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Issue Brief

Hypersonic Weapons and Contemporary Conflicts

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Summary

The use of hypersonic weapons in contemporary conflicts marks a turning point in modern warfare as they make defences vulnerable and expand strategic ambiguity. The US, China and Russia have operational hypersonic weapons. India has recently joined the list by successfully testing a hypersonic missile.

Introduction

The emergence of hypersonic weapons has reshaped the strategic and operational dynamics of modern warfare. Hypersonic weapons are weapons that move at the speed of Mach 5 or more. Their extreme speed, low-altitude flight paths and unpredictable trajectories make detection and interception extremely difficult for existing missile and air defence systems. There are two primary categories of hypersonic weapons—Hypersonic Glide Vehicles (HGVs) and Hypersonic Cruise Missiles (HCMs). HGVs are launched atop ballistic missiles, glide at hypersonic speeds through the upper atmosphere before manoeuvring towards their target. HCMs are powered by advanced air-breathing engines (like scramjets), sustain hypersonic speeds within the atmosphere and follow flatter trajectories.

Both HGVs and HCMs are designed to dodge traditional radar systems and missile defences given the significantly reduced reaction times and the ability of these weapons to alter their flight paths mid-course. Several countries are investing in hypersonics. The US, China and Russia have operational hypersonic weapons and India has recently joined the list by successfully testing a hypersonic missile. Other countries like Iran, Japan, North Korea, Germany, Australia and France have active hypersonic weapons programs.

These next-generation weapons have seen battlefield deployment in the Russia–Ukraine war and the Israel–Iran conflict, marking the beginning of a new missile age. Countries that lack adequate counter-hypersonic capabilities risk strategic extortion, erosion of deterrence, and vulnerability in high-speed conflict environments. The urgency to create effective countermeasures like space-based tracking systems, rapid-response interceptors, AI-based early warning systems and electromagnetic technologies continues to grow. One such emerging response is Japan's investment in electromagnetic railgun technology. The Brief highlights the use of hypersonic weapons in modern warfare, evaluates Japan's railgun programme as a potential counter-hypersonic solution, and flags the implications for India's security as a result of these developments.

Russia–Ukraine War and Hypersonic Weapons

Russia has claimed it has used hypersonic missiles several times during the ongoing war with Ukraine. It became the first country to use hypersonic weapons in real-world conflict when it used the Kh-47M2 Kinzhal, an air-launched ballistic missile, against Ukraine in March 2022. The Kinzhal is capable of reaching speeds up to Mach 10 and has a range of about 2,000 km with a payload of 480 kg. It can carry both conventional and nuclear warheads and is designed to be launched from Tu-22M3 bombers, MiG-31K interceptors and modified Su-34 fighter-bombers.[1]

[1] **"Kinzhal Hypersonic Missile, Russia"**, *Airforce Technology*, 23 February 2024.

Initial reports suggested it was used to destroy underground weapons storage facilities and other fortified positions. There are some experts who note that the Kinzhal is not a true HGV but an air launched ballistic missile with quasi-hypersonic characteristics (while being fast, it does not manoeuvre enough to be considered as a true hypersonic missile).[2] The use of the Kinzhal notably demonstrated speed, surprise and strategic signalling. Ukraine's initial inability to intercept these weapons signalled the limitations of traditional missile defence systems. By late 2022 and into 2023, Ukraine began receiving advanced Western missile defence systems, including the Patriot PAC-3, National Advanced Surface-to-Air Missile System (NASAMS), and Infrared Imaging System Tail/Thrust Vector-Controlled Surface Launched Missile (IRIS-T SLM).[3] In May 2023, Ukraine claimed that the US-supplied Patriot missile systems successfully intercepted several Kinzhal missiles.[4]

Russia's use of hypersonics in Ukraine has accelerated the global focus on hypersonic defence given that intercepting these missiles requires an extremely short response time, high-level of training and layered systems. At present, only a few countries have these capabilities. Russia has expanded its hypersonic capabilities to include Zircon (Tsirkon) missiles which are naval-based HCMs reportedly reaching Mach 8, the YU-71 (reportedly having a speed of up to 11,200 kmh), and Avangard (a nuclear-capable HGV which can be launched atop ICBMs) under development.[5]

Iran–Israel Conflict and Hypersonic Weapons

In June 2023, Iran unveiled its first indigenous hypersonic missile, Fattah I, with a claimed range of 1,400 km and manoeuvrability during mid-course and terminal flight phases. According to Iranian claims, it also possesses two fast and manoeuvrable missiles known as the Khorramshahr and Fattah 2 which are more difficult to counter. Iranian officials asserted these missiles could penetrate all missile defence systems, including Israel's.[6] While the missile has not been operationally deployed in any conflict, its announcement has garnered global attention due to the psychological and deterrent value associated with hypersonic capabilities.

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[2] Illia Ponomarenko, **"Russia's Kinzhal Missile is Not Hypersonic. Nor Is It Invincible"**, *The Kyiv Independent*, 25 May 2023; **"Hypersonic Weapons – A Technological Challenge for Allied Nations and NATO?"**, NATO Parliamentary Assembly, NATO, 20 November 2020.

[3] Infrared imaging system tail/thrust vector-controlled Surface Launched Missile. See **"IRIS-T SLM"**, *Global Defense News*, Army Recognition Group, 17 June 2025.

[4] Kateryna Tyshchenko, **"US Does Not Doubt Veracity of Ukraine's Statement about Kinzhal Interception – CNN | Ukrainska Pravda"**, *CNN*, 7 May 2023.

[5] Paul Bernstein and Harrison Menke, **"Russia's Hypersonic Weapons"**, *Georgetown Journal of International Affairs*, 12 December 2019; Ajay Lele, "Hypersonic Weapons", Occasional Paper No. 46, Institute for Defence Studies & Analyses, July 2017, pp. 24–27.

[6] Maziar Motamedi, **"Iran has a Hypersonic Missile. What Does That Mean?"**, *Al Jazeera*, 7 June 2023.

Even without battlefield validation, such declarations serve as strategic signalling tools intensifying the regional arms race and challenging Israel's perceived defence superiority. Israel, meanwhile, does not have an explicit, separate 'hypersonic programme'. However, it possesses one of the most sophisticated, multi-tiered missile defence systems globally, including Iron Dome for short-range intercepts, David's Sling against medium-range threats and Arrow 2/3 for ballistic missile defence.[7]

During the 2024 Israel–Iran missile exchange, no verified use of Fattah or equivalent hypersonics by Iran was reported. Yet, growing concerns about Iran's expanding missile capabilities, including potential hypersonic deployment, has prompted the Israeli strategic community to re-evaluate the future missile defence needs. Currently, Israel has begun collaborating with the US on directed-energy weapons and advanced tracking systems and also upgrading its space-based early warning systems.

Challenges of Hypersonic Defence

Hypersonic weapons threaten to disrupt the balance of power in both conventional and nuclear domains. Their most dangerous attribute is that it's hard to defend against them due to their speed as it reduces the interception window to mere seconds. They are also capable of changing trajectory mid-flight, evading traditional radar tracking. They usually fly below ballistic arcs and above most cruise missiles and operate in a "grey zone" of radar coverage.

Existing missile defence systems were designed originally for ballistic or cruise missiles, which makes it difficult for them to track and neutralize these hypersonic threats. While systems like Terminal High Altitude Area Defense (THAAD), Aegis and Patriot have seen some success, they are not foolproof. The enormous cost of missile defence interceptors compared to the hypersonic threat further complicates strategic planning. In this scenario, countries are exploring alternative counter-hypersonic approaches, including directed-energy weapons, satellite-based tracking networks, and kinetic kill systems such as railguns.

Amidst the global race for hypersonic defence, Japan's investment in electromagnetic railgun technology presents a unique solution. Unlike interceptor missiles, Japan's electromagnetic railgun uses magnetic fields generated by electric currents to accelerate a projectile to speeds exceeding Mach 6. It is designed to intercept cruise missiles, drone swarms, and potentially hypersonic threats as a part of future multi-layered missile defence systems. The kinetic energy alone is sufficient to destroy or disable incoming threats which makes it a safer and cheaper long-term option.

[7] **"What are Israel's Iron Dome, David's Sling, Arrow and Thaad Missile Defences?"**, *BBC News*, 16 October 2024.

Railguns were first conceptualised in the 1920s and many countries, including the US, China, France, Germany and India, have tried to develop one. The US abandoned its railguns development programme 'Dream Shell' in 2021 after facing several technical hurdles.[8] Tokyo started its railgun development programme in 2016 and the Ministry of Defense unveiled its railgun prototype in 2022.[9] In October 2023, Japan became the first nation to successfully test-fire the medium calibre maritime electromagnetic railgun.[10] In 2024, Japan's Acquisition, Technology, Logistics Agency (ATLA) and the French-German Research Institute of Saint-Louis (ISL) signed an agreement with the objective "to explore the possibility of collaboration for research, development, test and evaluation of railgun technologies".[11] In April 2025, they tested a prototype on the warship JS Asuka. Japan's MoD also showcased the model of a futuristic railgun at Defence & Security Equipment International, one of the largest defence exhibitions in May 2025.[12]

This initiative by Japan is strategically significant as the threats from China's DF-ZF HGV and North Korea's missile arsenal are rising. Notably, it also aligns with Japan's "defensive only" doctrine which is rooted in its constitution under Article 9. It is noteworthy that Japan's system is the only operational counter-hypersonic system being publicly pursued in the Indo-Pacific.

Relevance for India

India faces challenges from China's offensive hypersonic capabilities and regional proliferation. Pakistan has also been seeking to bolster its strategic capabilities to counter India's advancements in missile technology. Pakistan has also requested for the supply of Chinese hypersonic missiles along with the technological transfer. Reports note that China has rejected this request for now.[13]

India's hypersonic programme, meanwhile, is expeditiously advancing with the Defence Research and Development Organisation (DRDO) making notable progress in developing hypersonic systems, exemplified by the 2020 Hypersonic Technology

[8] Steve Balestrieri, **"The Navy's Railgun Nightmare Has Just Begun"**, *National Security Journal*, 6 May 2025; Sumit Ahlawat, **"Japan Succeeds Where USA Failed! Tokyo Displays 'High-Power' Railgun, A Concept Pentagon Shelved in 2021"**, *The Eurasian Times*, 23 May 2025.

[9] **"Defense of Japan 2022"**, Defense of Japan Booklet, Japan's Ministry of Defense, 2022, p. 9.

[10] Shubhangi Palve, **"After 'Historic' Test of EMG Firepower, Japan to Arm Its 13DDX Destroyers with Electromagnetic Railgun"**, *The Eurasian Times*, 7 July 2024.

[11] **"Video: Japan Joins European Efforts for Railgun Research Project"**, *Naval News*, 16 October 2024; Interviews with representatives from Japan's ATLA and the French-German ISL, 10 October 2024; Naval News, **"Japan Joins European Efforts for Railgun Research Project"**, *YouTube*, 10 October 2024.

[12] **"Japan Shows Off Futuristic 'Railgun' at Defence Expo"**, *The Times of India*, 22 May 2025; Liu Zhen and Hayley Wong, **"Japan Hits Rail Gun Milestone in Race to Counter China's Hypersonic Development"**, *South China Morning Post*, 24 April 2025.

[13] **"China Rejects Pakistan's Request for Hypersonic Missile Supply and Technology Transfer"**, Indian Defence Research Wing, 26 June 2025.

Demonstrator Vehicle (HSTDV) test.[14] This test validated scramjet propulsion for shorter duration and brought India closer to operationalising a hypersonic cruise missile. In 2024, India also tested a Long Range Anti-Ship Missile (LRAShM) which will enhance the Indian Navy's maritime capabilities.[15]

In 2025, India unveiled a full-scale model of Dhvani which is a hypersonic Glide Vehicle (HGV), being developed by the DRDO.[16] The BrahMos II missile is also under development.[17] DRDO is simultaneously developing an HGV with a range exceeding 5,500 km and a speed of Mach 21.[18] However, there remains a lack of operational hypersonic weapons or a counter-hypersonic defence system.

India should, therefore, prioritise investments and initiate programmes for space-based tracking systems, rapid-response interceptors, AI-based early warning systems and electromagnetic technologies like railguns. It must strengthen cooperation with partners like Japan and the US which can also help in accelerating the development of a robust hypersonic strategy. India must also work on drafting a National Counter-Hypersonic Strategy by integrating space, cyber and conventional assets. As the strategic pace of missile warfare evolves, India must act conclusively to bridge the gap between capabilities and preparedness in both offensive and defensive domains.

Conclusion

The use of hypersonic weapons in the Russia–Ukraine war and increasing relevance in the Middle East demonstrate a paradigm shift in how conflicts will be fought. These weapon systems mark a turning point in modern warfare by compressing time, expanding strategic ambiguity, and rendering many old defences obsolete. Traditional missile shields alone will be insufficient. Countries now need to find affordable, adaptable and future-ready responses. Japan's railgun initiative proposes a compelling alternative and demonstrates that even within constitutional and financial constraints, technological innovation can provide feasible responses. For India and other regional countries, the path forward lies in not only just matching offensive technologies but also to lead into the next generation of cost-effective defence innovation. India must see hypersonics as a strategic opportunity to improve its missile defence architecture by embracing both strategic foresight and scientific collaborations to stay ahead.

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[14] **"DRDO Tests Hypersonic Technology Demonstrator Vehicle"**, DRDO Newsletter, Defence Research and Development Organisation (DRDO), October 2020, p. 4.

[15] **"DRDO Chief Announces LRAShM Hypersonic Missile Trials to Conclude in 2-3 Years"**, Indian Defence Research Wing, 21 June 2025.

[16] **"DRDO'S Dhvani Hypersonic Glide Vehicle Set for Induction by 2029-30"**, Indian Defence Research Wing, 19 June 2025.

[17] **"India and Russia Rekindle BrahMos-II Hypersonic Missile Program"**, Indian Defence Research Wing, 26 June 2025.

[18] **"DRDO's Hypersonic Glide Vehicle Program with have 5500+km range"**, Indian Defence Research Wing, 25 June 2025.

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