ISSUE BRIEF

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HYPERSONIC MISSILES: RACING TO WIN?

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September 3, 2021

The US, Russia and China have been embroiled in yet another race to develop hypersonic missiles. For Russia and China, the push to develop hypersonic missiles was the threat from the US deployment of missile defence systems. For the US it was Russian and Chinese development of hypersonic missiles. Thus, the cycle to develop better and more sophisticated hypersonic missiles continues. Others are also developing hypersonic technology including Australia, France, UK and the European Union. India is not remaining behind in this race. It tested the High-Speed Technology Demonstrator Vehicle (HSTDV) using an indigenously developed propulsion system on September 7, 2020. Both Russia and the US have recently flight-tested their hypersonic systems. The hypersonic missile race is well on its way. It is important to look at what the technology is? What are the drivers of hypersonic development globally? How far has the hypersonic race gone and what are their dynamics for nuclear deterrence and strategic stability?

What are Hypersonic Weapons?

A hypersonic missile can travel at least five times the speed of sound or Mach 5. There are hypersonic weapons that can travel more than 20 Mach. What is special about hypersonic missiles is their ability to manoeuvre once launched. The US and Russia have had hypersonic missiles for years (ballistic missiles) but they could not be manoeuvred after launch. What makes hypersonic missiles

special is the combination of tremendous speed and their ability to manoeuvre once launched? It is due to this characteristic that hypersonic missiles can penetrate missile defence systems.

There are inherently two kinds of hypersonic missiles that are being developed – boost-glide vehicles and hypersonic cruise missiles. The boost-glide missiles use an existing Intercontinental Ballistic Missile (ICBM) for launch on a normal ballistic trajectory and are then launched and glide to the target. Hypersonic cruise missiles use supersonic combustion ramjet or turbo ramjet engines for propulsion. This is more manoeuvrable and can travel at a lower altitude.

Status of Russian Hypersonic Missiles

Russia has already deployed Avangard in December 2019. It is a hypersonic boost-glide vehicle deployed on top of an ICBM and has a speed of Mach 20. It also has Kinzhal, a guided cruise missile with a range of 1200 km and a speed of Mach 10. Russia is also developing Tsirkon, which is a ship-launched hypersonic cruise missile capable of targeting on the ground and at sea at speeds of Mach 6-8. Russia's latest test of Tsirkon came in July 2021 from one of Russia's most powerful warships, the Admiral Gorshkov frigate, when the missile travelling at Mach 7 flew 350 km to hit a target on the coast of the Barents Sea.[1] Tsirkon may soon enter the deployment phase. According to Russia's 13th Missile Division Commander, Major General Andrei Cherevko, the first regiment of strategic missile systems with the Avangard boost-glide vehicle will go on combat duty by the end of 2021.[2] The Second Avangard hypersonic missile regiment is expected to go on combat alert by 2023.

Russia accelerated work on its hypersonic missiles once the US withdrew from the Anti-Ballistic Missiles (ABM) Treaty and ignored the Russian concerns over the deployment of missile defence systems. The Russian President, Vladimir Putin, clearly stated in his state-of-the-nation address in 2018 that the country was developing an array of hypersonic weapons that could defeat all existing missile defence systems.[3] Thus, the key concern for Russia is the ability to defeat the US missile defences and restore mutual vulnerability to a nuclear attack.

1 "With Cutting-Edge Hypersonic Weapons, Russia Leads In New Arms Race," *NDTV,* June 22, 2021, https://www.ndtv.com/world-news/with-cutting-edge-hypersonic-weapons-russia-leads-in-new-arms-race-2492488

2 "Russia's 1st Regiment of Avangard Hypersonic Missiles to go on Combat Alert by yearend," *Tass*, August 10, 2021, https://tass.com/defense/1324415

3 "Presidential Address to the Federal Assembly," President of Russia, March 1, 2018, http://en.kremlin.ru/events/president/transcripts/messages/56957

China's Progress towards Hypersonic Missiles

China's drive to develop hypersonic missiles comes from the concern that the US hypersonic weapons could enable it to conduct a pre-emptive, decapitating strike on China's nuclear arsenal and supporting infrastructure. Subsequently, the US missile defences could limit China's ability to conduct a retaliatory strike against the US.[4]

China also has several hypersonic missiles. It has successfully conducted tests of the DF-17, a medium-range ballistic missile, which carries the DF-ZF hypersonic glide vehicle with a Mach 10 speed. China has also tested the DF-41 ICBM, which could be modified to carry a conventional or nuclear hypersonic glide vehicle. Its range put the US mainland within reach and is a cause of concern for the US. It is also developing an air-launched CH-AS-X-13 missile with Mach 10 speed and a 1500 km range. China successfully tested Starry Sky-2, a nuclear-capable hypersonic vehicle prototype with Mach 6 speed, in August 2018. Starry Sky-2 is a "wave rider" which uses powered flight after launch and derives lift from its shockwaves. According to some reports, the Starry Sky-2 could be operational by 2025.[5]

Both Moscow and Beijing have time and again protested against the US missile defence deployments in Europe and East Asia. They have expressed concerns that the US missile defence deployments affect nuclear deterrence. While the US has maintained that their deployments are aimed against countries like Iran and North Korea. However, the US missile defence capabilities can be used against China and Russia. Thus, both countries have invested in hypersonic weapons. Russia clearly stated that its hypersonic missiles are meant to counter the US missile defence deployments.

US Hypersonic Development Programmes

The US is also well into the hypersonic missile race. The Biden administration has requested funding of US$3.8 billion in the fiscal year 2022 budget, a considerable increase in the Trump administration's allocation of US$3.2 billion for the fiscal year 2021. According to the US

4 Tong Zhao, "Conventional Challenges to Strategic Stability: Chinese Perceptions of Hypersonic Technology and the Security Dilemma," Carnegie-Tsinghua Center for Global Policy, July 23, 2018, https://carnegietsinghua.org/2018/07/23/conventional-challenges-to-strategic-stability-chinese-perceptions-of-hypersonic-technology-and-security-dilemmapub-76894.; and Lora Saalman, "China's Calculus on Hypersonic Glide," August 15, 2017, Stockholm International Peace Research Institute, https://www.sipri.org/commentary/topicalbackgrounder/2017/chinas-calculus-hypersonic-glide.

5 Kelley M. Sayler "Hypersonic Weapons: Background and Issues for Congress," Congressional Research Service, R45811, July 9, 2021, p. 15-16, https://fas.org/sgp/crs/weapons/R45811.pdf

Government Accountability Office, the efforts to develop hypersonic weapons and related technologies are estimated to cost almost US$15 billion between 2015 and 2024.[6]

The US is working to develop hypersonic systems across all three of its armed forces. However, most of its hypersonic systems are envisioned in a conventional role. The US Navy is developing Conventional Prompt Strike (CPS), the Army Long-Range Hypersonic Weapon (LRHW) and the Air Force AGM-183 Air-Launched Rapid Response Weapon (ARRW). It also has the Tactical Boost Glide (TBG) and the Hypersonic Air-breathing Weapon Concept (HAWC) and the HyRAX unmanned craft projects.[7] The US Air Force's ARRW hypersonic boost-glide missile has failed two test launches in recent months and is behind its developmental schedule.[8]

The US Missile Defence Agency (MDA) has made a budget request of US$8.9 billion for 2022, to develop a next-generation interceptor for homeland missile defence and hypersonic defensive capability.[9] Against hypersonic threats, the MDA is reported to be pursuing a hypersonic and ballistic tracking space sensor (HBTSS). The MDA has requested US$256 million for the research, development, testing and evaluation of HBTSS.

In the 2000s the US presented hypersonic missiles as a means of intercontinental attacks on terrorist groups. Now the US claims that the driver for its hypersonic missile development are its adversaries advancing capabilities in these realms, namely Russia and China. However, some experts have described the US hypersonic as a missile in search of a mission.[10] The US hypersonic missiles do not have a defined mission. The US is pouring billions of dollars into weapons systems that it does not need or it is not sure how they will contribute to its national security. One thing is clear, a hypersonic missile race is already well on its way.

6 "Hypersonic Weapons: DOD Should Clarify Roles and Responsibilities to Ensure Coordination across Development Efforts," US Government Accountability Office, March 22, 2021, https://www.gao.gov/products/gao-21-378

7 Kelley M. Sayler "Hypersonic Weapons: Background and Issues for Congress,"

8 "US Air Force's ARRW hypersonic boost-glide missile fails second launch test," July 31, 2021, https://www.ucsusa.org/resources/slowing-hypersonic-arms-race

9 Ankit Panda, "Missile Defence Strategy, Policies, and Programs in Review of the Defence Authorization Request," June 9, 2021, https://carnegieendowment.org/2021/06/09/missile-defense-strategy-policies-and-programs-in-review-of-defense-authorization-request-pub-84737

10 James Acton, 2013. *Silver Bullet? Asking the Right Questions about Conventional Prompt Global Strike* (Washington, DC: Carnegie Endowment for International Peace, 2013) https://carnegieendowment .org/files/cpgs.pdf

Hypersonic Missiles of US, Russia and China

	Missile	Propulsion	Basing Mode	Prospective or Reported Deployment
United States	Army Long-Range Hypersonic Weapon (LRHW)	Boost-glide	Ground-launched	Early 2020s
	Navy Conventional Prompt Strike weapon (IR-CPS)	Boost-glide	Submarine-launched	Late 2020s
	Air Force Air-Launched Rapid Response Weapon (ARRW)	Boost-glide	Air-launched	Early 2020s
	DARPA/Air Force Hypersonic Air-Breathing Weapon Concept (HAWC)	Cruise	Air-launched	Demonstration program
	DARPA/Air Force Tactical Boost-Glide weapon (TBG)	Boost-glide	Air-launched	Demonstration program
	DARPA/Army Operational Fires weapon (OpFires)	Boost-glide	Ground-launched	Demonstration program
Russia	Avangard	Boost-glide	Ground-launched	2019
	3M22 Tsirkon	Cruise	Ship- and submarine-launched	Early 2020s
China	Dongfeng-17 (DF-17)	Boost-glide	Ground-launched	2020
	Xingkong-2	Cruise	Unknown	Unknown

Source: Cameron Tracy, "Slowing the Hypersonic Arms Race: A Rational Approach to an Emerging Missile Technology," Union of Concerned Scientists, May 5, 2021, https://www.ucsusa.org/resources/slowing-hypersonic-arms-race

Indian Pursuit of Hypersonic Technology

India tested HSTDV in September 2020, which was powered by a scramjet engine and has a speed of Mach 6. The DRDO is also working on a hypersonic cruise missile BrahMos-II in collaboration with Russia. It is also expected to attain Mach 6 speed using hypersonic scramjet technology. The Indian pursuit of hypersonic technology destabilises nuclear deterrence in South Asia by further reducing missile flight times between India and Pakistan. Pakistan is concerned that it would increase Indian first strike tendencies with the confidence that it can strike its adversary and absorb a counter strike through missile defence.[11]

Conclusion

The major powers' pursuit of hypersonic weapons has already accelerated yet another arms race. The pursuit of hypersonic technologies will not only have destabilising effects on nuclear deterrence, as each country tries to outdo the other in this technological race to develop hypersonic systems and counter hypersonic, it will also have a cascading effect where other countries also scramble to develop the technologies. France, Japan, Australia and India are already working on their hypersonic

11 For details of effects of Hypersonic missiles in South Asia see Ghazala Yasmin Jalil "Hypersonic Missile Race: Implications for Regional and Global Security," Issue Brief, Institute of Strategic Studies, Islamabad, October 2, 2020, http://issi.org.pk/wp-content/uploads/2020/10/IB_Ghazala_April_2_2020.pdf

weapons. Pakistan feels threatened by Indian hypersonic missiles may also be tempted to follow suit.

The US, China and Russia will also be embroiled in a race to develop better, faster and more sophisticated hypersonic missiles. The race to develop counter hypersonic missile technologies has already started. Just like the nuclear arms race, there will be no winners in the hypersonic missile race. Just like all other arms races this one will end up in a vicious cycle of offensive hypersonic systems and hypersonic defensive systems. The US and other countries are pouring billions of dollars into a race that will have no winners and none of the countries will be more secure for it. What is needed is a check on the development of hypersonic missiles. However, the countries that have already developed the weapons are unwilling to talk about any arms control measures. This bodes ill for global strategic stability.