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Addressing the Air and Ballistic Missile Threat to Europe

Cooperating in a Shifting Strategic Environment

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Introduction

Next month's Warsaw Summit could prove to be one of the most consequential for the alliance since the end of the Cold War as leaders from member states convene to discuss a myriad of threats. NATO Summits are convened on an ad-hoc basis, as required by the evolving political and security situation. In recent years, summit locations have held some thematic significance. This year's summit in Warsaw is indicative of the increasing threat the alliance faces from the east, particularly in regards to the air challenge.

The proliferation of ballistic missile technology also continues to demand the attention of NATO members. In May of this year, two key milestones were achieved in the deployment of European Phased Adaptive Approach (EPAA) capabilities, the plan put in place by the Obama Administration to protect Europe from a ballistic missile attack originating from Iran. On May 12 Phase II of the EPAA, the Aegis Ashore site in Deveselu, Romania, was deemed operationally certified. The following day on May 13, a groundbreaking ceremony took place for Phase III of the EPAA, an Aegis Ashore site in Redzikowo, Poland. When the work in Poland is complete, Phase 3 will provide the necessary capabilities to provide ballistic missile defense coverage of all NATO European territory and populations in the 2018 timeframe against intermediate-range ballistic missiles.

Defending the air above NATO member states also remains a challenge, particularly from an increasingly modern Russian military. In the past year, Russia has taken delivery of new combat aircraft and upgraded long-range bombers as well as long-range surface-to-air missiles, cruise missiles and air defense systems. In an effort to control access to air and the sea around the Baltics, Black Sea and elsewhere, Russia has deployed a number of capabilities in or around these areas to include its enclave city, Kaliningrad. This strategy is referred to by U.S. defense officials as Anti-Access/Area Denial A2. Anti-access strategies aim to prevent US forces entry into a theater of operations while area-denial operations aim to prevent their freedom of action. Russia's growing A2/AD capabilities are causing NATO allies to consider options to address the air challenge. Recently, Lithuania's Defense Minister Juozas Olekas discussed potential solutions saying "We need to stop possible air aggression. We are discussing creating a regional medium-range air defense system together with the Latvians, the Estonians and the Poles."

Russian vessel launches a cruise missile in the Caspian Sea

Collective security amongst the NATO allies remains critical as the air and ballistic missile threat to the region increase. Members states have responded to these threats by re-focusing their efforts on increasing their own military capabilities and defense budgets. NATO Secretary-General Jens Stoltenberg announced a very modest 0.6% increase in military spending last year. Stoltenberg cited the small increase in spending as a success after many years of declining budgets saying "after many years going in the wrong direction we are starting to go in the right directions."

Section I:
The Air and Ballistic Missile Threat

Iran Test Fires a Ballistic Missile in October of 2015

Iranian Missile Capabilities

Iran's Ballistic Missile Arsenal Since the Iran-Iraq War in the late 1980s, Iran has obtained and developed a sophisticated arsenal of ballistic missiles. Beginning in the late 1980s, the Islamic Republic—with assistance from North Korea—began constructing a vast array of underground tunnels and facilities for production and storage of nuclear- and non-nuclear-capable missiles. Currently, the regime possesses short- to medium-range ballistic missiles, most of which are capable of carrying a nuclear payload. Tehran continues to improve its arsenal by researching, developing, testing, and deploying longer-range delivery vehicles with increased accuracy. To prevent European vulnerability to ballistic missile attack, the Obama administration initiated the European Phased Adaptive Approach (EPAA) in 2009, which was structured to periodically improve the scope and ability of European missile defense in accordance with improvements to Iran's delivery capability. As the Islamic Republic develops longer-range capabilities, the EPAA will mandate the deployment of longer-range and more capable missile defense technologies. Once fully deployed and implemented in 2018, systems deployed under EPAA will protect much of Europe from Iranian medium- and intermediate-range ballistic missiles.

Short-Range Ballistic Missiles (SRBMs) SRBMs are missiles that have a range less than 1,000 km. Iran currently deploys a wide variety of one-stage SRBMs that are road-mobile and capable of delivering a nuclear payload. The country's arsenal of short-range delivery vehicles includes the Shahab-1, -2, and -3, the Tondar-69, the Fateh A-110, the Qiam-1, and the Fateh-313. These missiles can be launched from anywhere within Iranian territory and strike targets along its borders and in neighboring states. Iran continues to improve its SRBM arsenal by researching, developing, testing, and fielding SRBMs with enhanced accuracy, survivability, and reliability. If deployed to the western portion of the country, these short-range missiles are capable of striking targets in neighboring Turkey.

The **Shahab-1**, which is similar to the Soviet R-17/R-300 (Scud-B) and the North Korean Hwasong-5, was first deployed and used by Iran in the late 1980s during the Iran-Iraq War. The liquid-fueled SRBM uses inertial guidance, has a range of around 300 km, and a payload capacity of about 1000 kg. The **Shahab-2**, which similar to the Soviet R-17M (Scud-C) and the North Korean Hwasong-6, was first obtained by the Islamic Republic from North Korea between 1990 and 1991. It is liquid-fueled, has a range of 500 km, and a payload capacity of around 730 kg. In the early 1990s, with assistance from North Korea, the Iranians developed the capacity to indigenously produce Shahab-1s and -2s. Currently, Iran is speculated to possess 200 to 300 Shahab-1s and Shahab-2s.

The **Shahab-3** is a liquid-fueled single-stage SRBM that is both road-mobile and silo-capable. This missile is modeled after the North Korean No Dong, which was acquired by Tehran in the 1990s. The Shahab-3 was first tested in 1998, and by 2005 Iran claimed to have the ability to produce the missile domestically. This short-range delivery vehicle has a maximum range of 1,000 km and a payload capacity of approximately 800 kg. It is speculated that the Islamic Republic has between 25 to 100 Shahab-3s, however, these numbers are based on imports and do not account for domestic production.

The **Tondar-69**, also known as the CSS-8 (M-7), is a solid-fueled SRBM that entered service in 1992. It is speculated that Iran purchased 200 CSS-8s from China in 1989, and later renamed the weapon the Tondar-69. This missile uses inertial guidance, has a payload capacity of 190-200 kg, and a range of between 150 and 180 km. It is believed that the Tondar-69 will soon become obsolete, and estimates claim that only around 100 Tondar-69 missiles remain operational in Iran.

The **Fateh A-110** began development in 1995 and is designed to have greater accuracy than previous Iranian SRBMs. It is solid-fueled, inertial- and GPS-guided, and has a payload capacity of between 500 and 600 kg. The Fateh A-110 was first tested in 2002, after which Iran purportedly began domestic production. The Fateh A-110C variant has the longest range reaching 300 km. The Fateh A-110 is solid-fueled, which makes it easy to transport and allows Iran to transfer the missile to state-supported groups such as Hezbollah, Hamas, or Bashar al-Assad in Syria. Upgraded versions of the Fateh A-110—called the Hormuz 1 and Hormuz 2—were unveiled in May 2014 and appear to be equipped with further improved guidance and countermeasure capabilities.

The **Qiam-1** is a liquid-fueled SRBM produced by Iran that was declared operational after being tested in 2010. Reports speculate that the SRBM is a modified Shahab-2 with reduced time required for launch preparation. According to Iranian officials, it is also capable of carrying a multi-reentry vehicle warhead (MRV), which deploys multiple unguided warheads in a pattern against a target to oversaturate missile defense systems. This SRBM is road-mobile, but also compatible with missile silos. It is estimated that the Qiam has a range of between 700-850 km and a payload capacity between 500-600 kg.

First unveiled in 2015, the **Fateh-313** is an Iranian-designed, short-range, surface-to-surface ballistic missile. It is a variation of the Fateh A-110 series, featuring an improved guidance system and the ability to strike targets at 500 km. However, the accuracy of the Fateh-313 may come at the expense of payload size, as some experts believe the smaller nose section indicates it carries a payload of less than 500 kg. The missile also features an enhanced rapid launch capability and longer lifespan than earlier models. Iran mass produces and stockpiles the Fateh-313, increasing the size and scope of its ballistic missile arsenal, which is already the largest in the Middle East.

From left to right: nosecone of the Shahab-3, Gahdr, and Emad

Medium-Range Ballistic Missiles (MRBMs) MRBMs are classified as having a range between 1,000 and 3,000 km. Iran has three types of medium-range missiles: the Ghadr-1, the Sejiil, and the Emad, all of which are capable of striking targets in Southern Europe. Tehran is actively improving the capability of its MRBM arsenal and has recently made significant progress with guidance and propulsion. Phases one and two of the EPAA, carried out in 2011 and 2015 respectively, were planned and implemented specifically to counter Iran's progressing MRBM capability.

The **Ghadr-1**—also known as the Shahab-3A—is an improved variant of the Shahab-3 with an extended airframe and larger fuel tanks, allowing the missile to travel longer distances. First flight-tested in 2004, the Ghadr is estimated to have a range between 1,800 and 2,000 km, however, little else is known about the MRBM. The payload capacity, type of propellant, and number of stages is uncertain. In June 2014, a U.N. Panel of Experts report stated Iran had tested the Ghadr in November 2013 and January 2014.

The **Sajjil**—also known as the Ashura—is a solid-fueled two-stage MRBM that is road-mobile and developed indigenously. Development of the missile began in the 1990s with assistance from China and was first tested in 2008. It has a payload capacity of 750 kg and a range between 2,200 and 3,000 km. Using solid propellant, the Sajiil is more mobile than Iran's other MRBMs, allowing it to more effectively evade preemptive strikes. Intelligence estimates claim that the Islamic Republic has around 10 to 12 mobile launchers and 24 airframes for the Sajiil.

The **Emad** is a liquid propelled road-mobile MRBM and, like the Ghadr, derives its design from the Shahab-3. It has a range of 1,700 km, can carry a payload weighing up to 750 kg, and is scheduled to be deployed some time in 2016. Iranian reports claim that the Emad is the country's first precision-guided MRBM, using a maneuverable reentry vehicle (MaRV) to hit within 500 m of its target. The Emad has improved accuracy because the MaRV compensates for reentry errors and contains sensors that allow the warhead to hone in on specific coordinates or target signatures. With the ability to change its flight path after launch, the MaRV also increases the Emad's survivability, making it more difficult for ballistic missile defense systems to track the missile's trajectory. Iran first tested the Emad on October 11, 2015.

Intermediate-Range Ballistic Missiles (IRBMs) Intermediate-Range Ballistic Missiles (IRBM) have a range between 3,000 and 5,000 km. Currently, Iran has no operational IRBMs, however, the country has demonstrated a desire to obtain and field long-range delivery vehicles. In 2005, it was reported that Iran acquired an IRBM prototype from North Korea called the Musudan. If successfully developed and fielded, Iranian IRBMs would be capable of striking targets throughout Central Europe. In anticipation of this threat, the United States has mandated the implementation of phase three of the EPAA, which calls for deployment of an additional missile defense system to Europe equipped with enhanced interceptors that will expand defensive coverage and have the capacity to intercept future Iranian IRBMs.

An Iranian Safir Space Launch Vehicle (SLV)

Intercontinental-Range Ballistic Missiles (ICBMs) ICBMs have a range of over 5,500 km. While Iran does not currently possess or openly pursue intercontinental-range missiles, the country's indigenous rocket motor research and development, coupled with a growing space program, indicate the Islamic Republic is moving closer to developing an ICBM. Since 2008, Tehran has been developing and testing rocket motor technology and multi-stage boosters that could be modified to construct a ballistic missile with intercontinental-range. Currently, Iran possesses two Space Launch Vehicles (SLV): the Safir and the Simorgh.

The **Safir** is a two-stage SLV and variations of the rocket were used to put satellites into orbit in February 2009, June 2011, February 2012, and February 2015. It uses a modification of the Ghadr-1 for the first stage, and a Soviet R-27 Vernier steering engine for stage the second stage. The Safir is road-mobile and launched via a transport-erector, yet, it is unlikely that the rocket could be employed as an ICBM in its current state because its upper-stage cannot provide the thrust needed to carry a nuclear warhead.

The **Simorgh** is a multi-stage liquid-fueled SLV designed to launch heavier payloads into orbit than the Safir. Iran first launched the Simorgh in April 2016, but the rocket did not reach orbit. U.S. defense officials believe the launch was either an unsuccessful attempt to put a payload into orbit or a test of the rocket's third-stage. U.S. officials are divided on the capacity of the Simorgh to deliver a military payload. While some claim that the rocket can double as a long-range missile, others estimate that it would take years to weaponize the SLV.

Cruise Missiles Cruise missiles can be air- or surface-launched, fly low to the ground, are guided by onboard computers, and vary from short- to intercontinental-range. They are used to target naval forces, as well as terrestrial-based civilian and military assets. To threaten Europe, Iran needs long-range cruise missiles capable of delivering conventional, chemical, or nuclear payloads. Currently, the country possesses various short-range cruise missiles, most of which are purposed for anti-ship missions. Some reports speculate that Iran imported long-range nuclear-capable cruise missiles in the 1990s and early 2000s that, while not likely deployed, provided Tehran with the technical knowledge required to research and domestically produce its own long-range cruise missile arsenal.

In 2015, the country unveiled a long-range ground-launched cruise missile known as the Soumar, which is speculated to have a range over 2,000 km and is aesthetically similar to the nuclear-capable Soviet Kh-55, implying that the Iranians had imported and reverse engineered the Soviet cruise missile. Analysts speculate that Iran cannot develop the cruise missile domestically. NATO, employing variations of the Patriot Air and Missile Defense System, has a limited capability to defend against Iranian cruise missiles, yet, no long-term plans have been implemented to counter a future Iranian cruise-missile threat.

Syrian Missile Capabilities

After Iran, Syria has one of the largest ballistic missile arsenals in the Middle East and is an active proliferator of ballistic missile technology. Its arsenal consists of short-range ballistic missiles (SRBM) and anti-ship cruise missiles (ASCM). Although the country has imported nearly all of its missile technology from nations such as Russia, China, North Korea, and Iran, it sustains a limited capacity to domestically produce and maintain its SRBM arsenal.

Syria's missile pursuit originated during the Cold War to counter the superior conventional capabilities of the nation's primary adversary, Israel. Starting in the 1970s, Damascus obtained battlefield short-range ballistic missiles (BSRBM) from the Soviet Union. This outside assistance evolved, and in 1974, the Soviets provided the Syrians with a Scud-B SRBM.

After the collapse of the Soviet Union, Syria continued to advance its ballistic missile program with assistance from China, North Korea, and Iran. These nations provided the country Syria with new types of ballistic missiles, along with the capacity to domestically produce and maintain its own arsenal of Scud and M-600 SRBMs. The liquid-fueled Scud makes up the foundation of Syria's ballistic missile arsenal, and the nation currently develops and maintains three different Scud variants: The Scud-B (SS-1C), the Scud-C (Hwasong-6), and the Scud-D (Hwasong-7). Syrian Scud missile variants are liquid-fueled, have a range up to 700 km, and are capable of delivering conventional or chemical payloads. The M-600 derives its design from the solid-fueled Iranian Fateh A-110, which has a range of 300 km and has the capacity to deliver conventional or chemical payloads.

Syria's current civil war has forced the nation's government to exhaust its arsenal of ballistic missiles and freeze progress of its ballistic missile program. Consequentially, the nation is unlikely to produce longer-range ballistic missiles anytime soon. The civil war has also increased the risk of missile proliferation, and many of Syria's ballistic missiles have fallen into the hands of non-state actors operating in the country.

Russian Air Defense Capabilities

Overview On December 1, 2011, Russia formed the Aerospace Defense Force (Vozdushno-Kosmicheskaia Oborona: VKO) placing all air defense systems under its command. In August 2015, Russia combined the VKO with the Russian Air Force to form the Aerospace Forces (Vozdushno Kosmicheskikh Sil: VKS) with plans to establish a comprehensive and integrated multi-tier air and missile defense network. Air defense systems such as the Tor and Pantsir will form the lowest tier of this network and the S-300 and the S-350E systems will provide short to medium range defense. The medium- to long-range air defense will be provided by the S-400 air defense system. Finally, the S-500 air defense system, with its long-range, exo-atmospheric, and kinetic hit-to-kill defense capabilities, will provide defense for the upper-tier. All of Russia's air and missile defense systems are mobile, allowing them to deploy wherever and whenever they are required to counter a threat. This mobility makes Russian air and missile defense shoot, move, shoot capable, by engaging incoming targets and then moving before reengaging additional targets. Such mobility allows Russian air and missile defense systems to evade attacks while maintaining a defense posture.

S-300P (NATO Designation: SA-10 Grumble) The Soviet Union initiated the development of the S-300P in the late 1960s. The system was first deployed in 1982 and was designed to detect, track, and destroy incoming cruise missiles and low-flying aircraft. Subsequent versions, the S-300PS and the S-300PM, were also designed to destroy ballistic missiles and are currently operationally deployed. However, the Russian Federation ceased production of the S-300PS in March 2012. The S-300PS and S-300PM (NATO Designation: SA-20 Gargoyle) systems are land-based and road-mobile. They use the Russian 48N6E single-phase, solid-fuel missile that has a range of 150 km and a maximum altitude of 30 km, and the 5V55R with a range of 75 km. A full S-300 battalion includes a command-and-control vehicle, an engagement radar vehicle, an acquisition radar vehicle, and six launch vehicles that carry four missile containers each, for a total of 24 missiles. The long-range surveillance radar is called the Big Bird and has a tracking range of over 300 km. For target tracking and fire-control, the S-300P employs a phase array radar with a range of 40 km and the ability to track and engage up to six targets simultaneously. S-300P launch vehicles are capable of firing five minutes after stopping and, in accordance with Russian shot-doctrine, the system fires two interceptors within three seconds to defend against one incoming target. Russia has exported variations of the S-300P system to several different countries including China and Syria.

S-350E Vityaz

S-300V (NATO Designation: SA-12A Gladiator, SA-12B Giant) The S-300V has two different versions based on the missile it uses, the SA-12A Gladiator primarily for targeting aircraft and the SA-12B Giant primarily for tactical ballistic and cruise missiles. The S-300V was initially deployed in 1986 and is still being produced and employed today. The Gladiator has a range of 75 km and a max altitude of 25 km. The Giant has a range of 100 km and an altitude ceiling between 30 and 40 km. The S-300V system uses a phased-array sector-scan radar with a range of 175 km and can track up to 16 targets simultaneously. A modified version of the S-300V system was revealed in 1998 called the Antey-2500. The Antey-2500 version has a range of 200 km, a max altitude of 30 km, and can engage 24 targets simultaneously. The Antey-2500 can target ballistic missiles with a range of 2,500 km. Russia has sought to export the S-300V system to numerous countries including Iran and India.

S-300F Fort (NATO Designation: SA-N-6 Grumble) The S-300F Fort provides limited ballistic missile defense for ships and is based on the S-300P system. The S-300F uses the 5V55RM missile with a range of 90 km. It first became operational in 1984 and is still operational on one of the Kirov class nuclear-powered missile cruisers (the Petr Veliky) and three Slava class conventional-powered cruisers. A later version of the S-300F called the S-300FM Fort-M (SA-N-20 Grumble) became operational in 1990. It has only been deployed on one ship, the Petr Veliky Kirov class cruiser. The Petr Veliky is equipped with 48 S-300F Fort and 46 S-300FM Fort-M missiles. The S-300FM uses the 48N6 and 9M96 missiles, which gives it a range of 200 km.

S-400 Triumf (NATO Designation: SA-21 Growler) The S-400 Triumf is a mobile medium- and long-range air defense system. The S-400 began development in the 1990s and was first deployed in 2007. The system uses four different types of interceptors to destroy various airborne targets and also has the capability to use some S-300 legacy missiles. The first interceptor is the 48N6E3, a modified version of the 48N6E2 that is used in the S-300P systems, and has a range of 250 km. The second is the 40N6, which has the longest range at 400 km. It is believed the 48N6E3 and 40N6 are used primarily to target stealth aircraft, cruise missiles, and drones. The third is the 9M96E which has a range of 40 km and a max altitude of 20 km. The fourth is the 9M96E2 which has a range of 120 km and a max altitude of 30 km. The 9M96E and 9M96E2 are believed to target medium-range ballistic missiles at a range of 60km, but also aircraft, cruise missiles, and drones. The 9M96E and 9M96E2 missiles are also smaller, allowing four to fit into one S-400 missile container. Therefore, one erector launcher vehicle for the S-400 system is capable of carrying 4-16 missiles depending on the missile variants fielded. A battalion of the S-400 includes a command-and-control vehicle, engagement and acquisition radar vehicles, and eight launch vehicles with a total of 32 – 128 missiles. The acquisition radar of theS-400 is a modified version of the same Big Bird radar used by the S-300 system, but has a detection range of 600 km. The S-400 system is believed to be able to and engage up 36 targets simultaneously.

S-400 Battery Components

Recent reports indicate Russia currently has a total of eleven regiments equipped with the S-400 system and expects to have an additional five regiments equipped by the end of October 2016. Russia's ministry of defense expects to have 28 total regiments equipped with the S-400 by 2020. As early as 2012, there have been conflicting and unconfirmed reports claiming that Russia may have deployed S-400 systems to Kaliningrad. In early 2015, two regiments were deployed with S-400 systems to the Arctic region, the Novaya Zemlya archipelago and the Yakutian port of Tiksi in the Arctic Ocean. One regiment in the Novosibirsk region of Siberia was equipped with the S-400 system in late 2015. Also in late November 2015, Russia deployed S-400 systems to its Khmeimim airbase in Latakia, Syria. At least three regiments in the cities of Dmitrov, Zvenigorod, and Elektrostal, all in the Moscow region have been equipped with the S-400 and an additional regiment is expected by the end of 2016. Also at least one regiment in both the Southern Military District and Eastern Military District have had S-400s deployed. Russia has also looked to export the S-400 system. It was reported in April 2015 that China and Russia signed a contract in order for China to purchase at least six S-400 battalions for $3 billion. However, on June 3, 2016 it was reported that Russia did not have any plans to deliver any of the S-400 systems to China before 2018. India is also planning to purchase five battalions of the S-400 system for a reported $6 billion. However, a contract for their purchase has not been signed by Russia and India.

S-400F The S-400F is the ship based version of the S-400 Triumf air defense system. It is expected to use the same missiles as the S-400 Triumf, with the exception of the 40N6 missile, indicating that the expected range of the S-400F system would be up to 250 km. In 2010 the Russian Navy planned to modernize and equip three of its suspended Kirov class nuclear-powered missile cruisers with the S-400F system. The first ship undergoing the modernization effort is the Admiral Nakhimov. Conflicting reports indicate the ship is expected to complete its modernization and enter into service between 2017 and 2019. Reports have also indicated the modernization of the two suspended Kirov class ships may be cancelled because of funding limitations. Finally, when the Admiral Nakhimov enters back into service, the currently operational Petr Veliky is expected to undergo a modernization program that will include replacing its S-300F and S-300FM systems with the new S-400F system.

S-350E Vityaz The S-350E Vityaz is Russia's planned replacement for the S-300PS systems. It began development in 2007 and was first tested in 2013. The air defense system uses the S-400's 9M96E2 missile, giving it a range of 120 km. It also uses a short-range missile that has not officially been identified, although many reports indicate it is the 9M100 short-range missile with a range of 10 km. A battalion of the S-350E consists of one or two engagement radars, a command and control post, and up to eight launch vehicles that carry twelve missiles each. It can engage up to 12 missiles or 16 aircraft simultaneously. The first S-350E system is schedules to become operational in 2016 and the Russian Defense Ministry plans to acquire 30 of the S-350E systems by 2020.

S-500 Prometheus The S-500 Prometheus began development in 2002. The S-500 system is not a modernization of the S-400 Triumf system, but instead an entirely new long-range anti-aircraft and anti-ballistic missile system. It is designed to engage high priority aircraft, intercontinental ballistic missiles (ICBMs), and cruise missiles and is believed to have the capability to engage up to ten targets simultaneously. With a range of 600 km and an altitude ceiling of up to 200 km, the S-500 has the ability to intercept ballistic missiles in space, before they re-enter the atmosphere. So far there are three missiles reported to be used by the S-500. The first is the 40N6, which is also employed by the S-400 Triumf. The second and third missiles are the 77N6-N and 77N6-N1. Currently there is little information on these two missiles, yet, they are believed to utilize hit-to-kill interceptors. A battalion of the S-500 will comprise of a command and control vehicle, an acquisition radar vehicle, an engagement radar vehicle, and eight launch vehicles. It has been reported that it is capable of engaging targets ten minutes after stopping. The acquisition radar is believed to be able to detect ballistic missiles at a range of 2,000 km and warheads at a range of 1,300 km. Reports indicate the first S-500 systems are expected to become operational later in 2016 and the Defense Ministry is expected to purchase five S-500 systems by 2020 for deployment in the Moscow region.

Russian Tactical Ballistic Missile and Cruise Missile Capabilities

Short-Range Ballistic Missiles (SRBMs) SRBMs are classified as having a range less than 1,000 km. However, the Intermediate-Range Nuclear Forces Treaty (INF), signed by the U.S. and Russia in 1987, requires both nations to eliminate all ground-launched ballistic and cruise missiles with ranges between 500 and 5,500 km. Therefore, all of Russia's SRBMs are required to have a maximum range of 500 km. Currently Russia has only two SRBMs in its arsenal, the Tochka and Iskander, although both have multiple variations.

The ***9K79 Tochka (SS-21 Scarab)*** was first developed by the Soviet Union in 1968 and deployed in 1975. The original Scarab A version is a single-stage solid fueled engine with a range of 70 km and inertial guidance to achieve an accuracy of 150 m Circular Error Probable (CEP). It can deliver up to a 482 kg warhead that can be equipped with conventional, chemical, or nuclear munitions. The nuclear warhead for the missile is believed to have a selectable yield of 10 or 100 kT, with an air burst option to create an Electromagnetic Pulse (EMP). The Scarab B began development in 1984 and began replacing Scarab A variants in 1989. The Scarab B also uses a single-stage solid fuel engine, but has an extended range of 120 km. While the missile employs inertial guidance for targeting, it also utilizes a GPS and radar - or optical terminal correlation system - to increase its accuracy to 95 m CEP. The Scarab B is also capable of launching conventional and nuclear warheads. Both versions use a road-mobile Transporter-Erector-Launcher (TEL) which makes them highly mobile and able to quickly redeploy after launch. Russia has exported these missiles to various countries including Syria.

The Iskander-K and Iskander-M Cruise Missile System

The ***Iskander (SS-26 Stone)*** began development in the early 1970's to replace the Scud B. However, its development was accelerated to replace the SS-23 Spider, which Russia retired in 1988 because of the INF Treaty. There are two versions of the missile, the ***Iskander-M*** and the ***Iskander-E***. The Iskander-M variant was operationalized in 2006 and is currently used by the Russian Army. It has a range of 400- 500 km and uses both internal and optical guidance systems to achieve an accuracy of 10-30 m CEP. It can carry conventional and nuclear warheads up to 700 kg. The Iskander-M also has a maneuverable re-entry vehicle (MARV) and decoys to defeat theater missile defense systems. The Iskaner-E variant is purposed for export and has a range of 280 km and a warhead capacity of 480 kg. Like the Iskander-M, this version also has an internal guidance system that gives it an accuracy of 30 – 70 m CEP. Reports indicate the Iskander-E variant has been exported to countries such as Syria. Both versions of the missile use a road-mobile TEL, that can carry up to two missiles. In 2015, Russia briefly deployed Iskander missiles to Kaliningrad for military exercises to demonstrate its quick deployment abilities, yet, some reports and Polish defense officials believe Russian Iskander-Ms are still deployed in Kaliningrad today. Recently, Russia has threatened to deploy the Iskander-M to Kaliningrad in response to NATO BMD and the U.S. European Phased Adaptive Approach (EPAA), placing the future Aegis Ashore site in Redzikowo, Poland within range of Russia's short-range missiles. In March 2016, it was reported that Russia had deployed at least one Iskander missile system to its Humaymim Air Base in Syria. Russia has also reportedly developed a cruise missile version that is currently operational and is capable of being launched by Iskander TELs called the ***R-500*** or ***Iskander-K***. Russian news sources state it has a range of 500 km, but other sources argue the range could be at or easily extended up to 2,000 km.

A Kalibr Cruise missile in a shipping container

Cruise Missiles fly within the atmosphere, typically at low altitude, and do not fly on a ballistic trajectory. They are capable of being launched from ground, sea, and air platforms. The Russian Federation possess numerous cruise missiles for every launch platform. Only the ground-launched cruise missiles are restricted to a range shorter than 500 km, or greater than 5,500 km because of the INF Treaty.

The **KH-55** is an air-launched cruise missile that began development in 1971 and was first deployed in 1984. The missile was designed to carry a 410 kg nuclear warhead with a yield of 200-250 kT up to 2,500 km. It uses inertial navigation and Terrain Contour Matching (TERRCOM) to achieve an accuracy of 25 m CEP. This version of the missile is still fielded today by the Tu-95 (Bear) and Tu-160 (Blackjack) strategic bombers. A later version, the **KH-55SM** is similar to the KH-55, except that it has a range of 3,000 km. The **KH-555** version extended the range even further to 3,500 km and replaced the nuclear warhead with a 400 kg conventional warhead.

The Russian **Klub-S** (for submarines), **Klub-N** (for surface vessels), and Klub-M (for land-based anti-ship missiles) missile system fires several cruise missiles designed for various missions. The **3M-54 Klub (SS-N-27 Sizzler)** and ***3M-541 Klub*** are anti-ship cruise missiles capable of being fired from the Klub-S, Klub-N, and Klub-M systems. Some Russian media outlets report these missiles have a range of 440-660 km and can carry a 200-450 kg conventional or (reported) nuclear warhead. The 3M-54 anti-ship missile also has the reported ability to accelerate in the last 20-40 km to Mach 3 in order to defeat anti-ship missile defenses.

Russia's Kalibr cruise missiles are believed to be the land-attack version the Klub family cruise missiles, yet, not much is currently known about these variations. The **3M-14T Kalibr-NK** is a land-attack cruise missile carried by Russia's surface vessels. Reports have puts its max range at 1,500 – 2,500 km. In October and November 2015, Russia launched a salvo of Kalibr missiles from the Caspian Sea at ISIS targets inside Syria. The Kalibr-NK cruise missiles were launched from a Russian Gepard-class frigate and Buyan-M-class corvettes and travelled 1,500 km to reach their targets. It has been reported it is capable of carrying a 450 kg conventional or (reported) nuclear warhead. The missile is believed to fly 64 ft above the sea and 164 ft above the ground at speeds up to 965 km/hour. It is believed to be guided, using GPS and terminal-phase active radar seekers to achieve a reported 3 m CEP. The **3M-14K Kalibr-PL** is similar to the 3M-14T except that is launched from a submarine. This variant was reported to have been launched from an improved Kilo-class submarine in the Mediterranean to strike targets inside Syria in December 2015. Russia plans to equip most of its submarines and surface ships with the respective versions of the Klub anti-ship and Kalibr land-attack cruise missiles. This will include ships in Russia's Baltic Sea, Black Sea, Caspian Sea, Northern, and Pacific Fleets. Novator Design Bureau, the designers of the Klub launch system, have developed a shipping container version of the launcher, capable of holding up to four missiles. This shipping container version allows the cruise missile to be forward deployed on ships, trucks, and trains without detection.

2015
The **KH-101/-102** air-launched cruise missiles began development in the early 1990s to replace the KH-55 family of cruise missiles. Little is known about these weapons, but it is speculated the KH-101 can carry a 400 kg conventional warhead and the KH-102 can carry a 250 kT nuclear warhead. Both are believed to have a range of 3,000–3,500 km, but some Russian media outlets report it to be 5,500–6,000 km; some even up to 10,000 km. According to Russian media, these missiles have an accuracy of 5-6 m CEP, using GPS and TV/Imaging Infrared scene matching for guidance and targeting. The cruise missiles purportedly employ stealth technology to evade radar and missile defenses. It is likely Russia's Tupolev Tu-160 (Blackjack) and Tupolev Tu-95 (Bear) strategic bombers are equipped with the KH-101/-102 cruise missiles. In November 2015, it was reported the KH-101 was operationally employed for the first time when several Russian strategic bombers launched the cruise missile over the Mediterranean to strike ISIS targets inside Syria.

Section 2:
Strategic and Theater Air and Missile Defense in Europe

Belgium
- 2 Karel Doorman class frigates equipped with Sea Sparrow interceptors for air and cruise missile defense

Denmark
- Hosts a U.S. Upgraded Early Warning Radar (UEWR) in Thule, Greenland
- 2 Absalon class frigates equipped with Evolved Sea Sparrow Missiles (ESSM) for air and cruise missile defense
- 3 Iver Huitfeldt class frigates equipped with ESSM for air and cruise missile defense

France
- 7 Surface-to-Air Missile Platform/Terrain (SAMP/T) batteries equipped with Astor 30 interceptors for air and missile defense
- 2 Horizon class frigates equipped with Principle Anti-Air Missile System (PAAMS) and Astor interceptors for air and missile defense
- Vertical launch MICA short-range air defense system for air and cruise missile defense
- MIM-23 HAWK for air and cruise missile defense

Germany
- Hosts U.S. EUCOM C2BMC Command and Control at Ramstein Air Base
- Hosts the U.S. 10th Army Air and Missile Defense Command (AAMDC) headquartered in Kaiserlautern, Germany:
  - 2 regiments equipped with Patriot/PAC-3 air defense batteries
  - 2 detachments to provide surveillance and tracking of intercontinental- and intermediate-range ballistic missiles
- 3 [German] Patriot/PAC-3 battalions for air and missile defense
- 3 Sachsen class frigates equipped with ESSM for air and cruise missile defense
- Future capabilities:
  - MBDA Deutschland is producing the Medium Extended Air Defense System (MEADS) for air and missile defense in cooperation with Lockheed Martin and Italy

Greece
- 6 Patriot/PAC-2 Guidance Enhanced Missile (GEM) batteries for air and missile defense
- 4 Hydra class frigates equipped with ESSM for air and cruise missile defense
- MIM-23 HAWK for air and cruise missile defense

Italy
- Hosts U.S. Command Task Force 64 in Naples, which, part of U.S. Naval Forces Europe-Africa, is responsible for operational and tactical integrated air and missile defense
- 3 SAMP/T batteries equipped with Aster 30 interceptors for air and missile defense
- 2 Horizon class frigates equipped with PAAMS and Astor interceptors for air and missile defense
- Spada 2000 Air Defense Missile Systems for air and cruise missile defense
- MIM-23 HAWK for air and cruise missile defense
- Future capabilities:
  - Cooperating with Germany and Lockheed Martin on development of MEADS for air and missile defense

Netherlands
- Patriot/PAC-3 batteries for air and missile defense
- 4 De Zeven Provinciën class frigates equipped with SMART-L BMD Radar and ESSM for air and cruise missile defense
- 2 Karel Doorman class frigates equipped with Sea Sparrow interceptors for air and cruise missile defense
- National Advanced Surface-to-Air Missile System (NASAMS) for air and cruise missile defense

Norway
- 5 Fridtjof Nansen class Aegis frigates equipped with SPY-1F radar and ESSM for air and cruise missile defense
- NASAMS for air and cruise missile defense

Poland
- Future Capabilities:
  - Plans to host a U.S. Aegis Ashore site at Redzikowo Base; equipped with SM-3 Block IIA interceptors, this site is planned to provide regional ballistic missile defense for northern and central Europe against ballistic missiles fired from the Middle East
  - Considering purchase of U.S. Patriot air defense system and possibly MEADS for air and missile defense

Romania
- Hosts a U.S. Aegis Ashore system in Deveselu as mandated by Phase 2 of the EPAA
  - Equipped with SM-3 Block IB interceptors, Aegis Ashore in Romania provides regional ballistic missile defense for southeastern Europe from ballistic missiles launched from the Middle East
- MIM-23 HAWK for air and cruise missile defense

Spain
- Hosts 4 U.S. Arleigh-Burke class Aegis BMD-capable destroyers at Rota, Spain as part of Phase 1 of the European Phased Adaptive Approach
  - Equipped with SM-3 Block IA and IB interceptors, these U.S. destroyers deploy throughout the Mediterranean and provide missile defense for southern Europe against ballistic missiles launched from the Middle East
- 6 Patriot/PAC-2 batteries for air and missile defense (one deployed to Adana, Turkey)
- 5 Alvaro de Bazan class Aegis frigates equipped with SPY-1F radar, SM-2 interceptors, and ESSM for air and missile defense
- NASAMS for air and cruise missile defense
- Spada 2000 Air Defense Missile Systems for air and cruise missile defense
- MIM-23 HAWK for air and cruise missile defense

Turkey
- Hosts U.S. Army/Navy Transportable Radar Surveillance (AN/TPY-2) at Kurecik for surveillance and tracking of ballistic missiles coming out of the Middle East as mandated by Phase 1 of the EPAA
- Hosts a Spanish PAC-2 battery at Adana for air and missile defense
- 4 Barbaros class frigates equipped with Sea Sparrow missiles for air and cruise missile defense
- Rapier FSC missile system for air and cruise missile defense
- MIM-23 HAWK for air and cruise missile defense
- Future capabilities:
  - Barbaros class frigates to be upgraded and equipped with ESSM
  - Indigenously developing its own air and missile defense system; in the meantime, interested in acquisition of foreign air and missile defense systems as a stop-gap solution until domestic development can be completed

United Kingdom
- Hosts a U.S. UEWR in Fylingdales
- 6 Type 45 destroyers equipped with PAAMS (called Sea Viper in U.K.) and Aster interceptors for air and missile defense
- Rapier FSC missile system for air and cruise missile defense

Europe Air and Missile Defense Capability

Defense Against:

Subsonic and supersonic aircraft, unmanned aerial vehicles, and cruise missiles

Short-range ballistic missiles in the terminal phase

Short– to intermediate-range ballistic missiles in the midcourse and terminal phase

Belgium
-2 Karel Doorman class frigates

Denmark
-2 Absalon class frigates
-3 Iver Huitfeldt class frigates

Poland
-Plans to host a U.S. Aegis Ashore site at Redzikowo Base

Norway
-5 Fridtjof Nansen class Aegis frigates
-NASAMS

Greece
-Patriot/PAC-2 GEM
-4 Hydra class frigates
-MIM-23 HAWK

Italy
-SAMP/T
-2 Horizon class frigates
-Spada 2000
-MIM-23 HAWK

France
-SAMP/T
-2 Horizon class frigates
-Vertical launch MICA
-MIM-23 HAWK

The United Kingdom
-Hosts a U.S. UEWR in Fylingdales
-6 Type 45 destroyers
-Rapier FSC

Germany
-Hosts the U.S. 10th AAMDC with Patriot/PAC-3
-German Patriot/PAC-3
-3 Sachsen class frigates

The Netherlands
-Patriot/PAC-3
-4 De Zeven Provinciën class frigates
-2 Karel Doorman class frigates
-NASAMS

Turkey
-Hosts U.S. AN/TPY-2 Radar at Kurecik
-Hosts a Spanish PAC-2 battery at Adana
-4 Barbaros class frigates
-Rapier FSC
-MIM-23 HAWK

Romania
-Hosts a U.S. Aegis Ashore system in Deveselu as mandated by Phase 2 of the EPAA
-MIM-23 HAWK

Spain
-Hosts 4 U.S. Arleigh-Burke class Aegis BMD-capable destroyers at Rota as part of Phase 1 of the EPAA
-5 Alvaro de Bazan class Aegis frigates
-Various other systems for air and missile defense