the wake of persistent reports in the media that US aerospace majors, such as Lockheed Martin with its Patriot system, were keen to involve with India's homespun ballistic missile defence (BMD) programme, which has made impressive progress recently. Closer strategic ties with the US and the gradual acquisition of American military equipment have prompted Washington to push the relationship further. Other aerospace majors, apart from Lockheed, who could become partners in such a programme, include Boeing, Raytheon and Northrop Grumman Corp, all of whom have developed advanced systems in the air, sea and space based segments of a BMD system. At present, more than 50 defence-related US companies are represented in India.

The Indo-US missile defence cooperation, which is still at an early stage, is part of an evolving strategic partnership between the two countries. Until now, India's policy has been to develop its missile shield domestically. However, India signing a deal with the United States to buy six C-130Js worth about \$1 billion,³² is a shift from its previous heavy reliance on Russian transport planes. It offers a potential multi-billion dollar market to US companies in the missile defence system.

In the coming days, India might need to focus on the development of space-based early warning system to supplement the existing radar network. This is vital to envelop the entire geographical landscape of Pakistan. This could allow for enhancing the performance of early warning capabilities. The noble idea would be that India should invest in developing its own expertise in this field, which India is technologically capable of. A pilot project may be started by utilising existing network of satellites in the low earth orbit namely the IRS (Indian Remote Sensing) and Cartosat (I, II and IIA) series. Subsequently, India could establish a dedicated network of mini and micro satellites and near-space platforms like high altitude balloons and blimps. But in the current scenario, the US DSP (Defence Support Programme) and SBIRS (Space Based Infra Red System) give information to the NATO forces within the region. This network also makes data available to states like Israel, South Korea and Japan. In this regard, the Indo-US cooperation in the missile defence area becomes important. On the one hand, India can continue with its own indigenous efforts, but on the other, India could look for help from the US, in this regard, as a temporary measure.³³

India and the United States are in the direction of signing a Memorandum of Understanding (MoU) in ballistic missile collaboration. The discussions at the preliminary level on possible collaboration on missile shield systems to enhance cooperative security and stability have been reported.³⁴ These talks are at the scientific and technical level under the Joint Technical Group, a sub-group of the overall Defence Policy Group structure, which has been guiding the Indo-US defence cooperation since its inception in 1996.

Accordingly, American defence officials and scientists have conducted some simulations and a couple of live tests of the US missile defence system with their Indian counterparts. The US is offering to sell the PAC-3 system to India and as New Delhi is pursuing its own BMD, it welcomes any assistance from Washington. The US' interests in entering into a collaboration with India in the areas of missile defence cooperation does not mean that this proposed American missile defence shield is on the lines of Poland and the Czech Republic, which led to major diplomatic tensions between US and Russia. Incidentally, both Russia and Israel have also made similar technical demonstrations – on their anti-tactical ballistic missile systems 'S-300V' and 'Arrow-2', respectively – to India in the past.

Missile Defence Collaboration with Israel, Russia and European Nations

Apart from the US, India has been in close cooperation with Israeli and Russian missile defence programmes. Israel has made excellent advancement in missile defence and has become a major player in interception technologies at the global level. The Arrow II system is the most sought-after Israeli missile defence interception technology. Its origin dates back to 1986 when Israel needed to shield itself from Iraqi Scud missiles. The Arrow Weapon System (AWS) is supposedly a far reliable defence shield than the Patriot missile defence system demonstrated by the US during the 1991 Gulf War. The Arrow II has the capability of detecting and tracking up to 14 incoming missiles. Its usefulness lies in it to be stationed along the Line of Control (LoC) to secure population and military establishments in Kashmir.³⁵ Besides the Arrow system, Israel has developed a series of augmented air and theatre defence systems. Prominent among them are the Barak anti-ship missile, Spyder, Hawk, and Nimrod—all with augmented air defence capabilities. A short-range interceptor called 'Iron Dome' and medium-range interceptor called 'Magic Wand' is under development.³⁶

India wanted to buy the Israeli Arrow-2 system from Israel, a deal which required US endorsement. However, America expressed its helplessness to sell the Arrow, citing Missile Technology Control Regime (MTCR) commitments, and in its place, offered the PAC-3. India acquired the Green Pine early warning and fire control radar associated with the Arrow II Anti-Tactical Ballistic Missile (ATBM) and the Phalcon Airborne Warning and Control System (AWACS) from Israel. The Indian Navy got the Barak anti-ship system to be co-produced in India and the Indian Air Force (IAF) is looking for induction of Spyder system to fill its air defence requirements from Israel.³⁷

The European countries also offer a variety of missile defence technologies. The most important of them is the MBDA's Aster SAMP/T, a limited-TMD system incorporating the Aster-30 missile, in service since 2001 and designed for point defence against lower-tier threats. Aster is a family of SAM missiles manufactured by Eurosam, a European consortium consisting of MBDA France and Italy (combined 66%) and the Thales Group (33%).³⁸ The Spada 2000 is another MBDA product. This all-weather air defence system provides air

defence missile coverage of 2,000km². Target detection and tracking range is up to 60 km and the missiles can intercept crossing and approaching targets to a range of 25 km. The kill probability is high, even against highly agile crossing targets. The system can engage up to four targets simultaneously with Aspide missiles.³⁹ Pakistan is reportedly negotiating with Italy for the Spada 2000 and is also known to be seeking the MBDA Aster SAMP-T. India can also survey these missile defence systems and procure them, if they fit into India's missile defence programme.

Like USA, Russia too has a varied array of missile defence and interception technology but displays a different deployment character. The Russian interception technology is fully advanced and equipped with both endo and exo-atmospheric interception capabilities. However, its concentration is on theatre defences and extended air defence capabilities, with the objective of building a consolidated network that can be utilised against all possible aerial threats. This implies integration of ABM and air defence systems as operationally compatible components in a comprehensive multi-tier architecture. Russia employs a unique BMD architecture comprising the ABM-1, ABM-2, and ABM-3.⁴⁰ Apart from these, the strength of the Russian missile defence system is its theatre defence and augmented air defence platforms. The Russian theatre defence venture mainly consists of the S-300, the S-400, and the S-500 programmes. The S-300 is developed in two variants: S-300P (SA-10/PMU Grumble) and S-300V (SA-12A Gladiator, SA-12B Giant). China has variants of the S-300 in its inventory. India was also reportedly offered the same.⁴¹

The Indian missile defence programme is collaborating with Russia too. The Russian proposal of helping India to build a missile shield in 2001⁴² and its offer to transfer S-300V and S-300PMU systems during Defence-Expo in New Delhi were positive steps in that direction.⁴³ The S-400 (SA-20 Triumph), which is Russia's new air defence system with ABM utility, is an upgrade of the S-300 with an over 400 km range.⁴⁴ The S-500, with an intended range of over 3,500 km, is an ambitious project planned to match the US mid-course interceptors. According to Russian Air Force Commander, Colonel General Alexander Zelin, Russia is developing compact and manoeuvrable fifth-generation ABM systems that "combine the elements of air, missile and space defence for targeting enemy system deeper into space", implying an effort

to gain exo-atmospheric and Anti-Satellite (ASAT) capabilities. This will be something which might interest India depending upon its requirements.⁴⁵ Russia has also placed huge stakes on augmented air/limited TMD systems such as the Pechora, OSA, Iglu, Tor, and Strela, some of which are used around the world, including in India. Of particular interest to India would be the mobile Tor-MI system,⁴⁶ which could be a utility component in an augmented air defence environment if India prefers to have dedicated systems for point defence.

Inadequacy and Shortcomings of the Existing Network

From the above, it is clear that India is developing its own missile defence system and collaborating with other nations having better technological advancement to defend its territory against possible attacks from Chinese and Pakistani missiles. There is little apprehension that the existing air defence set-up is formidable and presents an effective challenge to aerial attacks upon airbases and important installations in India. With upgrades to radars, aircraft and missiles, this network is likely to remain a viable defence against air and cruise missile attack for the foreseeable future.

However, though India will continue to face a threat from air-attacks, the principal menace comes from short, medium and intermediate range ballistic missiles launched by Pakistan and China. In time, these will be augmented by stealth cruise missiles and represent a clear and present danger to the entire landmass of India - no target, no matter how far from the borders is immune from attack. The current air defence network has many shortcomings with respect to dealing with these future threats and it is worthwhile to summarize these shortcomings before looking at what needs to be done to upgrade India's defences:⁴⁷

- At present, SAM defences are confined to relatively short-range defence of target points. Area defence is almost exclusively the preserve of manned interceptors.
- Many of the principal long-range 3-D surveillance and GCI radars are ageing. Most of the systems are of 1980s vintage and, despite being upgraded, would provide inadequate detection capabilities against stealth cruise missiles and ballistic missiles.
- Neither the Air Defence Ground Environment System (ADGES) nor Base Air Defence Zones (BADZ) system is truly nationwide. Defences

are concentrated at targets within aircraft range from Pakistan and China. Defences are wholly inadequate around targets deep within India's heartland and in the south.

- Neither India's SAMs nor manned interceptors have any meaningful capability against ballistic missiles.
- The entire system is insufficiently hardened to survive an attack by ballistic missiles. It cannot be ruled out that initial attacks would be aimed at suppressing defences prior to a nuclear strike.

In addition to these fundamental shortcomings, it is also essential to point out that the ADGES network was designed at a time when the missile threat to India from China was at best existential and, from Pakistan, non-existent.

The limitations on accuracy of missile defence systems remain an important issue of concern in the BMD system. Regarding the performance of the Patriot defence missile in the Gulf war and of high-altitude missile defence systems, test preparations for projected systems prior to manufacture and deployment in the US shows that when the new ballistic missile defence system is used in combat, they have not yielded intended results. It puts a question mark on the effectiveness of these systems.

In fact, there is global susceptibility as far as accuracy and foolproof protection is concerned. A BMD system can be overwhelmed by a flurry of ballistic missiles. A nuclear attack also could be launched by using deep penetration strike aircrafts and BMD technology offers no resistance to it. Moreover, it's quite vulnerable to cruise missiles since they evade enemy radars by flying at low altitudes, virtually hugging the terrain. India's endo-atmospheric system may be able to tackle the cruise missile travelling at lower altitudes to a certain extent. Destroying a nuclear missile just 10-15 km above ground may only lessen the level of damage but would not warrant foolproof protection.

According to Nathan Hughes, a defence and military analyst at the Texas-based geo-political intelligence company Stratfor, the limitation for India has not been the lack of a desire to field the systems, but the technical limitation that they are not ready. Even with Akash, it is not at all clear that the missile has meaningful operational capability against Pakistani missiles and cruise missiles which present a very different targeting challenge.⁴⁸

However, military experts are of the opinion that looking at the recent developments in the missile defence system, it is unlikely that the systems will fall totally short, but the evidence indicates that they will perform considerably below either tested, near-perfect intercept rates or predicted kill rates. Accordingly, India can also rely on the ballistic missile defence mechanism to make Pakistan's no to "NFU" policy less potent, provided Indian missile defence technology advancement takes cognizance of and tackles low altitude missiles of its adversary.

Conclusion

India's missile defence programme's impressive progress and its collaboration with the United States and other countries such as Israel creates uneasiness in China and Pakistan. To counteract the growing Indo-US missile shield cooperation and the US NMD and TMD programme, China might go for an increase in its nuclear arsenals and ICBMs, including numerous other counter-measures. China is also known to be considering Multiple Independently Target Reentry Vehicle (MIRV) warheads as another method to break through the NMD and TMD shields of the US and its allies. China will also endeavour to further improve its nuclear warhead technology to make warheads more compact, lighter and more efficient with a better explosive yield to weight ratio. Once developed, China could employ all such capabilities against India. As a result, India will be left with no option but to develop some of these capabilities for itself to qualitatively raise the level of its deterrence against China.⁴⁹ Also, the possibility of Pakistan joining the fray and further escalating the arms race in the region, cannot be denied.

India needs an unfailing and perfect missile shield against burgeoning nuclear weapons and missile threats. Today, Indian missile defence technologists are addressing key technical challenges which need to be taken care of, before integrating the missile shield into the existing force architecture, including integrating long-range sensors, surveillance technologies, and external cueing systems; managing information fusing for different levels of threat complexity and defence system interoperability; and developing the requisite kill assessment algorithms associated with intercept endgames.⁵⁰ India must address these technological concerns before making the system fully operational. To make its nuclear deterrence more reliable and protect

important political, economic and strategic targets, India needs either ABMD system or a permutation of ABMDS and TMDS. BMD's development involves high risk and brings a burden on the national exchequer. India can't afford to go it alone in the long run. It will have to enter in international collaboration with friendly nations which are willing to enter in mutually beneficial agreements and work to develop ballistic missile shields for the future. International collaboration will certainly lead to substantial advancement in India's nuclear deterrence.

At present, the Indo-US relationship is witnessing a robust bilateral relationship in the form of the strategic partnership. The recently concluded Indo-US civilian nuclear deal is part of a larger set of initiatives involving space, dual-use high technology, advanced military equipment and missile defence. This would lead to dismantling of the technology denial regimes that had constrained Indo-US cooperation and commerce in defence technology earlier. The deal would strengthen Indo-US defence ties as it expands the scope of the NSSP and HTCG and open up avenues for India to commerce in dual use technology including missile technology with the US. Indo-US collaboration in missile defence is going to be advantageous in the long run as it is going to lessen the burden on the Indian exchequer for developing accurate counter-measures against the looming Chinese and Pakistani missile threat.

Therefore, it is in New Delhi's interest to use the Indo-US strategic partnership to press forward and enhance its own perception of strategic defence; address the key technological challenges being faced by its indigenous missile defence programme; strengthen its own ongoing R&D endeavor in missile defence; and secure commitments from Washington to sell the most sophisticated missile defence systems needed to defuse specific missile threats facing India while scanning a range of American, Russian, Israeli, and European missile defence systems and sub-systems for their relevance to India's long-term needs. As it is unlikely that these countries are going to accept one-way transfer of such high-end technology, India should mull over entering into a collaborative agreement for the joint development of future BMD systems with one or more of them. As far as the United States is concerned, it can get benefits by making inroads into India's lucrative defence market and by collaborating with Indian missile defence programmes, reduce its R&D cost and access India's recent scientific & technological advancements

in missile technology. As a final point, India must identify its envisaged threats, evaluate its own technological constraints to face them, and collaborate with international players like US, Israel, Russia, etc. to build a missile defence architecture to enhance its air defence and nuclear deterrence capability and ensure nuclear stability in the subcontinent.

Notes

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