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Introduction

Intercontinental ballistic missiles (ICBMs) and hypersonic missiles represent the pinnacle of modern military deterrence, combining advanced propulsion systems and warhead technologies to deliver high-precision strikes across vast distances. Today, intermediate-range ballistic missiles (IRBMs) are also becoming a factor, utilising both aspects of ICBMs and hypersonic missiles. Historically, ICBMs have been crucial for the global nuclear strategy, enabling states to project power far beyond their borders. While IRBMs are slightly more localised, they remain integral to regional dominance and rapid-response tactics. In this context, the emergence of Russia's missile program has attracted significant attention, raising questions about its strategic purpose. With the recent use of the secret 'Oreshnik' missile, hypersonic capabilities of Russian missiles applied to IRBMs are now a new level of concern for Ukraine's defence.

Since the start of the full-scale invasion in 2022, Moscow has frequently used Ukraine as a battlefield to demonstrate its military advancements, including hypersonic missiles, drones and precision-guided systems (Jensen and Atalan, 2024). These experiments serve dual purposes: exhausting Ukraine's morale on the ground and signalling Russia's capability to project power across Europe (Roggeveen, 2024). Among these developments, the introduction of the Oreshnik missile in November 2024 represents a significant escalation in both technological sophistication and strategic ambition. Deployed for the first time in November 2024, the Oreshnik missile struck an industrial zone near Dnipro, Ukraine, carrying six warheads, albeit lacking a destructive payload (Doyle et al., 2024; Vialko, 2024).

This deployment signals a potential shift in Russia's military strategy, which blends advanced precision-strike capabilities with a demonstration of technological prowess. While the US Department of Defence officially designated the Oreshnik as a medium-range system (therefore IRBM), its advanced features and hypersonic capabilities make it challenging for the Ukrainian aerial defence systems (Tucker, 2024). Such technology complicates strategic assessments, particularly for Europe, which faces heightened vulnerability given the missile's potential reach and Europe's lack of air defence systems to intercept hypersonic missiles. Testing systems like the Oreshnik in active combat suggests that Moscow is accelerating their development, gaining critical data on operational performance while showcasing their missile technology to undermine Europe's support to Ukraine.

This paper explores the significance of the Oreshnik missile within the broader context of Russia's missile development and its implications for European security. Starting from the classification of different missiles, it situates the importance of hypersonic technology and how Oreshnik blurs the line between conventional use and political messaging. The use of

hypersonic missiles could carry a new level of security threat in Ukraine and potentially affect Ukraine's defensive capabilities as it is undetectable by the current Ukrainian air defence systems.

1. Anatomy of Next-Generation Missiles

To understand the strategic implications of Russia's missile developments, it is crucial to define and differentiate between key missile categories: ICBMs, hypersonic missiles and IRBMs. Each type serves specific purposes, leveraging distinct technical features such as speed, range, payload and guidance systems.

IRBMs occupy an intermediate range of 3,000 to 5,500 km and are typically employed in regional conflicts or as tactical deterrents (Feickert, 2005). These missiles share ballistic trajectories similar to ICBMs but are optimised for shorter-range applications. Technically, Russia has been mostly using missiles that are quasi-ballistic and shorter in range (<1000 km), alongside drone swarms in its full-scale invasion of Ukraine (Ivaniuk, n.d.). Models such as Iskander-M and Kh-69 are frequently deployed for quick, impactful strikes, often targeting infrastructure or serving as tools of intimidation (Army Recognition, 2024a). Other models that Russia uses include the North Korean-made KN-23 and Iranian-made Fath 360 close-range ballistic missiles (Khomenko, 2024; Lopez, 2024a). The recent Oreshkin missile falls under the category of IRBM since it is a variant of the RS-26 Rubezh IRBM (Jakes, 2024). Although it was launched from a 900 km distance (which classifies its use as a short-range missile), the Oreshkin missile is an important milestone for Russia's full-scale invasion as it is produced domestically, albeit at a high cost (Syngaivska, 2024).

ICBMs are long-range ballistic missiles designed to deliver nuclear or conventional warheads over distances exceeding 5,500 km (Davenport, 2023). These missiles are a cornerstone of strategic deterrence, capable of reaching intercontinental targets through suborbital trajectories with precision strikes all over the world (Costlow, 2021). They are often equipped with multiple independently targetable reentry vehicles (MIRVs), allowing a single missile to strike multiple targets (Shalvey et al., 2024). Modern Russian ICBMs, such as the RS-24 Yars and the RS-28 Sarmat, demonstrate advanced capabilities and the extent of Russia's global threat. These ICBMs include speeds exceeding Mach 20 during their terminal phases, making them exceptionally challenging to intercept (Evans, 2024).

In contrast, hypersonic missiles represent the next-level category of weaponry that combines extreme speed (greater than Mach 5) with advanced manoeuvrability (Harriss and Noone, 2023). Unlike traditional ballistic missiles, hypersonic systems can evade missile defence systems by re-entering the atmosphere faster than traditional ballistic missiles,

which follow a parabolic trajectory that is easier to detect by radar systems (Center for Arms Control and Non-Proliferation, 2023). Hypersonic glide vehicles (HGVs), such as Russia's Avangard, and hypersonic cruise missiles like the Kinzhal are prime examples of this technology that are also used in Ukraine (Mitchell, 2023). While these missiles often have shorter ranges compared to ICBMs, their precision and ability to strike high-value targets with minimal warning significantly enhance their strategic utility (Elefteriu and Freer, 2023). Oreshkin is the latest version of a hypersonic missile that is used on the battlefield. While little is known about the technicalities of Oreshkin, some analyses can be made considering its modification from the RS-26 Rubezh.

Several technical aspects define the missile capabilities of Oreshnik. The payload includes MIRVs, enhancing the missile lethality by overwhelming missile defences or striking multiple targets (York, 2024). Speed is another critical factor, with ICBMs and hypersonic systems achieving Mach 20 or more, while Oreshnik was launched at the typical IRBM speed of Mach 5 to Mach 10 (Greenall and Partridge, 2024). Even if it is limited in inventory, the Oreshkin missile can become a lethal strike with a combination of guidance systems, such as inertial navigation, microsatellite positioning (e.g., GLONASS) and advanced terminal guidance, further refining precision outside the atmosphere (Nikolov, 2024).

Understanding these distinctions stretches the importance of a layered threat posed by Russia's missile arsenal. ICBMs underpin strategic nuclear deterrence, hypersonic systems disrupt conventional defences, and IRBMs excel in regional power projection. Together, this forms a dual-capable missile advantage for Russia to use both hypersonic conventional missiles and nuclear-capable ICBMs to threaten European security (Lunn and Williams, 2024).

2. Russia's ICBM and Hypersonic Missile Development: Status and Trends

Russia's missile development has consistently focused on advancing its ICBM and hypersonic weapons capacity, which together form the backbone of its strategic deterrent and asymmetric warfare strategy (Aarten, 2020). Amid renewed geopolitical tensions with NATO and the West following the US' approval of Ukraine to fire long-range missiles into Russian territory, Russia has accelerated efforts to modernise its missile arsenal and boost production.

ICBM Development: Evolution and Modernisation

Russia remains one of the global leaders in ICBM technology, boasting a diverse arsenal capable of delivering nuclear and conventional warheads across continents (Woolf, 2022).

The cornerstone of its current ICBM fleet is the RS-24 Yars, a solid-fuelled system capable of carrying MIRVs (Missile Defence Project, 2024). Designed to replace the ageing RS-18 and RS-20 (SS-19 and SS-18), the Yars exemplifies Russia's focus on mobility, as it is deployable via both silo-based and mobile platforms (Gleason, 2017). This mobility enhances survivability by complicating detection and targeting by enemy forces (Trevithick, 2019).

The most notable recent advancement in Russian ICBM technology is the RS-28 Sarmat, also known as 'Satan II.' Officially introduced in 2022, the Sarmat is a liquid-fuelled heavy ICBM capable of delivering up to 10 MIRVs or HGVs like its hypersonic counterpart, Avangard (Army Recognition, 2024b). With a range exceeding 18,000 km, it is specifically designed to bypass US missile defences through unconventional trajectories, such as over the South Pole, where Western conventional missile defence systems are not oriented (Felstead, 2023). This ability to evade traditional interception systems shows a strategic shift in Russia's missile strategy towards destabilising the global nuclear security order (Starchak, 2024a).

Russia is also investing in new-generation systems like the Kedr ICBM, set to replace older models post-2030 (TASS, 2021). Although details remain sparse, Kedr is expected to integrate advanced MIRV technology of Russian missiles such as Oreshnik and potentially feature dual-capability warheads (Wilk and Żochowski, 2024). However, very little is known about Kedr's operational use, the only evidence being the Kapustin Yar testing site in the Astrakhan region of Russia where the project was launched, the same place where Oreshnik missiles were launched towards Dnipro on November 21st (Kabachynskyi, 2024). One idea is that according to Ukraine's Main Intelligence Directorate, both Oreshnik and Kedr might be the same missile under different names (Kabachynskyi, 2024). However, another idea suggests that both missiles could be different variations that can be fired with the same system since Oreshnik is reported to be an IRBM, contrasting Kedr's ICBM features (Shcherbak, 2024).

Hypersonic Missile Development: A Strategic Game-Changer

Parallel to its ICBM advancements, Russia has been a frontrunner in the development of hypersonic weapons since the 2014 Military Doctrine (McDermott, 2022). Hypersonic missiles represent a paradigm shift in modern warfare by combining speed, manoeuvrability and precision, rendering existing defence systems in Europe inadequate (IISS, 2020). Hypersonic missiles open a new page for Russia's threat to global security, as these missiles can penetrate Ukraine's air defence in the long-run and threaten the general European security framework (Proud, 2024).

Several hypersonic missile programs have been ongoing in the Russian military. The

Avangard, a hypersonic glide vehicle deployed atop ICBMs, increases Russia's breakthrough in hypersonic technology. Deployed operationally since 2019, it is paired with the RS-28 Sarmat, reinforcing Russia's strategic deterrent on both conventional and nuclear strategy. With the ability to manoeuvre unpredictably during its descent phase, the Avangard is claimed by Russian officials to have the ability to penetrate even the most sophisticated missile defence systems (Missile Threat, 2024b). However, this claim remains speculative since the Avangard missile remains a 'super weapon' that Russia has not officially used in combat.

In addition to the Avangard, Russia has developed the Kinzhal ('Dagger') air-launched hypersonic missile, capable of striking targets up to 2,000 km away (Airforce Technology, 2023). Mounted on modified MiG-31 fighter jets, the Kinzhal is optimised for rapid deployment against European infrastructure and defence systems like THAAD (Missile Threat, 2024c). Reports indicate its use in Ukraine (earliest use in March 2022), which demonstrated Russia's willingness to operationalise hypersonic missiles in regional conflicts as well as strategic deterrence scenarios (Kirby, 2022). Although hypersonic missiles are believed to be 'uninterceptable,' Ukraine has been able to shoot down other hypersonic missiles via US-supplied Patriot systems (Brown, 2023). Chinese analysts claim that this is largely due to Kinzhal using a predictable ballistic route, unlike other hypersonic missiles (Goldstein and Waechter, 2024). The Oreshkin missile stands out in this context, as its route constantly changes and travels through the upper atmosphere in contrast to Kinzhal's launch-from-air trajectory (Santora et al., 2024).

Alternatively, the Zircon missile is another hypersonic platform under development, designed for ship- and submarine-based launch systems. Intended primarily for anti-ship and land-attack roles, Zircon's range of 1,000 km and Mach 9 speed make it a potent tool for challenging NATO's maritime dominance (MDAA, n.d.). According to Ukrainian military experts, the first operational tests were conducted on Ukrainian territory in 2021. (Lendon, 2023). Since their first deployment, the Ukrainian military claims that they were able to shoot down the missiles, contrary to Russia's claims that the Patriot systems are unable to defend against them (Militaryni, 2024a).

3. Strategic Implications of Oreshnik: A New Era for Missile Insecurity

Deployment of the Oreshnik missile presents a new challenge for European security. Traditionally, Russia has always maintained a 'nuclear triad' that is based on deterring the US and the West through conventional ballistic missiles and nuclear-capable ICMBs (Singh, 2023). However, with the full-scale invasion of Ukraine, Russia has shifted towards the deployment of rapid and experimental hypersonic missiles at a greater volume

(Jensen and Atalan, 2024). By focusing on hypersonic missiles that can carry unconventional warheads (i.e. nuclear), Russia aims to bring down the Ukrainian defence while deterring European nations from aiding Ukraine through the threat of rapid, precise and hard-to-counter attacks (Grand, 2024).

In this context, Russia's missile advancements serve both tactical and political purposes (Grand, 2024). Hypersonic weapons have been previously deployed in large quantities to strike Ukraine's critical infrastructure (Jensen and Atalan, 2024). Simultaneously, missiles like Oreshnik serve as a political message, signalling that any escalation involving NATO remains fraught with unacceptable risks (Starchak, 2024a). This rhetoric has been further reinforced by Putin's revision of Russia's nuclear doctrine, which lowered the threshold for a nuclear response (Starchak, 2024b).

Therefore, Russia's missile strategy needs to be understood in two different parts. On the one hand, Russia is increasingly investing in hypersonic missiles that are aimed to blur the lines between conventional and unconventional missiles (Grand, 2024). Another objective is to deprive Ukraine of air defence responses or bypass the existing systems like Patriot to force Ukraine to acquire more advanced systems such as THAAD (Horobets, 2024). On the other hand, hypersonic missiles are costly, and Ukraine does not possess any critical infrastructure or military threat significant enough for Russia to use these missiles or ICBMs (Starchak, 2024a). It can thus be argued that Oreshnik and other 'super weapons' are essentially Russia's blackmailing attempt to prevent the West from aiding Ukraine while at the same time intimidating the rest of Europe (Hird et al., 2024).

4. EU and NATO Responses: Supporting Ukraine and Strengthening Defence

The EU and NATO have intensified their efforts to counter Russian missile advancements and support Ukraine in the face of increasing missile threats. Their approach combines robust military aid, bolstering regional air defence systems, and enhancing technological cooperation (Baldor and Mahdani, 2024; Pugnet, 2024). Regarding the aftermath of Oreshnik, NATO Spokesperson Farah Dakhlallah stated that this will not change the trajectory of NATO's aid to Ukraine (The Kyiv Independent, 2024).

Since the onset of the conflict, NATO countries have supplied advanced defence systems, such as the US-manufactured Patriot PAC-3 and NASAMS, which have proven effective in countering Russian missiles like the Kinzhal (Militaryni, 2024b; NATO, 2024). The EU has also coordinated the provision of artillery, missile systems and training to improve Ukraine's military resilience (European Parliament, 2024). This assistance has been upgraded following the involvement of North Korean soldiers and Oreshnik's deployment (Goleanu, 2024).

In response to the increased missile threat, NATO's European members have prioritised the deployment of integrated air and missile defence systems. The European Sky Shield Initiative (ESSI), led by Germany, aims to unify air defence capabilities across the continent, ensuring a cohesive response to potential threats (Wachs, 2023). Similarly, increased investment in early-warning radar systems and missile interception capabilities highlights NATO's commitment to deterring Russian aggression (Allison, 2024). NATO's already installed SPY-1 radars in Aegis Ashore facilities can detect such ballistic missile launches, though Ukraine would need Standard Missile-3 (SM-3) and Terminal High Altitude Area Defence (THAAD) exo-atmospheric interceptors if Russia continues to produce and launch hypersonic IRBMs as in the case of Oreshnik (Roaten et al., 2024).

Beyond military measures, the EU has continued to impose stringent economic sanctions targeting Russian arms manufacturers and supply chains (Bureau of Industry and Security, 2024). In parallel, Russian missile production did not decrease as was anticipated in the beginning despite it becoming costly for Russia to continue (Williams, 2023). Though Ukraine received advanced ballistic missiles such as Storm Shadow and SCALP from the UK and France (Le Monde, 2024), it remains unclear if advanced missile defence systems such as THAAD will be delivered (Denisova, 2024).

Conclusion

Russia's missile strikes in Ukraine have showcased a range of technologies, from older Iskander ballistic systems to modern cruise missiles and hypersonic platforms like the Kinzhal. These systems have targeted critical infrastructure, military installations and civilian areas, demonstrating a blend of tactical and psychological warfare. The consistent use of such systems in urban centres serves to demoralise the population and disrupt economic stability.

This paper has analysed the current status of Russian missile programs and their strategic implications for the future of European security. At the same time, certain programs have been ongoing since the overhaul of Russian military doctrine, emerging technologies like the Oreshnik, whose classification as either an IRBM or ICBM signals a shift towards integrating experimental platforms in live conflict scenarios. As Western aid continues to supply Ukraine for its defence against the Russian invasion, Russia looks for an increase in its strike capabilities. This approach allows Russia to refine its weapons systems under combat conditions and test out experimental weaponry. Hypersonic missiles, for example, have shown their effectiveness in penetrating Ukrainian and NATO-supplied air defence systems, such as the Patriot, using unpredictable routes and over-the-surface travel.

By supporting Ukraine and adapting their defence strategies, the EU and NATO are confronting the challenges posed by Russia's evolving missile technology. These measures not only bolster Ukraine's defences but also strengthen the Alliance's overall security framework. As the conflict persists, continuous innovation and collaboration will be pivotal in addressing future threats. The Ukrainian military has also focused on integrating high-tech radar and countermeasure systems to bolster their defences further. However, as Russia continues to escalate the use of hypersonic missiles, Ukraine's land forces will face growing challenges in both defending key infrastructure and maintaining their military capabilities, requiring ongoing adaptation and support from NATO and EU allies. As for the European states, Russia's continuous attempts at using hypersonic missiles alongside ICBMs as a form of political blackmail must be taken seriously. While initiatives such as ESSI attempt to be an answer, air defence is becoming increasingly important alongside the development of the land forces.

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