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# Strategic Security in Northern Europe: The Implications of Russian Anti-Access/Area Denial Strategies in Developing Complex Threat Environments


## Abstract

Anti-Access/Area Denial (A2/AD) is a term that came into use to describe an environment in which an air and air defense force could use a combination of surface-launched ballistic missiles, surface and air launched cruise missiles and long-range surface-to-air missiles to prevent an opposing force from accessing or operating within a large airspace effectively. The descriptions and subsequent analyses of the penetrability of these environments often rests on assessments of the capabilities of just a few newly developed missiles and may fail to consider the additional complexity induced by the large array of the entire complement of air, land and sea launched missiles available to adversaries. This article will focus on Northern Europe as one example of the higher degrees of complexity that our air forces are likely to face should the need arise to fight and win in a 21$^{st}$ Century highly contested environment.

# Introduction

Anti-Access/Area Denial (A2/AD) is a term that came into use to describe an environment in which an air and air defense force could employ an array of surface and air launched ballistic missiles, cruise missiles and long-range surface-to-air missiles to prevent an opposing force from accessing or operating within a large airspace effectively. Possible A2/AD environments in Europe are typically ascribed to potential Russian operations in the Baltic Region, Ukraine, or the Black Sea Region. The descriptions and subsequent analyses of the penetrability of these environments often rests on Western assessments of the capabilities of just a few newly developed missiles and may fail to consider the additional complexity induced by the large array of the entire complement of air, land and sea launched missiles available to our adversaries. Russian armed forces field a much wider array of missiles than are generally addressed in Western discussions of A2/AD and, in most classes of missiles, Russian systems tend to out range their United States and North Atlantic Treaty Organization (NATO) equivalents. This brief assessment will focus on the compressed geography of Northern Europe as one example of the higher degrees of complexity NATO air forces are likely to face should the need arise to fight and win in a 21st Century highly contested environment.

## Understanding A2/AD

The Center for Strategic and International Studies provided a good working definition of A2/AD. It asserted, "A2/AD forces are classified as those that contribute to denying an adversary's forces access to a particular region or otherwise hinder freedom of maneuver."[1] Biddle and Oelrich expanded the definition to include, "a series of interrelated missile, sensor, guidance, and other technologies designed to deny freedom of movement to hostile powers in the air and waters."[2] It is important to note that A2/AD is not limited to kinetic weapons; Russia could employ capabilities such as cyber, electro-magnetic pulse and other non-kinetic weapons to support the establishment of an A2/AD environment. However, the focus of this article is on the kinetic effects produced by multiple, overlapping missile systems.

Geography matters in any kinetic combat and the physical constraints imposed by the battlespace will shape the manner in which A2/AD is

implemented in a given operational context. In order to be successful, an A2/AD construct must be able to establish a protected operational maneuver space for its own forces while being able to conduct offensive operations against an opponent outside of its own protected operational maneuver space. Such an A2/AD capability is enhanced to the extent that the A2/AD power can hold the opposing power at risk while retaining relative sanctuary for its own forces. One way to do this is by building and operating offensive and defensive missile systems that out-range those of the opponent. In addition, this, as will be described in detail, is precisely what the Russians have done.

Most western descriptions of a potential Russian A2/AD environment in Northern Europe rest on the capabilities of three Russian missile systems: The Iskander M mobile theater ballistic missile (TBM), often operating in a mixed battery with the Iskander K cruise missile (CM); the Oniks supersonic cruise missile can be launched from shipboard or land-based launchers; and the S-400 Triumf long range surface-to-air missile (SAM) system.[35] The Iskander, Oniks and Triumf taken together are quite formidable but, as will be discussed later in this article, there is much more at work here than these three systems, both in terms of offensive and defensive capabilities. It is the overlapping capabilities of these systems, compounded by their range advantages vis-s-vis their NATO counterparts, that renders the A2/AD environment in Northern Europe to be particularly challenging for NATO.

For the western military planner, the essential questions are straightforward: Does Russian A2/AD capability offer early strategic advantages in a large force-on-force conflict. If so, does Russia have the capacity to exploit those advantages? Finally, have western military planners properly characterized the Russian A2/AD threat?

In order answer those questions and to understand the overlapping and mutually supporting threats posed by these systems, it is necessary to undertake a brief excursion to describe their capabilities and to discuss how these three systems complement each other. Taken in context, it is necessary to discuss both the three large primary systems as well as other


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complementary systems that add complexity and lethality to the battlespace.

## The Big Three: Iskander, Onyx, and Triumf

The Iskander system is deployed as a brigade level system. An Iskander brigade and employs both TBM and cruise missile variants. Published maximum ranges for the Iskander M TBM vary from 400-500 km.[3] At least one Iskander TBM was launched to a distance of 480 km on the Kapustin Yar missile range during Zapad 2017.[4] This compares to only 300 km for the United States counterpart system, the AGM-140 Army Tactical Missile System (ATACMS).[5]Assuming the published ranges are correct, the Iskander would be able to engage the ATACMS while remaining out of ATACMS range. The Iskander K cruise missile has a published range of 500 km. The United States had expressed concerns that its actual range is longer and in violation of the Intermediate-Range Nuclear Forces (INF) Treaty's 500 km range limit on cruise missiles.[6] On August 2, 2020, the United States announced its intention to withdraw from the INF Treaty for that reason.[7] The United States has subsequently withdrawn from the INF treaty.

The Iskander TBM poses particularly difficult technical challenges for the NATO defender. The Iskander M employs a quasi-ballistic profile beginning with a vertical launch into a flattened ballistic trajectory with the rocket booster. After engine burnout, the missile begins to pitch over and continues to climb to high altitude while maintaining hypersonic cruise.[8] Hard evasive maneuvering (20-30 G) during the re-entry phase complicates NATO missile defense.[9] If these evasive maneuvers begin outside of the maximum effective range NATO defensive systems, intercept of the Iskander M missile becomes extremely difficult. Further complicating the problem of countering the Iskander is the high mobility and off-road capability of the mobile launchers. One would anticipate that the missile launch vehicles would remain radio silent and would be camouflaged prior to launch. Following launch, the mobile launchers would likely displace quickly in order to reload and move to a new launch location.

Five Iskander Brigades have been deployed in Russia's Western Military District since 2010, with one brigade west of St Petersburg; it can range much of the Baltic region from its garrison location[10]. Iskander missile

systems have been deployed intermittently in the Kaliningrad enclave in recent years; it appears that a system will now be stationed in the Kaliningrad enclave on a permanent basis.[11]

The Onyx is a ramjet powered system and is intended for use against naval and land-based targets. In addition to its shipboard and air launched versions, the same missile is also used in Bastion-P land-based launchers. Onyx systems have been deployed to the Kaliningrad enclave at least since 2016, with a range of up to 600 km and a flight envelope ranging from just above sea level up to 14,000 m; following booster burnout, the ramjet continues to accelerate to a maximum speed of Mach 2.5 which the missile sustains until impact.[12] The Onyx can range most of the Baltic region, making it an effective system for use against both ships and land targets.[13]

As with the Iskander and Oynx, the S-400 Triumf SAM system, with a maximum effective range of 400 km, can out range its United States equivalent, the Patriot PAC 2, which has a published maximum range of 160km.[14] Whereas the US Patriot employs a single missile type to engage targets across its defended area, the Triumf employs four different missiles (hence the designation S-400) to cover various range, altitude and engagement conditions (an S-500 with a 500 km range is reportedly in development). Alternatively, the US Theater High Altitude Area Defense (THAAD) with a 200 km+ range against TBMs[15] does offer significant range advantages over the S-400 system in an anti-ballistic missile (ABM) role. In that mode the S-400 is limited to an effective range of 60 km against TBMs[16]. A number of NATO countries employ the NATO Surface-to-Air Missile System (NASAMS) mobile air defense system; however, its 55–180 km engagement envelope is well short of range needed to defend against longer-range offensive missiles.[17]

Given the effective ranges of the various S-400 missiles, the S-400 system would be capable of defending the Russian battlespace while remaining out of range of NATO's offensive missiles. At the same time, the S-400 would retain a capability to hold at risk United States and NATO Battle Management, Surveillance and Reconnaissance aircraft such as the E-3 AWACS (Airborne Warning and Control System), E-8 JSTARS (Joint Surveillance and Radar Attack System) plus the high-altitude U-2 and RQ-4 aircraft. The extended range of the S-400 system would potentially force these aircraft to retrograde for survivability, significantly diminishing their



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ability to monitor and respond to Russian military movements across the border. Drones could partially compensate by way of penetrating hostile airspace, but would still be vulnerable to Russian air defense systems. Taken together, these conditions would reduce the depth of NATO airborne sensor coverage of the battlespace and would degrade NATO's capacity to monitor Russian forces in Russian territory.

## And All the Rest….

The Iskander, Triumf, and Onyx are formidable systems but there are more. While there are shorter-range tactical systems, they contribute less to the A2/AD environment than do the longer-range systems. The focus of the remainder of this discussion will address the rest of the air-launched systems that add additional complexity to the A2/AD environment. For purposes of this discussion, these missiles can be broken down into three categories: Anti-radiation missiles, air-to-air missiles, and air-to-surface missiles. These Russian systems can be launched from outside of NATO air space, generally from outside the range of NATO's offensive and defensive missiles, and could be employed in coordination with previously described land based offensive and defensive missile systems in a campaign to achieve local air superiority.

### *Anti-Radiation Missiles*

The Russian Air Force operates a number of anti-radiation missiles, including some short-range tactical systems; in the context of this paper, the longer-range systems are more relevant since, as with the systems previously discussed, they can be launched from aircraft remaining in Russian airspace in many cases. The KH-58 has been produced in several variants, but the KH-58U has extended range (250 km) when launched from high altitude, as well as the capability to acquire and lock onto the targeted radar after launch.[18] One KH-58 variant is designed to counter both the Hawk and the Patriot SAM systems.[19]

### *Air-to-Surface Missiles*

The Russian Air Force fields a broad array of conventional air-to-surface ballistic and cruise missiles. For purposes of this discussion, however, the long-range missiles are the systems of interest, at least for the opening

phase of an air campaign against NATO. This points to two missiles—the Kh-555 and the Kh-101—both of which are predominantly bomber launched. These cruise missiles are not stealthy per se, but do have relatively small radar cross sections, 400 kg warheads, and extended ranges of 3500 km for the Kh-555 and up to 5500 km for the Kh-101. Both the TU-95 and TU-160 heavy bombers are capable of carrying these missiles. [20] [21]

The most recent addition to the Russian Air Force arsenal is the Kh-47M2 Kinzhal, an air-launched hypersonic missile, capable of carrying either a nuclear or conventional 480kg warhead.[22] The Kinzhal appears to have been developed from the ground launched Iskander M missile. The Kinzhal is classified as an air-launched ballistic missile, and is carried by a modified MiG-31 fighter aircraft. Reportedly, at least eight MIG-31 aircraft have been modified to carry the missile, which has an advertised range of 1500-2000 km. The Kinzhal appears to have been developed to target key NATO airfields, command centers, and theater missile defenses with attacks from multiple axes.[23]

*Air-to-Air Missiles*

As with the air-to-surface missiles, the Russian Air Force has a number of short range and medium range air-to-air missiles, but when considering the air-to-air missile contribution to establishing and maintaining an A2/AD environment, the long-range missiles count. The R-37M is the missile of interest with a potential range of 400 km. The R-37 reportedly employs semi-active guidance through midcourse switching to active radar homing at end game. The R-37 was designed specifically to attack NATO's large battle management and reconnaissance aircraft such as the E-3 AWACS, E-8 JSTARS, and RC-135 Rivet Joint[24]. Potentially, it could also be employed against highflying reconnaissance aircraft such as the US RQ-4 and the U-2.

## Understanding A2/AD as an integrated counter-air campaign

The purpose of an A2/AD environment is to deny the opposing force access to one's own battlespace while also limiting the opponent's freedom of action in his own battlespace. To support this objective, Russia has developed a wide array of missile capabilities offering a range of



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capabilities, flight profiles, and destructive effects. While individually defeating or pre-empting any one of these threats is feasible, the potential for Russian aerospace forces to introduce complexity, time compression, and simultaneity of multiple missile systems that poses the greatest threat. These missile systems are collectively capable of employment in multiple speed and altitude regimes, with a wide variety of flight profiles, delivering a wide range of effects. Presumably, Russian Air Forces would integrate cyber effects with the planned kinetic effects.

An A2/AD threat environment comprising the full range of Russian missile capabilities would present formidable challenges for NATO forces. The Russian A2/AD threat does not depend on any one advanced missile system, but results instead from the over-lapping and mutually supporting effects of multiple advanced missile systems operating offensively and defensively in the same battlespace. In addition, as noted above, the inclusion of multiple air and surface launched complementary systems adds to the complexity and simultaneity of the modern battlespace. The forces to accomplish this are largely in place today in northern Europe.

A Russian missile-based air campaign against NATO, based on the capabilities and range advantages described in the foregoing discussion, would likely incorporate the following features:

- Iskander-M TBM batteries would be capable of launching pre-emptive strikes against key NATO command and control systems and bases. These first strikes would be followed by immediate launcher displacement to alternate firing sites to reload and fire a second strike.

- Iskander-K and P-800 Onyx systems could launch cruise missiles from multiple locations, on multiple axes of attack, against key forward areas, with sufficient separation to avoid fratricide while retaining the simultaneity needed to complicate the defenses.

- Russian medium and heavy bombers, operating well outside of NATO radar detection range, could launch cruise missiles on multiple axes, for low altitude penetration with times-over-target synchronized with the Iskander strikes. Concurrently, selected

bombers could launch Kinzhal hypersonic missiles on lofted trajectories against high value targets.

- Selected Russian fighter aircraft, operating in Russian air space, could launch Kinzhal long-range hypersonic missiles against key NATO targets.

- Russian aircraft could launch anti-radiation missiles from multiple platforms on high altitude profiles with near vertical dive angles in the terminal phase to target key NATO radar systems.

- Russian fighter aircraft could launch long-range air-to-air missiles against NATO battle management, surveillance, and reconnaissance aircraft in coordination with attacks by S-400 long-range surface-to-air missiles, again employing multiple attack axes with varying profiles and ranges.

Although Russian military doctrine does not formally include pre-emption, there appears to be great concern among Russian military strategists about the need to engage forcefully and early in any conflict with NATO. Hence, any pre-emption would be characterized as defensive in nature and the Russian military has exercised pre-emption in multiple military exercises.[25] Moreover, Russian military thought are increasingly focused on the potential need for pre-emption and the need for early decisive air operations at the outset of any conflict with the intent of "destroying Western equipment before it can even get airborne."[26]

## Strategic Implications

NATO relies on integrated air and ground-based missile systems to defend against hostile missiles and aircraft. These defenses include both fighter aircraft and various anti-aircraft and anti-missile systems. Installation of European Phased Adaptive Approach (EPAA) SM-3 missile sites in Romania and Poland, although planned for defense against ballistic missile launches from the Middle East, could contribute to defense against other missile threats as well.[27] However, with that notable exception, the remainder of NATO's in place air defense and missile defense systems are largely short-range systems. These include the United States built PATRIOT system. While the Patriot has a maximum range of about 70 km



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against aircraft, its maximum effective range against ballistic missiles is limited to about 15-22 km, depending on target and intercept geometry.[28] The SAMP/T Air Defense System, jointly developed by France and Italy, features intercept ranges of 30-120 km, depending on the interceptor missile used.[29] Area defense could be provided by the THAAD system, which has a range of approximately 200 km and is designed for employment against short, medium, and intermediate range ballistic missiles.[30] However, the THAAD system is not permanently stationed in Europe and would have to be deployed to support a NATO contingency.

Taken together, the simple fact is that in most cases, Russian missiles outrange and, in some cases outnumber the NATO counterpart systems. Russia can employ these systems at the outset of a NATO conflict in a way that achieves early strategic advantages. Moreover, the Russians are continuing to develop newer systems as well, while paying particular attention to development of hypersonic missiles. As stated at the beginning of this article, with some notable exceptions, few of the Russian missile systems described in this article are truly new and virtually all of them can be defeated when addressed individually. However aggregated, they present an impressive array of capabilities that can establish a complex and formidable aerospace threat environment.

While newer, longer-range systems are in development for the United States and NATO missile arsenal, it is not clear that these efforts will be sufficient to close the capability gap. The Russians, after all, are continuing to modernize as well. The US Army's long-range precision fires programs include development of several longer-range systems. The Precision Strike Missile, with a range of 700-800 km will eventually replace the ATACMS. A Long-Range Hypersonic Weapon with a range described only as thousands of kilometers is also in development.[31] The US Air Force plans to begin deploying the long-range AIM-260 to replace the current AIM-120 air-to-air missile.[32] The AIM-260 is expected to reach initial operating capability by 2022.[33]

Russian ground forces in the Western Military District and in the Kaliningrad enclave have been reorganized and repositioned in recent years. In addition, Russian engineers have improved transportation infrastructure opposite the Baltic Region to permit quick border crossings of Russian Army forces into the Baltic States[34]. Such preparations

potentially place Russian forces in a position to move rapidly into Northern Europe, through the Baltic States or beyond, under the protection of an A2/AD complex that is multi-layered, robust, and generally outranges NATO counterpart systems. This A2/AD complex would be able to hold NATO resources at risk across northern Europe, push airborne surveillance, reconnaissance and battle management aircraft back for survivability, and conduct precision missile attacks on key NATO airbases and other high value resources while Russian ground forces invested NATO territory under a formidable air defense system.

Deterring and/or countering such a threat may require more military capacity than NATO's air forces can provide and planners should assume that any conflict between Russia and NATO would be an all-domain undertaking. The fact that this article focuses on the air components of that battle should, therefore, not be misconstrued to infer that other military components would not be involved.

## Discussion

This article posed three questions. With the important caveat that certainty only occurs after the fact, one can draw some conclusions based on the information available. Each question is addressed in turn.

Does Russian A2/AD capability offer early strategic advantages in a large force-on-force conflict? The evidence certainly suggests that Russia has potential military advantages in the early stages of a conflict in Europe, assuming Russia initiates the conflict. Based on the missile capabilities discussed in this article, Russia enjoys range advantages in multiple categories of air and surface launched missiles and these range advantages accord Russia the potential to strike first while remaining out of the range of the NATO counter-part systems. Moreover, there is evidence that, while Russian military doctrine does not promote first strike or pre-emption, Russian strategists are, contemplating such changes in doctrine, nonetheless. For example, two associate professors from the Russian pilot training academy recently published an article advocating first strike as an option, arguing that "the combined use of drones, missiles, cyber warfare, and new weaponry" could destroy NATO aircraft on the ground.[35] Presumably, any such Russian air attack would not be limited to destroying NATO aircraft and airbases, but would include attacks on



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DOI: https://doi.org/10.5038/1944-0472.14.1.1871

radars, command and control, plus offensive and defensive missiles as well.

If so, does Russia have the capacity to exploit those advantages? Russia has sufficient forces to sustain air combat operations in northern Europe for some period. This article does not address the sustainability of such a campaign, but clearly, Russia has the capacity to conduct large-scale air and missile attacks at the outset in support of land attacks across Northern Europe. Russian offensive missile attacks against NATO targets could be exploited by penetrating manned aircraft—fighters and bombers—to strike key NATO military formations, installations, command and control, and lines of communication.

Finally, have western military planners properly characterized the Russian A2/AD threat? It is not clear that western military planners have properly characterized the A2/AD threat. This is mainly so because the assessments of that threat focused on the introduction of the three newer systems discussed earlier in this article—the Iskander TBM, Triumf SAM system and the Oynx cruise missiles. Missing from many assessments are two key factors that are likely to affect the outcome of a large, multi-domain conflict in northern Europe. The first of these factors, and the point of this article, is that the Russian missile threat is larger and far more complex than is typically characterized in the open-source literature. Complexity creates additional risk and carries with it the potential to overwhelm local defenses. As has been discussed throughout this article, the range advantages enjoyed by most Russian missiles over their NATO counterparts create tactical and strategic advantages at the outset of any conflict. Further, in going beyond Iskander, Triumf, and Onyx, the integration of large numbers of other offensive and defensive Russian missiles in the air battle introduces degrees of complexity that will challenge NATO air and air defense forces.

## Conclusion

The purpose of a Russian A2/AD environment would be to achieve military superiority at the operational level of war and, in so doing, to achieve strategic effects by denying NATO air, ground and sea access in specific regions under the umbrella of highly lethal offensive and defensive missiles and launch systems. The establishment of the A2/AD

environment would thus have the capacity to enable Russian freedom of action under the protection of the A2/AD umbrella. Obviously, such an A2/AD umbrella would be contested by NATO air and missile forces, but as discussed in this article, Russia has the capacity to impose a much more complex A2/AD environment in a given operational theater of war than is generally described by most Western descriptions of these weapon systems.

Developing an effective response to Russian A2/AD requires a more comprehensive examination of the complex threats posed by multiple overlapping Russian systems and the evolution of improved tactics, techniques, and procedures to deal with them. NATO should develop decision criteria well in advance with respect to when, and whether, to allow large (and vulnerable) ISR and battle management aircraft to retrograde for survivability prior to any outbreak of hostilities. Planners should give priority to continuous intelligence preparation of the battlespace, before the outbreak of hostilities, to identify and monitor mobile missile locations and movements to facilitate identification of potential deployment sites for Iskander TBM mobile launchers. Tactics, techniques, and procedures (TTP) must be developed and maintained for the employment of fifth generation fighters and low observable reconnaissance aircraft to penetrate hostile airspace and track, identify, and defeat mobile missiles early in the fight. Engagement of the offensive and defensive missile threats must include both kinetic and non-kinetic means.

None of the foregoing discussion is intended to suggest that development of new weapon systems and capabilities is not underway. The US Air Force is already reportedly working on development of a sixth generation fighter aircraft under its Next Generation Air Dominance (NGAD) program. Hypersonic missiles are under development as well in both the Army and the Air Force. Initial work is underway to develop disaggregated command and control systems, which should reduce single points of failure. However, all of these capabilities lie in the future and will be of little use should hostilities erupt in the near term. In addition, of course, Russian air and military forces are developing new systems as well.

However, the simple fact of the matter is that if Russia goes to war against NATO tomorrow, NATO must go with the Air Forces it has. In addition, as



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outlined in this article, that fact renders the reassessment of NATO responses to expanded Russian A2/AD capacities all the more urgent.

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