CENTRE FOR STRATEGIC AND CONTEMPORARY RESEARCH

CSCR

Perspectives
Issue No. 26

24 June 2021

Ballistic Missile, Missile Defence, and Arms Race: Past, Present, and Future

Author: Samran Ali*

Key Points:

- Ballistic missiles and their defences were an important feature of the Cold War arms race between the United States (US) and the Union of Soviet Socialist Republics (USSR).
- The development of ballistic missile defences (BMDs) is now fuelling the development of new technologies such as hypersonic weapons, with China as the third player.
- The US has more role and responsibility in the current arms race, withdrawal from arms control treaties and developing capabilities that have serious implications for the Russian and Chinese nuclear forces.
- Despite the large sum of money and efforts gone into the development of BMDs in the US, their performance remains controversial.
- So far, Russia and China have refrained from developing strategic BMDs despite having the capability and know-how.
- Expansion of BMDs in the US can decrease the support for strategic arms control in Russia and China.
- In the regional context, India's development of BMDs and hypersonic weapons pose a serious threat to Pakistan.

INTRODUCTION

Ballistic missiles, defence against them, and the ensuing arms race by these weapons systems have been an important component of the Cold War between the US and the Soviet Union. Both countries had developed ballistic missiles of different ranges to hold each other at risk and tried to achieve parity by developing a large number of warheads and delivery platforms. Furthermore, to secure their important cities and assets, both sides also started developing ballistic missile defences. The efforts to maintain parity against the adversary resulted in an arms race that had risks of turning the Cold War into an actual war.

Today, more powers not only possess ballistic missiles and their defences but are also developing advanced hypersonic weapons. China has emerged as a third important military power possessing a variety of firepower affecting the US-Russia dyad. Regional theatres such as India-Pakistan are also becoming equally important in this new nuclear age. The deployment of BMD systems across the world specifically the US, is now fuelling the development of new types of weapons such as hypersonic missiles and may result in an increased arms race in the future.

WHAT ARE BALLISTIC MISSILES?

Towards the end of World War II, (WWII) when nuclear weapons were developed and used, questions about the delivery of these weapons were also raised. The concept of air superiority and strategic bombardment had matured during that time. It was, therefore, used extensively to break the enemy's morale and will to fight by bombing its social, economic, and industrial hubs. When the first nuclear bomb was dropped from an aircraft in 1945, bombers became their primary

* Samran Ali is a Research Assistant at the Center for International Strategic Studies, Islamabad

delivery system. The prominence of the air force, particularly long-range bombers, grew manifolds during this period. But the airpower had limitations in terms of delivery, range, and survivability as aircraft could be traced and downed.

With the introduction of V-2 rockets by the Germans during WWII and the subsequent maturity of the technology in the US and Soviet Union, ballistic missile technology became not just an alternative but also an efficient means of delivering nuclear weapons.[1] The missiles were needed to be powered only during their boost phase and could reach continental ranges with fair chances of striking the target. With time, the issues of accuracy were solved. Since the 1960s, Intercontinental Ballistic Missiles (ICBMs) have been an important part of nuclear deterrence and are now developed by all world major powers. Both the US and the USSR had developed thousands of ballistic missiles of varying ranges within the ten years of their initial successful testing. Ballistic missiles can be categorised according to their range, such as short, intermediate, medium, long, and intercontinental range.[2] They can carry conventional and nuclear warheads, but since developing them is a complex and costly process, ballistic missiles of longer ranges are best designated to carry nuclear warheads to have strategic significance.

The development and induction of ballistic missiles by both adversaries led them to start exploring ways to defend themselves against ballistic missile threats.

BALLISTIC MISSILE DEFENCES

The arms race between the US and the USSR during this period resulted in developing their nuclear forces to maintain the weapon-to-weapon and missile-to-missile ratios. With the introduction of more potent nuclear weapons and accurate delivery systems, concomitant changes in nuclear postures morphed from counter-value to counter-force strategies. The idea of strategic stability revolves around the mutual vulnerability to each other's nuclear attack and the absence of a situation where one side finds it beneficial to attack the other side. Anything impacting this situation could disturb the balance and result in instability. If one side, in a crisis, could de-capitate the other's nuclear arsenal effectively in a first strike, then there were the risks of the first strike instability or crisis instability. This led to the development and maintenance of a secure second-strike capability by both sides. One efficient way of protecting nuclear forces was to take them under the sea. The concept led to the development of submarine-launched ballistic missiles. The other technologically more complex but less effective and considerably costlier solution was found in developing BMDs.[3] The purpose behind the development of BMDs was also to protect cities and populations.

Therefore, it can be argued that the BMDs were developed out of necessity to protect one's nuclear forces against the other. Contrary to adding to strategic stability, BMDs resulted in a demand for a larger and more survivable nuclear arsenal on both sides. The desire to penetrate each other's missile defences also fuelled the missile arms race.

Missile defence had started to develop during the 1950s and 1960s in both the US and USSR. The kinetic ballistic missile defence concept is the same as hitting a bullet with a bullet. The idea was to shoot down an incoming ballistic missile before it could hit the target to limit its own damage if not complete protection. A ballistic missile has three phases, from its launch to the impact on the target.[4] First, in the boost phase, the missile is boosted and launched, in the second or mid-course phase, the missile travels mostly in outer space and is the longest phase. The terminal phase is the last phase when a re-entry vehicle re-enters the atmosphere and descends towards its target. Intercepting the missile in the boost phase is more advantageous than the other phases as it ensures the destruction of all the re-entry vehicles. However, the boost phase is shortest and requires the interceptor to be fast and close to the launch site, which is not practical all the time. Most of the BMDs work by intercepting the re-entry vehicle in their mid-course and terminal phases.

During the Cold War, the US developed Safeguard Program to protect US Air Force's Minuteman ICBMs silos in March 1969 after considering Sprint and the Spartan defence systems.[5] In contrast, the Soviets developed A-35 anti-ballistic missile (ABM) system to protect the capital, Moscow.[6]

[1] Richard Hollingham, "V2: The Nazi rocket that launched the space age - BBC Future," *BBC*, September 8, 2014, https://www.bbc.com/future/article/20140905-the-nazis-space-age-rocket.

[2] "Ballistic Missile Basics," *Federation of American Scientists*, June 4, 2000, https://fas.org/nuke/intro/missile/basics.htm.

[3] Joseph Cirincione, "Brief History of Ballistic Missile Defense and Current Programs in the United States," *Carnegie Endowment for International Peace,* February 1, 2000, https://carnegieendowment.org/2000/02/01/brief-history-of-ballistic-missile-defense-and-current-programs-in-united-states-pub-133.

[4] Tommy Reed, "The 3 Major Phases of Effective Missile Defense Systems," *Microwaves & RF,* September 20, 2017, https://www.mwrf.com/ markets/defense/article/21848658/the-3-major-phases-of-effective-missile-defense-systems.

[5] "US Ballistic Missile Defense Timeline: 1945-Today," *Union of Concerned Scientists*, July 21, 2007, https://www.ucsusa.org/resources/us-missile-defense-timeline.

[6] "A-135 / ABM-3," *Global Security*, Accessed June 1, 2021, https://www.globalsecurity.org/wmd/world/russia/abm3.htm.

Effectiveness and the Risks of the BMDs

The supporters of BMDs view them as a protective shield from the ballistic missile threat. The opposers of these, on the other hand, view them as a dangerous illusion. Despite the major efforts underway to overcome the critical challenges and shortcomings in the successful operations of BMDs, a low success rate remains a key challenge.[7] Ballistic missile interceptions are conducted under choreographed and designed conditions during the tests and development phases.[8] There remains a question about their functionality in real-life conditions. Due to these factors, missile defences are said to give a false sense of security to the possessor.

Missile defences are costly and involve operational risks and challenges. They are supposed to enhance strategic stability by denying a de-capitating strike but turn out to intensify the instability given their costs, limited success rate, and a false sense of security provided by them.

BMD systems could easily be defeated by adding decoys or cooled shrouds that can be used to lower a warhead's temperature. Other means are increasing the number of missiles launched at a single target or multiple warheads (MRVs) and dummy warheads.[9] This way, the BMDs put a burden on the offensive forces to increase their firepower. Due to this, not only the size of the ICBM force grew, but the number of warheads on each launcher increased through multiple independently-targetable re-entry vehicles (MIRVs). Other than driving an increase in the number of missiles and warheads, BMDs also push for the development of new technologies of warheads and missiles for survivability and reliability. Among them is the development of hypersonic weapons by all the major powers.

Besides, the BMDs caused arms race and first strike instabilities. They increased the risk of arms race instability by affecting the scope and pace of the arms race from the planned deployments on both sides. They have caused first-strike incentives and temptations to initiate the use of nuclear weapons in a crisis to achieve comparatively better results by virtue of being first.

[7] Laura Grego, George N. Lewis, and David Wright, "Shielded from Oversight: The Disastrous US Approach to Strategic Missile Defense," *Union of Concerned Scientists*, July 2016 https://www.defensedaily.com/wp-content/uploads/post_attachment/137125.pdf.

[8] Ibid.

[9] "Fact Sheet: Multiple Independently-targetable Reentry Vehicle (MIRV)," *Center for Arms Control and Non-proliferation,"* March 2021, https://armscontrolcenter.org/multiple-independently-targetable-reentry-vehicle-mirv/#:~:text=Multiple%20Independently%2Dtargetable%20Reentry%20Vehicles,MIRVs%20can%20carry%20multiple%20warheads.

ABM TREATY

The US and Russia had realised the issues in missile defences and negotiated these in the Strategic Arms Limitation Talks (SALT) from 1969 to 1979. The desires to limit BMDs were materialised during the SALT I with the signing of an Interim Agreement to limit strategic offensive arms and ABM Treaty in 1972 to limit strategic defensive systems.[10] The treaty prohibited missile defences that covered all the Soviet and the US territory and allowed each side to protect only their national capitals and one International Continental Ballistic Missile (ICBMs) launching site to keep both the countries at nuclear strike risk. Later, these defences were reduced to one on each side to either protect the capital or the ICBM launching site. The allowed defences under the ABM Treaty could consist of up to 100 interceptor launchers by each side. It also prohibited the development, testing, or deployment of the sea, air, space, or mobile land-based ABM systems or components. The US and USSR also could not upgrade existing non-ABM missiles to ABM roles. The treaty allowed research, laboratory, and fixed land-based testing of any type of missile defence. It also allowed theatre missile defences (TMDs) against short and medium-range ballistic missiles.

The Demise of the ABM Treaty

In a major departure from the ABM Treaty provisions, US President Ronald Reagan gave a vision of a multi-layered missile defence system for the US homeland in his March 23, 1983 speech. It manifested into a missile defence research program called Strategic Defense Initiative (SDI).[11] However, many of the initiatives were scaled down due to technical, financial, and political reasons for the next decade. Both countries also signed the START I and II treaties in 1991 and 1993 to reduce their deployed nuclear weapons. After President George Bush Jr. came into power in 2000, his administration took the initiative of a multi-layered missile defence forward. Under the ABM Treaty provisions, it was not possible to expand the existing BMDs. The Bush Administration, therefore, decided to withdraw from the treaty to deal with the threat of a possible ICBM attack by the "terrorists" or the rogue states like Iran and North Korea. The US upgraded the Ballistic Missile Defence Organization (BMDO) into the

[10] "The Anti-Ballistic Missile (ABM) Treaty at a Glance," *Arms Control Association*, December 2020, https://www.armscontrol.org/factsheets/abmtreaty.

[11] "Strategic Defense Initiative (SDI)," *Atomic Heritage Foundation*, July 18, 2018, https://www.atomicheritage.org/history/strategic-defense-initiative-sdi.

Missile Defence Agency (MDA) in 2002[12] which is deep-rooted in Reagan's SDI.

Aftermaths of Treaty Demise

Two major but expected consequences of the departure from the ABM Treaty are the development of BMDs by the US and other countries and, secondly, the efforts to avoid and defeat those BMD systems. The US is primarily involved in the development of BMDs, while Russia and China have often raised their concerns on this development. Both China and Russia are doubtful of the US' claim that its strategic missile defences are dedicated to meet the threats from North Korea and Iran. Iran, for that matter, does not have ICBMs.[13] In comparison, North Korea has tested them years after the US departure from the ABM Treaty.[14] China also possesses a small nuclear arsenal as compared to both the US and Russia, which exacerbates its fear of a first strike from the US. The development of the US' BMD systems is fuelling the Russian and Chinese efforts to develop countermeasures against it.

US policies, strategies, and capabilities are guided by its Missile Defence Review (MDR), a document prepared by each US administration. The latest MDR 2019 guides the US government to counter threats from rogue states such as North Korea and Iran and revisionist states like China and Russia. The threats include ballistic, cruise, and hypersonic missiles.[15]

The US has developed the Ground-Based Midcourse Defence (GMD) system, a strategic level ballistic missile defence to defend itself from the ICBM level threats.[16] The GMD can intercept missiles during their midcourse phase or when in space. It involves a complex system of radars and sensors, which track the missile throughout its flight. Its interceptor missile sites are located in Alaska and California. These are based on the kinetic killing mechanism to destroy the target. A third site was planned in Poland but later cancelled in favour of Aegis BMD by President Obama, which can also intercept missiles in the midcourse or terminal phase. A missile normally stays in the midcourse phase for about 20 minutes giving enough time to the interceptor, but several defences have been made against the interceptor by adding decoys and other countermeasures. The interception tests of GMD have failed eight times out of eighteen in the last two decades.[17] The effort has cost the US about $40 billion during this period. The major problem with the system is that it does not address the countermeasures to the BMDs.

The US is also testing the ship-based Aegis short and intermediate-range[18] ballistic missile interceptors against the ICBM level threats. It was successfully launched in November 2020 against the ICBM class threat.19 Ship-based components of BMDs against strategic threats will be more flexible than the GMD system.

The idea of space-based interceptors is again getting a voice in the US after first being proposed by President Ronald Reagan in his SDI speech. President Trump's administration started to re-examine and undertake the feasibility of the idea in 2019.[20] The idea is also being supported by the US Congress, which voted and required the Department of Defense to develop such interceptors in 2018.[21] The idea of space-based interceptors has also attracted criticism for the weaponisation of space.

The Patriot and THAAD systems intercept the missile in the terminal phase, which is short, and warheads travel extremely fast at this phase, giving less time to the interceptor. Patriot, THAAD, and Aegis systems can only intercept short and medium-range targets moving at a slower speed and lower altitudes than the ICBMs.

DEVELOPMENTS OF MISSILE DEFENCE GLOBALLY

While the US BMDs efforts are the largest in the world, other countries such as Russia, China, and India also have capabilities and know-how of the BMD systems.[22] Russian expertise in the area, as discussed earlier,

[12] "US Ballistic Missile Defense Timeline: 1945-Today," *Union of Concerned Scientists,* March 29, 2019, https://www.ucsusa.org/resources/us-missile-defense-timeline.

[13] "Missiles of Iran," *Missile Threat, Center for Strategic and International Studies*, June 14, 2018, https://missilethreat.csis.org/country/iran/.

[14] "The CNS North Korea Missile Test Database," *Nuclear Threat Initiative*, March 31, 2021, https://www.nti.org/analysis/articles/cns-north-korea-missile-test-database/.

[15] "Missile Defense Review," *Department of Defense,* https://www.defense.gov/Portals/1/Interactive/2018/11-2019-Missile-Defense-Review/The%202019%20MDR_Executive%20Summary.pdf.

[16] "Ground-based Midcourse Defense (GMD) System," *Missile Threat, Center for Strategic and International Studies*, June 14, 2018, https://missilethreat.csis.org/system/gmd/.

[17] John Isaacs and Samuel M. Hickey, "Missile Defense Costs Soar Out of This World," *Arms Control Center*, https://armscontrolcenter.org/missile-defense-costs-soar-out-of-this-world/.

[18] Ibid.

[19] Shaan Shaikh, "US Completes SM-3 IIA Against ICBM-class Target," *Missile Threat*, *Center for Strategic and International Studies*, November 17, 2020, https://missilethreat.csis.org/us-completes-sm-3-iia-against-icbm-class-target/.

[20] John Harper, "SPECIAL REPORT: Pentagon Reexamining Space-Based Interceptors," *National Defense Magazine*, April 22, 2019, https://www.nationaldefensemagazine.org/articles/2019/4/22/special-report-pentagon-reexamining-space-based-interceptors.

[21] Kingston Reif, "Congress Calls for Interceptors in Space," *Arms Control Association,* September 2018, https://www.armscontrol.org/act/2018-09/news/congress-calls-interceptors-space.

[22] See: A. Arbatov, Vladimir Dvorkin, and Bubnova Nataliia, Missile Defense: Confrontation and Cooperation (Carnegie Moscow Center, 2013).

dates back to the Cold War Era. Russia has the A-135 ABM system around the capital city of Moscow. It is an advanced version of the A-35 system of the Cold War Era. The up-gradation of A-35 to A-135 was completed in 1995 under the ABM Treaty provisions. It is now developing an A-235 system to replace A-135 and will use conventional warheads instead of nuclear warheads in the case of A-135. Russian missile defence systems use warheads to destroy the target instead of kinetic kill mechanism.

Every country that possesses the anti-satellite capability has the capability to shoot down ballistic missiles in their midcourse phase or when in an exo-atmosphere.[23] China and India have demonstrated the anti-satellite technology and can use it to destroy the ICBM level ballistic threats. While China has not tested or made public any such development, India is one of the major contenders developing ballistic missile defences.[24] It is engaged in both the home-grown and foreign procured missile defence programs. The US has also extended its support to Indian BMDs efforts by offering it its own BMD systems. Indian BMDs are highly consequential for peace and stability in the South Asian region as they alter the strategic balance in India's favour vis-à-vis Pakistan. India has the Prithvi Air Defence system. It can intercept medium and intermediate-range missiles at higher or exo-atmosphere altitudes. India used the Prithvi Defence Vehicle Mark-II to demonstrate the anti-satellite capability in January 2019. It is a ballistic missile interceptor and with this India can intercept an ICBM. Israel has also the capability of exo-atmosphere hitting of missiles in the form of Arrow 3. The system is jointly developed by Israel and the US.[25]

BMDs and Arms Control

BMDs have also impacted the scope of strategic arms control. BMDs can simply be overwhelmed with the multitude of warheads directed against a specific target. It was observed during the Cold War that BMDs increased the missile race. This was one of the reasons for the signing of the ABM Treaty. Now that the ABM Treaty is no more effective and BMDs are being built, the situation of the Cold War era may return. Agreements like the NEW START have placed limits on the number of strategic warheads both the US and Russia can possess or deploy. This limitation on the warheads eases the burden on the BMDs. However, this can also lead to less support for any such strategic arms control agreements in the future when one or both sides are fearful of each other's BMD systems. For example, Russia has stated the plan to add BMDs to any future arms controls. The presence of BMDs can simply increase the necessity of possessing more warheads.

HYPERSONIC WEAPONS: A CONSEQUENCE OF BMDS?

Major consequences of the deployment of BMDs are the increase in the long-range missiles, development of advanced warheads, multiple warheads, putting missiles on high alert to launch on warning, and development of cruise missiles and hypersonic weapons.

The ABM Treaty and its demise provide an important starting point for the current debate over the deployment of missile defences and efforts to penetrate them. Among the efforts to penetrate defences are new technologies like hypersonic weapons which are being developed and deployed mainly in the US, Russia, and China.[26] Both Russia and China primarily state the US' BMDs as the reason for their hypersonic missile development. This is a technical reason and justified under the security demands. A BMD system can hit the incoming missile after assessing the trajectory of the warhead. The hypersonic missiles do not follow a ballistic or the same trajectory. A hypersonic missile glides towards its target and can manoeuvre during its flight which can easily defeat the BMD system. Russia has developed the Avangard hypersonic glide vehicle, which is deployed on an ICBM.[27] China has developed the DF-17 hypersonic missile.[28] Not to be left behind, the US has expediated its extensive efforts to develop hypersonic weapons after the tests by Russia and China.[29] It has many separate programs to develop these weapons. Currently, the three major powers are engaged in a hypersonic arms race to keep technological superiority.[30] Other countries

[23] Carter, Ashton B. "The Relationship of ASAT and BMD Systems." *Daedalus* 114, no. 2 (1985): p. 171 Accessed June 14, 2021. http://www.jstor.org/stable/20024984.

[24] See: Jalil, Ghazala Yasmin. "Indian Missile Defence Development: Implications for Deterrence Stability in South Asia." *Strategic Studies* 35, no. 2 (2015): 29-46. Accessed June 14, 2021. https://www.jstor.org/stable/48527460.

[25] Masao Dahlgren, "Israel, United States Test Arrow 3 Interceptor," *Missile Threat, Center for Strategic and International Studies*, July 29, 2019, https://missilethreat.csis.org/israel-united-states-test-arrow-3-interceptor/.

[26] Kelley M. Sayler, "Hypersonic Weapons: Background and Issues for Congress," R45811, *Congressional Research Service,* April 26, 2021, https://crsreports.congress.gov.

[27] "Avangard," *Missile Threat, Center for Strategic and International Studies*, January 3, 2019, https://missilethreat.csis.org/missile/avangard/.

[28] Paul Bernstein and Dain Hancock, "China's Hypersonic Weapons," *Georgetown Journal of International Affairs,* January 27, 2021, https://gjia.georgetown.edu/2021/01/27/chinas-hypersonic-weapons/.

[29] Richard Stone, "'National pride is at stake.' Russia, China, United States race to build hypersonic weapons," *Science Magazine*, January 8, 2020, https://www.sciencemag.org/news/2020/01/national-pride-stake-russia-china-united-states-race-build-hypersonic-weapons.

[30] Philip E. Ross, "Russia, China, the U.S.: Who Will Win the Hypersonic Arms Race?" *IEEE Spectrum,* November 17, 2020, https://spectrum.ieee.org/aerospace/aviation/russia-china-the-us-who-will-win-the-hypersonic-arms-race.

such as India, Australia, France, Germany, and Japan are also developing hypersonic technologies, not for overcoming adversary's missile defences but for other purposes.[31] Prestige factor, political and scientific reasons are major factors behind hypersonic efforts in some of these countries. India also demonstrated hypersonic technology in September 2020. It is developing hypersonic technology mainly for non-security reasons. Nevertheless, Indian hypersonic weapons will have serious implications for Pakistan.[32]

WAY FORWARD

The arms race is an ongoing process. It has various reasons and different implications for world security. The responsibility to control and limit these implications lies with the major global powers and countries engaged in the arms competition. The major and first step in this direction would be rethinking the rationale and effectiveness of the BMD systems. Scaling back or pausing the work on these systems can be an important confidence-building measure for Russia and China. This, in turn, will provide impetus for arms control negotiations between them. However, chances are grim for things to go in this direction. The geopolitical trends present a picture where great power competition is increasing.[33]

In the regional context, Pakistan faces threats from two major risky developments from India. First, the development of BMDs by India and secondly, the development of hypersonic technologies. Both these developments merit effective measures from Pakistan because they provide India with an over-confidence in its military capabilities and destabilise the region.

CONCLUSION

Ballistic missiles led to the development of missile defence. This technological invention worsened the arms race in the Cold War days between the US and Soviet Union. The signing of the ABM Treaty slowed down the pace of the arms race. The agreements to limit the strategic warheads increased the stability over the next decades. However, BMDs are being developed now after the demise of the ABM Treaty. BMDs development is not only affecting the prospect of arms control agreements in the future but also leading to the development of advanced warheads and missiles like hypersonic. Furthermore, the development of defences against hypersonic missiles is the new interest of defence planners. It is pertinent to mention here that the BMDs against the traditional missiles are not effective enough. The risk of defences against hypersonic missiles will be greater than the BMDs. However, bolstering defences against hypersonic weapons would need a lot of resources in the coming years that might lead to Cold War 2.0.

[31] Kelley M. Sayler, "Hypersonic Weapons: Background and Issues for Congress," R45811, *Congressional Research Service*, April 26, 2021, https://crsreports.congress.gov.

[32] Samran Ali, "Indian Hypersonic Weapons Bring New Challenges to South Asia," *South Asian Voices*, September 13, 2029, https://southasianvoices.org/indian-hypersonic-weapons-bring-new-challenges-to-south-asia/.

[33] Daniel H. Nexon, "Against Great Power Competition: The U.S. Should Not Confuse Means for Ends," *Foreign Affairs*, February 15, 2021, https://www.foreignaffairs.com/articles/united-states/2021-02-15/against-great-power-competition.