1. Introduction
The importance of outer space to military operations is growing. The United States remains the leader in the utilization of military space assets; however, Russia is investing a significant amount in this area with the clear goal of closing the gap and perhaps to get ahead of the world’s sole superpower, as the panoply of its satellites described below demonstrates. While in the area of military theory, Russia might have already achieved its goal of equality with the U.S., much work remains to be done to fully implement theoretical advances into practice and to utilize the benefits of military space assets in full.

This paper considers first, Russia’s appreciation for how space contributes to military power and second, the programs, plans and policies Russia has and is supporting to advance its military space and counterspace capabilities. In the first part, it summarizes relevant concepts that Russian theory developed since the late 1970s. The second part of the paper describes Russia’s military satellites, briefly comments on the Moscow’s launch capabilities and summarizes the developments in Russian anti-satellite weapons programs. The paper concludes that Russia’s desire to achieve self-sufficiency and superiority permeates all its military space activities. Russia currently cannot fully take advantage of its space-based systems, mainly due to the lack of supporting infrastructure and rigidity within its military. Nevertheless, it continues to slowly reform its army and gradually improve its military space and counterspace capabilities. It remains to be seen how much Russia’s military assertiveness will increase after the country masters the concepts of network-centric warfare, and reconnaissance and information strikes not only in theory but also in practice.

2. Russia’s Military Uses of Space: Theory and Practice

2.1. The Concepts of Reconnaissance and Information Strike
Although the mounting nuclear arsenal suggested the USSR’s preoccupation with nuclear weapons, since the 1970s, the country paid a lot of attention to advances in conventional
weaponry. Already in 1971, Marshal N.V. Ogarkov, who was later appointed Chief of the General Staff in Moscow, wrote that “the fundamentally new types of weapons and combat technology, combined with certain other means, have now become the decisive means for conducting armed combat.” Other members of the Soviet military establishment seemed to have shared Ogarkov’s view that the new conventional weapons were “almost as effective as weapons of mass destruction.” For example, in the early 1980s, Gen.-Maj. Makarevskiy and Marshal Petrov both expressed the opinion that the new conventional weapons could achieve many combat tasks that were previously assigned to tactical nuclear weapons. Ogarkov called for an immediate incorporation of the modern technology into Soviet military theory and practice and warned that “stagnation and a delayed restructuring of views (…) are fraught with the most severe consequences.”

Advances in military technology created new possibilities for conducting reconnaissance, command and control, and target engagement that the USSR planned to utilize in the development of reconnaissance-strike and reconnaissance-fire complexes. The reconnaissance-strike complex (razvedyvatel'no-udarnyi kompleks, RUK) represented the operational level (front and army), while the reconnaissance-fire (razvedovateln-o-gnevov kompleks, ROK) complexes were employed at the tactical level (divisions). According to the Soviet military journal Voyennyy Vestnik, “[i]f the strike element destroys the target by fire (for example with conventional or rocket artillery), the complex is called a reconnaissance-fire complex, while if it does so by a missile strike (tactical or army aviation, tactical and operational-tactical missile launchers), it is called a reconnaissance-strike complex. Therefore reconnaissance-fire complexes are more of a tactical command resource while reconnaissance-strike complexes are operational command resources.”

The RUK and ROK can be defined as formations of “missile (artillery) units (subunits) which organizationally, technically and functionally bring together the means of reconnaissance, guidance, command and control and effective engagement into a single loop that can carry out, with precision and in an automatic mode, the detection, target designation, targeting and scoring sure hits of enemy targets in the shortest time possible.” The RUK and ROK (often called “systems” instead of

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4 Ibid., 9.
“complexes,” and therefore RUS and ROS\textsuperscript{10} are designed to be self-sufficient and consist of the following subsystems: a subsystem of reconnaissance and targeting; a subsystem of guided weapons; a navigation-time support subsystem; a subsystem of control; and a subsystem of special-technical and logistic support.\textsuperscript{11} As the overlap between the names of the RUK/ROK subsystems and the general classification of satellites suggests, space-based systems and their supporting infrastructure on the ground are essential for the conduct of a reconnaissance strike/fire.

Continuing advances in space technology, electronic warfare and precision-guided munitions led to the introduction of the so-called information strike/fire, which is an evolution of the reconnaissance strike/fire.\textsuperscript{12} In a 2009 \textit{Vozdushno- kosmicheskaya I Oborona} article, Col. O. E. Kaminskiy, S.V. Baushev and Col. I. V. Morozov, who was Chief of the Space Troops Headquarters Operational Directorate, defined the information-strike system as “an automated weapon system, which is designed for the highly-effective destruction of one, several or many facilities (targets) using precision-guided strike weapons at great distances (...).”\textsuperscript{13} Among the components of an information-strike system are precision-guided weapons, automated weapon control systems, and precision-guided munitions information support (reconnaissance, coordinate-time, navigation-hydrographic, geodetic survey, and hydrometeorological) system.\textsuperscript{14}

Like many of their colleagues, Kaminskiy, Baushev and Morozov concluded that “information-space support is acquiring decisive significance in contemporary wars.”\textsuperscript{15} Space-based systems are essential not only for the integration of command, control, communications, information, surveillance and reconnaissance (C3ISR) necessary in today’s combat environment, but also for the conduct of a new form of armed combat known in Russia as the “information-strike operation.” An information-strike operation consists of coordinated “information-strike battles, information-weapon engagements and information strikes, which are being conducted with the goal of disrupting the enemy troop command and control and weapon control systems and the destruction of his information resource.”\textsuperscript{16}

\textsuperscript{11} Matveyev, “Precision Missile Forces & Artillery Systems: Creating Reconnaissance-strike and Reconnaissance-fire Systems.”
\textsuperscript{12} Igor Morozov, Sergey Baushev, and Oleg Kaminskiy, “Space and the Character of Modern Military Activities,” \textit{Vozdushno- Kosmicheskaya I Oborona} no. 4 (2009).
\textsuperscript{13} Ibid.
\textsuperscript{14} Ibid.
\textsuperscript{15} Ibid.
\textsuperscript{16} Ibid.

www.marshall.org
2.2. The Emergence of Aerospace, the Continuing Relevance of the Offensive and the Changed Character of Supremacy

Recognizing the growing importance of military space assets,\(^{17}\) the rise of various missile threats, Russia’s geopolitical location,\(^ {18}\) and the progress in military space and air technology, Russian military thinkers agree that the biggest threats to Russia’s security come from aerospace. Aerospace has become the main sphere of military conflict, and weapons employed in aerospace are the primary weapons of 21st-century wars since they can achieve many kinds of missions (operational-tactical, operational, operational-strategic and strategic), without the employment of nuclear weapons.\(^ {19}\) Although the term aerospace lacks a universal or a legal definition, Russian scholars contend that it is a term better suited for the new environment than the phrase “air and space” because it expresses the interrelatedness of the airspace and outer space in the context of contemporary threats and conflicts.\(^ {20}\) The Russian Defense Ministry apparently agrees given that it uses the term “Aerospace Defense Forces” on its website and not other translation variants.\(^ {21}\)

Russian thinking with regard to military operations in aerospace seems to follow the Soviet tradition of emphasizing offense over defense. Only in the 1980s and 1990s, the discourse prioritized defensive operations over offensive ones in the initial period of war,\(^ {22}\) and in the early 1990s, the concept of a “defensive-strike operation” was debated.\(^ {23}\) Today, the majority of Russian writings prioritize offensive action and preemption (again). For example, Kaminskiy, Baushev and Morozov wrote that “[a]mong the types of military operations in the air sphere and SKZ [near-Earth space], the preference is being assigned to offensive, and defensive operations are viewed as compelled and short-lived as far as possible, with the constant striving to recapture the initiative and transition to active offensive

\(^ {18}\) I.N. Vorobiov, “‘Time’ and ‘Space’ as Strategic Categories of Contemporary Wars,” *Military Thought* 17, no. 3 (July 2008): 38(9).
\(^ {19}\) According to Barvinnko, the aerospace threat to Russia “is aggravated by some peculiarities of its geopolitical and geospatial location and by a number of factors among which there are following: a long extension of the borders, vast territory, sparsely located objects of the Armed Forces, economy and infrastructure; availability of objects of strategic nuclear forces, nuclear power stations, chemical plants and other potentially hazardous objects; complexity of organizing of efficient informational forefields on most important directions; availability of enclaves (the Kaliningrad Region), as well as distant and hard-to-reach regions (Primoriye, Sakhalin, Kamchatka); location of mining and processing sites of strategically important mineral resources in distant hard-to-reach regions.” V. V. Barvinenko, “Aerospace Defense: Modern Aspects,” *Military Thought* 16 (January 2007).
\(^ {21}\) As Kupriyanov wrote in 2005: “The air space closely abuts outer space and there is no distinct border between the two. Both spaces, essentially, constitute a single air space/outer space (ASOS).” Kupriyanov, “Principal Trends in the Evolution of Space Warfare.”

operations (…).”\textsuperscript{24} Given official Russian rhetoric, Condoleezza Rice’s description of Soviet strategy and doctrine as one of a dichotomy is valid even today: “Soviet political doctrine is explicitly defensive, but Soviet military strategy is undeniably offensive, even preemptive in character.”\textsuperscript{25}

Another continuity is the goal of gaining supremacy. In contrast to the traditional emphasis on numerical superiority, today, the emphasis is laid on information superiority and on gaining supremacy in the aerospace – as the above-mentioned “information-strike operation” indicated.\textsuperscript{26} The current decisiveness of information superiority, supremacy in the aerospace, and maintenance of uninterrupted command and control for winning in contemporary wars point to the extreme importance of space-based systems, the capabilities of which are indispensable for communication, early warning, and successful conduct of missile strikes as well as incoming missile intercepts.

\textbf{2.3. The Gap between Russian Military Theory and Practice}

The 2010 Military Doctrine of the Russian Federation describes the main military threats to Russia. These include: the impeding of state and military command and control and the disruption of strategic nuclear forces, missile early warning systems, and systems for monitoring of the outer space. Together with the deployment of strategic missile defenses, the Doctrine classifies the weaponization of outer space and the deployment of strategic conventional precision weapons as the main military dangers Russia faces.\textsuperscript{27} Such views imply that not only the U.S. command and control (C2) but also the Russian C2 systems are regarded as high-value military targets. As will be discussed below, Russia has not yet fully integrated its space-based capabilities with those on the ground; consequently, its military would suffer less than its U.S. counterpart in case of satellite signal disruption or elimination, and therefore Russian military satellites are less attractive as military targets than the satellites of the United States.

The main guarantee of Russia’s national security continues to be nuclear deterrence, a mechanism for which proper functioning of Russia’s early warning satellites is vital. Despite the emphasis on nuclear deterrence, Russia presently relies on Soviet-era early warning satellites only (see section 3.1.1.). Due to disputes between industry and the government, Russia has been waiting for a new generation early warning satellite for years.

The variety of Russia’s satellites and its investment in the modernization of its conventional forces indicate that Russia is striving to match the conventional capabilities of the United States. Albeit doctrinally, Russian scholars and strategists are “on the same page” as their U.S. counterparts, translating those prescriptions on paper into actions has proven difficult for Russia. Since at least the

\begin{footnotesize}
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\item \textsuperscript{24}Morozov, Baushev, and Kaminskiy, “Space and the Character of Modern Military Activities.”
\end{itemize}
\end{footnotesize}
early 2000s, Russian periodicals have included articles dealing with “network-centric” warfare\(^\text{28}\) and the need for the creation of unified information, command and control systems.\(^\text{29}\) Russia’s pursuit of these goals appears to have fallen short. Russian scholars criticize the country’s information systems as underdeveloped (see below), and the quality of the Russian space-based communication system is also questionable. While according to some, the system is equal to its foreign counterparts, others criticize it as being obsolescent and lacking interference immunity. Russian communication satellites, critical for 21\(^{\text{st}}\)-century command and control, are mostly based on modernized Soviet designs, although new spacecraft are also being developed (see section 3.1.5.). Most likely, Russia uses some of its civilian communication satellites for defense purposes as well.

Equally important to the space-based echelon is its supporting infrastructure on the ground. According to analysts, Russia still lacks the infrastructure needed for the proper integration of space-based systems with those operating in other environments.\(^\text{30}\) Major insufficiencies in Russian conventional forces were revealed during the South Ossetia conflict in 2008. Writing about the August war, Gen. M.A. Gareyev, president of the Russian Academy of Military Sciences, argued that the existing gaps in Russia’s communication, radio-electronic, reconnaissance and target designation equipment, as well as deficiencies in the use of space equipment, required special and urgent examination by Russian authorities.\(^\text{31}\) According to former Air Force Major-General and Professor Alexander Tsymbalov, major shortcomings in Russian conventional forces persisted in July 2012.\(^\text{32}\) In his article in the Vozdushno-Kosmicheskaya Oborona, a prominent Russian military journal, Tsymbalov pointed out insufficiencies of the Russia’s military’s “New Look” that was introduced by then-Defense Minister Serdyukov in 2008, and also shortcomings in the Aerospace Defense Forces established in 2011. More importantly, however, Tsymbalov argued that there has been no adaptation of the forms and methods of employing Russian Armed Forces to the new combat realities. He stated that the documents published in 2010-2011 differ little from the contents of the Military Encyclopedic Dictionary (Voyenny Entsyklopedicheskiy Slovar) published in 1986.\(^\text{33}\) Tsymbalov also wrote that Russia yet needs to unify its reconnaissance and air attack warning systems, and that instead of targeting enemy’s strike systems, Russia should focus on enemy’s reconnaissance, electronic warfare capabilities, command and control, data processing and information distribution systems.\(^\text{34}\) Overall, Tsymbalov’s article confirmed the gap between Russia’s military theory and the reality of its military.


\(^{33}\) Ibid.

\(^{34}\) Ibid.
Russian military drills held in February and May 2013 again demonstrated that deficiencies in Russia’s command and control persist: participating units were criticized for lacking promptness in responding to processing orders via automated combat command and control systems. In his memo of June 2013, Dmitry Gorenburg, senior Analyst at Center for Naval Analyses, described the limited integration of Russia’s information systems: “While the organizational structure implemented under [the former Defense Minister] Serdyukov and so far retained by [his successor] Shoigu is far preferable to the bloated and inefficient Soviet legacy command system that preceded it, it can only be fully effective in a network-centric environment where automated control systems (ACS) extend to at least the company level. While the Russian defense industry is making some limited progress in developing such systems, there is no chance that ACS will reach further than the brigade level by the end of this decade.”

But some evidence suggests that Russia is investing in the capabilities needed. Early in 2013, Col.-Gen. Valery Gerasimov, the chief of the General Staff, reiterated that while Russia’s highest priority in the near future is its strategic nuclear forces, he also acknowledged that to keep up with the developments in modern warfare, Russia is pursuing network-centric capabilities, including the transition from vertical to global networked automation systems. Plans to achieve this goal are already on the way: a new automated command and control system integrating Russian Air Force and Aerospace Defense Forces is scheduled for deployment around Moscow in fall 2013, and the development of new Akvarel ground stations begun (see section 3.1.6.). In February 2013, Col.Gen. Vladimir Chirkin, the commander-in-chief of the Ground Forces, visited the facilities of the marine and aviation technology company Transas in St. Petersburg which, as The Jamestown Foundation’s analyst Roger McDermott noted, was meant to reinforce Moscow’s commitment to the development of “command, control, communications, computers, intelligence, surveillance and reconnaissance” (C4ISR) assets. Nevertheless, Russia’s backwardness in microelectronics or communication systems, a disadvantage openly admitted also by Russian scientists, severely limits the progress in the area of C4ISR.

The C4ISR are not unrelated to the cornerstones of Russia’s security, its nuclear forces. In 2009, Col. A.A. Protasov, Col. S.V. Kreidin and Col. S. Yu. Yegorov argued in Military Thought, a theoretical journal of the Russian General Staff, that Russian information control systems were underdeveloped compared to the sophistication of Russian nuclear forces. According to the authors, the improvement of information

39 McDermott, “Kondratyev, Network-Centric Warfare and the Race Against Time (Part One).”
40 See, for example, Roger Roffey, “Russian Science and Technology is Still Having Problems – Implications for Defense Research,” The Journal of Slavic Military Studies, 26, No. 2 (June 2013), pp. 162-188.
control systems, primarily of those in charge of Russia’s nuclear forces, “is the priority direction of ensuring strategic deterrence at the present stage.”\textsuperscript{41} While the quality of Russian information control systems depends on more than the quality and quantity of satellites, the importance of the space-based echelon in this context is undeniable. Besides the need to improve information control systems, Russian military thinkers point to the benefits of doing so.\textsuperscript{42} Protasov, Kreidin, and Yegorov also hinted at the relation between the quality of information control systems and strategic nuclear reductions when they stated that: “[t]here are close systemic connections between the quantity and quality of offensive weapons: the higher quality of the information control systems makes it possible to limit the quantitative levels of strategic offensive weapons.”\textsuperscript{43}

Even though there are major impediments to Russia achieving capabilities equivalent to the U.S., Russia is moving forward in this area, albeit slowly. Russian strategists and theorists recognize the importance of space to modern warfare, and therefore will likely advocate further investments in C4ISR.

### 2.4. Russia’s Diplomatic and Military-Technological Response to the Prospect of a War in Space

The Soviet Union viewed outer space as a theater where a war would be fought sooner or later; consequently, it made preparations to fight a war in space. In contrast to the United States, the USSR opted for numerous, less complex satellites, and built up reserves to be able to replenish its space-based network quickly.\textsuperscript{44} However, it was possible that this direction of Soviet space-systems’ development and deployment was not entirely voluntary, but, at least to a certain extent, the result of the low quality of Soviet (and subsequently Russian) satellites. To prepare for war in space, the USSR also developed and tested anti-satellite systems (including a co-orbital one) and deployed the Fractional Orbital Bombardment System (FOBS).\textsuperscript{45}

Likely because of economical and efficiency considerations, Russia has not revived its co-orbital ASAT system nor the FOBS, at least according to declassified information. Recently, Deputy Prime Minister Rogozin reiterated Russia’s official position towards space-based weapons: “Russia is categorically opposed to it. But if any country allows itself to break the tradition of preserving space as an area of cooperation, Russia will find its answer, which, however, will not involve the deployment of weapons in space.”\textsuperscript{46} What form Russia’s response would take is indicated by the resurrection of Russian ASAT


\textsuperscript{42}Ibid.

\textsuperscript{43}Ibid.


\textsuperscript{46}“Russia Will Be Able to Respond to Other States’ Weapons in Space - Rogozin (Part 2),” \textit{Interfax-AVN}, April 12, 2013.
programs (see below) and the country’s substantial investments in ballistic missiles, radars, and missile defense interceptors.47

Besides the technological response to other nations’ (hypothetical) weapons in space, Russia has already preventively responded to such development diplomatically. In 2008, Russia and China submitted the draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PPWT) to the Conference of Disarmament in Geneva.48 Given that the PPWT’s definition of a space weapon is inherently unverifiable and thus dooms the draft to failure, it is doubtful how genuine this attempt to prevent weaponization of space is. The PPWT defines a “weapon in outer space” as “any device placed in outer space, based on any physical principle, which has been specially produced or converted to destroy, damage or disrupt the normal functioning of objects in outer space, on the Earth or in the Earth’s atmosphere, or to eliminate a population or components of the biosphere which are important to human existence or inflict damage on them.” Besides the impossibility of verification of intent regarding the weapon’s purpose, a major criticism of the Sino-Russian proposal is the lack of regulation of non-co-orbital ASAT systems. The PPWT in its current form would not touch Russian ASAT or ballistic missile defense programs, while at the same time, it could limit the U.S. ballistic missile defense, especially if the United States were to reconsider plans for space-based interceptors. It seems that by insisting on the legal regulation of space-based weapons through the unverifiable PPWT, Russia once again hopes to create divisions in Washington that would slow down at least some of the U.S. space and ballistic missile defense programs.

Another example of Russia using space diplomatically for the advancement of its interests, though not for prevention of a war in space, is related to its GLONASS navigation system. As section 3.1.4.3. describes, GLONASS is much more than a source of prestige for Russia and a symbol of the country’s equality to and independence of the United States in the area of positioning, timing, and navigation. Through the offers of the GLONASS high-precision signal to foreign militaries, Russia is attempting to curtail U.S. influence abroad, cunningly exploiting some countries’ doubts about the reliability (undisturbed availability) of the U.S. GPS signal.

3. Russian Military Space and Counterspace Capabilities

Like the USSR, Russia runs a variety of military space programs, including ASAT programs. To demonstrate the Russian Federation’s commitment to extensive military use of outer space, the following sections briefly review Russian military satellites, ASAT programs, and launch capabilities.

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3.1. Russian Military Satellites

The following sections shortly examine the families of satellites that Russia uses for military purposes. They have been grouped into five categories: early warning, signal intelligence, optical reconnaissance, positioning, navigation, and timing (PNT), and communication. The last section briefly mentions Russia’s plans for a new network of ground stations known as Akvarel.

3.1.1. Early Warning

3.1.1.1. The US-K Family

Russia currently relies on a constellation of four early warning (EW) satellites: three US-Ks (also known as Oko satellites or the 73D6) in highly-elliptical orbit (HEO) and one US-KMO (Oko-1 or the 71Kh6) in geosynchronous orbit (GEO). They were both designed during the Cold War with first launches conducted in 1972 and 1991 respectively. In the past, Russia launched some US-K satellites in the geosynchronous orbit under the designation US-KS (Oko-S or the 74Kh6).\(^49\) The last early warning satellite Russia launched was the US-KMO in March 2012. It was the eighth and reportedly the last satellite of this type Russia has built.\(^50\) The last launch of the US-K satellite was conducted in September 2010. It is likely that it was the last US-K satellite produced in Russia.\(^51\) Russia’s military officials, including the Deputy Commander of the Russian Space Forces for Armaments General Oleg Gromov, criticized Russian EW satellites for being “hopelessly obsolete” in 2005.\(^52\) Kommersant hence concluded that the 2012 US-KMO launch “hardly strengthened” Russia’s EW capabilities.\(^53\)

The first-generation US-K system was designed to detect ICBM launches from the continental United States. A US-K satellite can detect U.S. ICBM launches only for about six hours a day.\(^54\) Although the continuous coverage of the continental United States requires only four US-K satellites in HEO, the full US-K constellation was designed to consist of nine satellites in nine orbital planes.\(^55\) To detect U.S. ICBM launches from other than land surface, Russia deploys the third-generation EW satellites designated US-KMO. The US-KMO detects U.S. SLBM launches in addition to those of the ICBMs.\(^56\) The full US-KMO constellation reportedly consists of seven satellites in GEO.\(^57\) In April 2009 Deputy Defense Minister Vladimir Popovkin said that Russia will operate only the minimal necessary quantity of the old EW


\(^{53}\) Ibid.

\(^{54}\) “Cosmos-2469 Is in Flight.”


\(^{57}\) Safronov, “The Last Fragment of the Soviet System.”
satellites until the next generation of EW satellites is launched. The currently deployed constellation of Russia’s EW satellites (consisting only from the old US-Ks and one US-KMO) corresponds to Popovkin’s statement.

3.1.1.2. The EKS Satellites

Russia is currently working on new-generation EW satellites that will form the so-called Unified Space System (USS), also known as the EKS (Russian Edinaya Kosmicheskaya Systema). Russia reportedly designed the new EW system in 1999-2000. The system was said to integrate detection, command and control tasks, and be comprised of GEO and HEO satellites. Representatives of the Aerospace Defense Forces revealed that the EKS system was designed to detect not only intercontinental ballistic missiles but also tactical theater and tactical missiles.

Initially, the first launch of the EKS satellite was scheduled for 2007. The program is apparently delayed since there have not been any EKS launches yet. Novosti Kosmonavtiki reported in December 2010 that Russia will conduct the first EKS launch in 2013. According to Pavel Podvig, an expert on Russian strategic military capabilities, there have been no launches of EW satellites scheduled for 2013. In reality, Russia has not launched an EKS satellite because its defense industry has not yet delivered it. In August 2011, Russian Defense Ministry filed a lawsuit against the Energia Company for non-observance of agreed timelines for the delivery of the first EKS satellite. Energia argued that Russian authorities changed the technical requirements multiple times which prevented timely completion of the order; the company won the case.

3.1.2. Signal Intelligence

Russia orbits two families of signal intelligence satellites, the US-PU and the Tselina-2 satellites, and one Lotos-S satellite that was launched in 2009 as an early version of the spacecraft developed for the future Liana signal intelligence network.

3.1.2.1. The US-PU Satellites

The US-PUs are electronic ocean reconnaissance satellites (EORSAT) used for the detection of radio communications and other electronic signatures from surface ships. The full constellation consists of

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61 Krasilnikov, “The End of Three Epochs.”
62 Ibid.
64 Krasilnikov, “The End of Three Epochs.”
three or four satellites in LEO (about 420 km).\textsuperscript{65} The US-PU’s lifespan is about two years.\textsuperscript{66} Prior to 1997, Russia used to launch one or two US-PU satellites annually. After 1997, it launched only one satellite every two years.\textsuperscript{67} The last US-PU satellite was launched in June 2006, but disintegrated in April 2008, possibly because some of its solar batteries did not open after its launch.\textsuperscript{68} In total, Russia has launched thirteen US-PU satellites.\textsuperscript{69} No further launches have been announced. Russia is likely waiting for the US-PU replacements known as Pion-NKS.

\subsection*{3.1.2.2. The Tselina Satellites}

The Tselina satellites represent the second family of Russia’s signal intelligence satellites. First operational in the 1970s, the Ukraine-made spacecraft has been significantly upgraded and is still being produced in the former Soviet republic.\textsuperscript{70} In November 2008, then-Prime Minister Yulia Timoshenko signed a resolution of the Ukrainian Cabinet that stood for the delivery of four Tselina satellites to Russia prior January 1, 2012.\textsuperscript{71} However, there are no reports that the deliveries have taken place (yet).

The latest version was designated Tselina-2 and first launched in 1984.\textsuperscript{72} The Tselina-2 is deployed in a LEO almost two times higher than the US-PU (850 km).\textsuperscript{73} Unlike the US-PU EORSAT, the Tselina-2 satellites are general-purpose signal intelligence spacecraft. The full constellation consists of four satellites in four orbital planes. Since 1984, the USSR/Russia has launched twenty-five Tselina-2 satellites, five times unsuccessfully. The last launch was conducted in June 2007.\textsuperscript{74} The Tselina-2’s lifetime is reported to be one year.\textsuperscript{75}

While the numbers and service lives would suggest that neither the US-PU nor the Tselina-2 network is fully operational today, Gorbenko claims that the Cold-War US-PU-Tselina system “is still completely capable of operations.”\textsuperscript{76}

\begin{thebibliography}{99}
\setlength\bibitem{67}{Krebs, “US-PM (US-PU).”}
\setlength\bibitem{68}{“Russian Navy Loses Satellite,” \textit{Interfax-AVN}, April 14, 2008.}
\setlength\bibitem{69}{Krebs, “US-PM (US-PU).”}
\setlength\bibitem{71}{Igor Izvekov, “Cosmos-2455 Is in Orbit,” \textit{Novosti Kosmonavtiki} no. 1 (2010): 33.}
\setlength\bibitem{73}{Krebs, “Tselina-2 (11F644).”}
\setlength\bibitem{75}{Krebs, “Tselina-2 (11F644).”}
\setlength\bibitem{76}{Gorbenko, “The Russian Military Space Program of Tomorrow: What Will This Be?”}
\end{thebibliography}
### 3.1.2.3. The Liana Network: Lotus and Pion Satellites

The US-PU’s and Tselina’s replacement is known as the Liana satellite network, expected to become partially operational in late 2013. The initial engineering proposal for the Liana system submitted by the Central Scientific Research Radio Technical Institute (TsNIRTI) in 1993 included only one type of spacecraft that was supposed to replace the Tselina satellites. However, the government’s requirement that the new network replace both the Tselina and the US-PU satellites resulted in the development of two satellite-types for Liana: the Pion and the Lotus satellites.\(^{77}\) *Izvestia* reported that the Liana constellation will consist of four satellites deployed in LEO (about 1000km): two Lotoses and two Pions.\(^{78}\)

The Liana program has suffered from many delays related to underfunding, the satellites’ technical shortcomings, and additional governmental demands to adjust the satellites to the Russian Soyuz rocket in 1996 and to standardize the spacecraft’s platform with the Kobalt photo-reconnaissance satellites in 2002.\(^{79}\)

The first of the Lotus-type satellites intended to replace the Tselina-2 spacecraft was launched in November 2009. Designated Kosmos-2455 and later known as the Lotos-S, the spacecraft successfully reached its sun-synchronous orbit.\(^{80}\) Despite being in development for about 15 years, the Lotos-S was reported to suffer from many imperfections. A spokesman of the then-existing Space Troops (now subsumed by the Aerospace Defense Forces) said: “After it was put into orbit, it was discovered that almost half of its onboard systems would not function.”\(^{81}\) Therefore, the developers reworked its programming system and improved its firmware. In September 2012, the above-mentioned spokesman said that Russian military had no further complaints about the system.\(^{82}\) Nevertheless, the needed adjustments likely led to further postponements and so far, the absence of other Lotos-S launches. However, according to Russian blogger Aleksandr Gorbenko, the second Lotos-S will be launched in 2013.\(^{83}\)

Some reports suggested that Lotos-S’s capabilities are only slightly better than those of the Tselina spacecraft, if at all.\(^{84}\) The TsSKB Progress’ head Aleksandr Kirilin said in November 2012 that the only Lotos-S in orbit had been working successfully and remained operational. A web poster in Novosti Kosmonavtiki forum suggested otherwise, claiming that the Lotos-S had not been able to perform its primary operational function since December 2011.\(^{85}\) Gorbenko, an apparently well-informed blogger, as

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79 Izwekov, “Cosmos-2455 Is in Orbit.”

80 Ibid.


82 Ibid.

83 Gorbenko, “The Russian Military Space Program of Tomorrow: What Will This Be?”.

84 Zak, “Liana Electronic Intelligence Satellite.”

85 Ibid.
rebuted these speculations about Lotos-S in June 2013 by stating that “everything is fine with the first Lotos.”

Reports about the Pion satellites that are commonly referred to as Pion-NKS are scarce. Izvestia reported that Pion’s development will be completed at the end of 2013. The second launch of an Pion-NKS satellite is envisaged for 2015 which, should present plans materialize, appears to be the date of the Liana network reaching full constellation of two Pion and two Lotos satellites.

According to Igor Lisov in Novosti Kosmonavtiki, the Liana signal intelligence system will increase several times Russia’s ability to detect and destroy targets. It was reported to provide constant coverage of air, land, and sea targets. In wartime, Russia would deliver precision-guided strikes on these (hostile) targets, a spokesman for the General Staff said. He also stated that the Liana system will provide real-time data; however, Izvestia quoted a source in the Navy high command who revealed that due to the operating algorithms of the Liana network, Russian ships and aviation bases receive the data from Liana only with delays and some problems. The source also said that the Akvarel intelligence system (see below) will solve this shortcoming so that customers receive the data in “practically on-line mode.”

3.1.3. Optical Reconnaissance

Russia operates several families of civil and military Earth observation satellites. The USSR and Russia in the 1990s and mid-2000s operated three families of military optical reconnaissance satellites: Yantar, Orllets, and Arkan. Given their relatively short service life and absence of launches since May 2012, Russia might not have any of the old satellites in operation. However, Russia is working on their follow-ons and has already launched some of them, e.g., the Persona photo-electronic satellites, and the Kondor radar imagining satellite. It is likely that Russia uses some of its civil optical reconnaissance satellites for military purposes as well. For instance, the Resurs-P remote sensing satellite is generally referred to as a civil satellite, but it is known that it is used by the Russian government as well.

3.1.3.1. The Yantar Family

The Yantar satellite family has been launched since the 1970s. It consists of four satellite generations all deployed in LEO: Neman, Kometa, Kobalt, and Kobalt-M. The last launches of these satellites were conducted in May 2000, February 2005, September 2002, and May 2012 respectively. With the exception of the Neman satellite, which is photo-electronic, the Yantar family satellites were all film-based. The disadvantages of film-based satellites are their limited life span (between one and four months) depending on the amount of film the satellite can carry, and their inability to provide

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86 Gordenko, “The Russian Military Space Program of Tomorrow: What Will This Be?”
88 Ibid.
89 Ibid.

www.marshall.org
immediate imagining information. By contrast, the photo-electronic Neman satellites could transmit data electronically and used the Potok (Geizer) geostationary relay satellites when necessary.

The Soviet Union/Russia launched several Yantar satellites annually and usually, at least one Yantar satellite was in orbit at any given time. Since the late 1990s, however, Russia has launched only about one satellite every one or two years, which resulted in significant coverage gaps. The prolonged service life that almost doubled to approximately four months could not compensate for the decrease in satellite launches.

In September 2006, Russia launched the first Resurs-DK satellite, which is reportedly still operational. Based on the Neman military satellite design, the Resurs-DK1 was the first civil Earth observation satellite that could acquire high-quality images with about one meter resolution in near-real-time. The electro-optical Resurs-DK1 uses a high-speed radio link to transmit acquired data, and relies on GLONASS satellites for navigation. The first (and only) Resurs-DK1 was launched to a sun-synchronous orbit and in 2010 moved to a higher, near-circular orbit to prolong its service life, which is estimated to be no less then three years.

In June 2013, Russia launched the first the Resurs-P satellites, a Resurs-DK’s follow on, from the Baikonur cosmodrome. The launch was originally scheduled for 2010, but has been postponed multiple times. The last delay was reportedly caused by Russia’s decision to upgrade the satellite’s sensors in fall 2012. Further Resurs-P launches are expected in 2014 and 2015. The Resurs-P has a better resolution (about 0.5-2 meters). It is the first Russian satellite carrying a hyperspectral imaging payload; in addition to that, it carries a wide-angle payload and a high-resolution camera. The Resurs-P’s images are used by several Russian ministries, including the Ministry of Defense.

Another reconnaissance military satellite that Russia launched was from the Kobalt-M series, known as the Yantar-4K2M. It carried a high-resolution (0.3 m) optical camera inside a re-entry vehicle and two small recoverable film capsules. According to the data delivered by U.S. radars, the Kobalt-M was deorbited after four months in operation in September 2012. Kommersant reported that the satellite cost one billion rubles and that it has a service life of 120 days. Kommersant’s reporter Ivan Safronov

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93 “Kobalt Series.”
98 “Kobalt Series.”
Russia used to launch the Kobalt-M satellites to a LEO with an inclination of about 67 degrees. However, the last two Kobalt-Ms (launched in November 2011 and May 2012) were both delivered to an orbit with an unusually high inclination: 81.4 degrees. The launch of November 2011 was the first time since 1994 that Russia launched a satellite to an inclination of 81 to 82 degrees, and also the first time since 1979 that a satellite was delivered to a near-polar orbit with an inclination of 81.4 degrees.101 Novosti Kosmonavtiki pointed out that the standard 67-degree inclination of the Kobalt and Kobalt-M satellites did not allow for observation of Greenland, Spitsbergen and Canadian Arctic islands.102 Russia’s interest in Arctic resources and the region in general has been on the rise for several years now.103 It seems therefore plausible that the Arctic’s attractiveness was the reason of the non-standard inclination of the last two Kobalt-Ms.

In 2006, Kommersant reported that Kobalt-M will be replaced by the Don reconnaissance satellite (also known as Orlets-1).104 More recent reports, however, mention the Persona satellites as the Kobalt-M’s replacement. The Persona is a photo-electronic satellite that transmits real-time data through a radio channel.105 Its lifetime was previously reported to be three to five years,106 but according to recently leaked information, it is not less than seven years.107 So far, Russia has launched two Persona satellites, in July 2008 and June 2013. The next launch is expected by the end of 2013 or early in 2014.108

According to Rossiskaya Gazeta’s report from February 2009, the first Persona lost its capability to transmit images to the ground stations before it entered service. The reported cause of the failure was the satellite’s electronics, more specifically, an imported low-cost avionics part that did not withstand space radiation. It has been rumored that the satellite manufacturers said that the failure could have been prevented if the spacecraft had been launched to a different orbit.109

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101 “Kobalt Series.”
105 Safronov, “Kobalt Joins Space Grouping. Reconnaissance Satellite Placed in Orbit.”
107 Gorbenko, “The Russian Military Space Program of Tomorrow: What Will This Be?”
108 Ibid.
109 Zak, “Persona (14F137) Spy Satellite.”
The second Persona was successfully delivered to LEO on June 7, 2013, and subsequently moved to a nearly circular orbit. After the June launch, Russian blogger Aleksandr Gorbenko disclosed some information about Persona. Gorbenko wrote that the Persona’s resolution is “significantly less than one meter” and thus “exceeds all European counterparts and does not lag behind American counterparts.” He also disclosed that the satellite’s new element is its electro-optical photoreceiver, “a PZS [charged coupled device]-based electro-optical processor with a completely digital information storage and transmission path” that was developed solely by and in Russia.

Russia might have started work on a Persona’s replacement. Rumors about such work emerged in 2008. According to Anatoly Zak, the author of RussianSpaceWeb.com website, the Persona satellite “could only serve as a transitional step toward yet another new generation of imaging spacecraft” because it “relied solely on the three optical telescopes inherited from the Sapfir program [authorized in 1983].” Nevertheless, Russia has not announced plans for a Persona’s follow-on (yet).

Russia is reportedly also working on Kometa’s replacement: the Bars satellite. The Bars will not be film-based like its predecessors, but an electro-optical surveillance satellite. The Bars project was revealed in about 2004-2006 and its first launch is expected in 2014.

### 3.1.3.2. The Orlets Family

The second family of Russian optical reconnaissance satellites consisted of two satellites known as the Orlets-1 and Orlets-2. Designed during the Soviet period, the Orlets-1 and Orlets-2 were first launched in 1989 and 1994 respectively. Like the majority of Soviet/Russian optical reconnaissance satellites, they were film-based. The Orlets-1 satellites, also referred to as the Don satellites, had a service life of sixty days and carried eight return film capsules. Eight Orlets-1 were launched in total, with the last launch conducted in September 2006. Russia built only two Orlets-2 satellites, also known as Yenisey, and launched them in 1994 and 2000. Compared to Orlets-1, the Orlets-2 had three-times longer service life (180 days), carried more film capsules (twenty-two), and provided higher resolution images. Like the Kobalt-M, the Orlets satellites are supposed to be replaced by the Persona photo-electronic satellites.

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111 Gorbenko, “The Russian Military Space Program of Tomorrow: What Will This Be?”
112 Zak, “Persona (14F137) Spy Satellite.”
3.1.3.3. The Arkon/Araks Family

Since mid-1980s, the Soviet Union/Russia had developed another family of optical reconnaissance satellites known as Arkon. In November 2012, Izvestia referred to an interlocutor in Roskosmos who said that the Arkon satellite program was cancelled in order to concentrate resources on other projects that are supposed to restore the domestic Earth-remote-sensing satellite constellation, namely the Arktika, Resurs, and Obzor satellites.

The Arkon satellites were also referred to as Araks. They were photo-electronic imaging satellites that could provide imaging data in real-time mode, or save them onboard for later uses. They were deployed in LEO but at an altitude of approximately 1,250km, which was unusually high for optical reconnaissance satellites. According to Pavel Podvig, USSR’s/Russia’s preference for higher orbits in this case can be explained the absence of atmospheric draft there, which enables longer operational life of satellites. Russia launched the first Arkon in June 1997 and the second (and last) in July 2002. Reportedly, they both ended their operation earlier than intended, after four and twelve months respectively.

3.1.3.4. The Kondor Satellite

In June 2013, Russia successfully deployed its first Kondor satellite to LEO. The Kondor is operated by Russian Defense Ministry and it is the country’s first military radar-imaging satellite. It can transmit images with a resolution of about one meter and has a reported design life of five years.

Work on Kondor satellite began in early 1990s. In 1997, Russian Defense Ministry ordered two versions of the satellite from the NPO Mashinostroyenia: one electro-optical and the other radar-imaging. Due to cuts in funding in late 1990s, the NPO Mashinostroyenia developed export variants of the Kondor satellites only, known as Kondor-E. Funding for the non-export Kondor satellites was later restored and the first launch was expected between 2004 and 2006. However, it was not conducted until June 2013.

3.1.3.5. Five New Spy Satellites

In April 2013, the Lavochkin aerospace research and production company won a Russian Defense Ministry tender for a series of five high-resolution optical-electronic surveillance satellites. The contract value amounted almost to seventy billion rubles ($2.2 billion). Lavochkin’s General Director Victor

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120 Ibid.
122 Graham, “Russian Strela Rocket Launches Kondor Satellite.”
Khartov said that his company will construct the satellites, but the payload will be supplied by a foreign company - as it is often the case with Russian communication satellites. Khartov said that the company is currently going over proposals of foreign suppliers; reportedly, three companies are under consideration: European EADS, Italian Thales Alenia Space and Israeli Israel Aerospace Industries. Over the long term, however, Russia wants to internalize the production of satellite payloads. According to Khartov, the share of domestic technologies in the payload will gradually increase. He said: “The share of localization will grow from spacecraft to spacecraft to provide a possibility to make such spacecraft fully independently.”

The new system of optical-electronic spy satellites will consist of five satellites, two of which will be launched first and the other three later. The Lavochkin design bureau is expected to submit the satellites’ draft design for approval to the Defense Ministry by the end of 2013. The satellites will be launched to LEO, reportedly to an altitude of 500 to 1,000km. One of the requirements was reported to be real-time data transmission at sub-meter resolution. Such resolution allows for the identification of license plates on cars or the general appearance of individuals. The new spacecraft was reported to be the first Russian spy satellite designed since the fall of the USSR. The Editor-in-Chief of Novosti Kosmonavtiki Igor Marinin said that Soviet/Russian optical-electronic observation satellites were made by the Arsenal design bureau in Leningrad only and that production stopped around 1990.

### 3.1.4. Positioning, Navigation and Timing

Russia uses two navigation systems simultaneously: Parus and GLONASS.

The Soviet Union launched the first satellites of the Parus and GLONASS networks in 1974 and 1982 respectively. The Parus satellites in circular orbit were used primarily by the Russian Navy, particularly by nuclear-powered strategic submarines. With the introduction of GLONASS, the Parus network assumed more and more civilian missions. It is possible that relaying of data has become Parus’ primary function. The Parus satellites were expected to be retired after the GLONASS network became fully operational and be replaced by the Meridian satellites. A recent report from Novosti Kosmonavtiki suggested that the Parus satellites are no longer operational.

According to information provided by Roscosmos, Russia has currently twenty-nine GLONASS satellites in orbit: twenty-four are operational, four are in reserve, and a GLONASS-K launched in 2011 is

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124. Ibid.
125. Ibid.
undergoing flight-testing. By 2020, Russia plans to have thirty GLONASS-class satellites in orbit, including six in reserve.\textsuperscript{130} The last successful launch of a GLONASS satellite, the GLONASS-M, was conducted in April 2013. On July 2, Russia attempted to launch a trio of GLONASS-M satellites. However, the engines of the Proton-M booster rocket switched off shortly after liftoff and the vehicle exploded. The accident cost Russia at least six billion rubles ($180 million), for which the rocket carrying three GLONASS-Ms was insured.\textsuperscript{131} The recent failure was a bitter reminder to Russia of several previous failed GLONASS launches (see below) and resulted in indefinite suspension of all slated Proton launches from Baikonur.\textsuperscript{132} According to the Aerospace Defense Forces head Maj. Gen. Alexander Golovko, the next GLONASS satellite will be launched in December 2013.\textsuperscript{133}

The full GLONASS constellation provides global coverage and consists of twenty-four spacecraft deployed equally in three orbital planes in medium Earth orbit. Eighteen satellites could cover the entire territory of the Russian Federation.\textsuperscript{134} Russia reached the full constellation in 1995, but the system soon deteriorated because of a lack of funding and short operational life span of the original GLONASS spacecraft (about three years).\textsuperscript{135} After more than a decade, the GLONASS network regained full operational capability in December 2011 when the second-generation GLONASS-M entered service. Russia intended to reestablished global coverage earlier, but it lost three GLONASS-M satellites due to a booster failure in December 2010.\textsuperscript{136} There were no GLONASS launches in 2012. According to Nikolai Testoyedov, general constructor and general director of the Information Satellite Systems-Reshetnev Company, “they were not needed” because the deployed cluster was “very stable and reliable.”\textsuperscript{137} In fact, one launch was scheduled for December 2012, but it was postponed until April 2013 because of problems with the upper stage of the carrier rocket.\textsuperscript{138}

\begin{itemize}
\item \textsuperscript{133} “Russia Set to Launch 4 GLONASS Satellites This Year,” \textit{RIA Novosti}, June 8, 2013, sec. Science, http://en.rian.ru/science/20130608/181571307/Russia-Set-to-Launch-4-GLONASS-Satellites-This-Year.html.
\item \textsuperscript{134} “Russia May Increase Number of GLONASS Satellites to 30 in 2 or 3 Years,” \textit{ITAR-TASS}, November 13, 2012.
\item \textsuperscript{137} “5-6 Satellites May Be Added to Glonass Orbital Group in 2013 - ISS Director,” \textit{Russia & CIS Business and Financial Newswire}, February 4, 2013, sec. Digest of headline news as of 3:30 p.m. Moscow time.
\item \textsuperscript{138} Cheberko, “The State Commission Postponed the Launch of the Navigation Satellite Until 2013 Because of Defects Detected in Tests of the Fregat Upper Stage of the Launch Vehicle.”
\end{itemize}
None of the original spacecraft is in service now. The network currently consists of the second-generation GLONASS-M only, while the third-generation GLONASS-K1, the first and only spacecraft of this type to have been launched so far, is tested. According to Gunter Krebs, Russia has built only two prototypes of GLONASS-K1 and intends to replace them with GLONASS-K2. The first GLONASS-K1 was launched in February 2011; the second is likely to be launched in December 2013. The GLONASS-K satellites were reported to have a service life of 10 years, three years longer than the GLONASS-M type. The GLONASS-K2 satellites are expected to be launched in 2014 and 2015. By 2020, the GLONASS orbital cluster should consist of GLONASS-K satellites only. In 2017, it is planned to launch GLONASS-K’s follow-on, designated GLONASS-KM. Russia’s space industry expressed doubts about such an early deployment and estimates GLONASS-KM’s availability for 2020s. The expected service life of the GLONASS-KM satellites is 12 years.

In late 2012, the deputy director general of the Joint Stock Company Russian Space Systems Grigory Stupak said that “[t]he immediate plans are to bring the cluster to 30 units deployed in additional planes” and that “[t]o implement this plan, only a political decision will be needed.” According to Stupak, foreign navigation systems outperform GLONASS in water areas, but this can be rectified by deploying a cluster of 30 spacecraft. This may well become true: an outline of the federal space program named “Space Activity of Russia for the Period between 2013 and 2020” published on the Roskosmos’ website includes 13 launches of GLONASS-M and 22 of GLONASS-K satellites. The document also promises improved accuracy of the system that is currently 2.8 meters. By 2015, the positioning accuracy expected to be of 1.4 meters and of 0.6 meter by 2020.

3.1.4.1. Delays in GLONASS’ Schedule

At the end 2012 and in early 2013, GLONASS moved to the center of many public discussions. Since January 2013, GLONASS equipment has become mandatory for all passenger transport and some cargo transport under Russian jurisdiction. At the end of 2012, however, GLONASS had still not been officially accepted into operation by the Defense Ministry; from the legal perspective, it still operated in experimental mode. Many companies did not implement the GLONASS regulation on time, referring to

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142 Zak, “GLONASS Network.”

143a “Russia May Increase Number of GLONASS Satellites to 30 in 2 or 3 Years.”

144a “Russia to Launch $10 Billion Space Program,” Qatar News Agency, January 15, 2013.

145 “GLONASS Will Pass to Satellites of the Third Generation.”

146a “Russia to Launch $10 Billion Space Program.”
GLONASS’ uncertain legal status. While the Defense Ministry rectified this situation in late January when it approved the document on acceptance of GLONASS for operation, other sources of criticism have remained unaddressed. Those involve corruption charges (one involving Popovkin’s daughter Natalia) and GLONASS’ accuracy. Versiya reported in January 2013 that although GLONASS expenses already exceeded those of the American GPS (between 2001 and 2011, 116.9 billion rubles were allocated for the GLONASS program), GLONASS’ accuracy remains 33.33% inferior to that of its American counterpart. Furthermore, GLONASS does not comply with international navigation standards. Reportedly, the majority of the piloting and navigation equipment used in Russia’s civil aviation cannot interact with GLONASS. Similar problems were reported in the automobile industry.

Further reasons for the delay in official acceptance of GLONASS were reported to be personnel changes within the Defense Ministry and the Aerospace Defense Forces that received a new commander in December 2012: General Alexander Golovko. The above-mentioned loss of three GLONASS-M satellites due to a launch failure in December 2010 was also cited as one of the reasons for the delay, together with the fact that Russia’s space industry cannot produce modern microcircuits. Reportedly, Russia has been importing them from China and Thailand, but their quality is too low to work reliably in space. The low-quality imported microcircuits were blamed for sometimes hours-long blackouts of GLONASS signal during the conflict in South Ossetia in 2008.

### 3.1.4.2. Internal Politicization of GLONASS

Russia is expected to adopt a Federal Target Program for GLONASS’ development for the period of 2013-2020. It would replace the current program document called “Maintenance, Development and GLONASS System Use for 2012-2020.” The draft Federal Target Program for 2013-2020 allocates 326.5 billion rubles ($10.77 billion) for the advancement of GLONASS. However, as of April 15, 2013, the Program’s adoption was stalled, and since then, open-source information about the Program has been lacking.

The Russian political commentary website Politkom.ru suggested that the current lack of progress in the federal target program adoption process is because of a behind-the-scenes power struggle and an emerging fight for the 326 billion rubles. On Cosmonauts’ Day in April 2013, President Putin gave a speech in which he said that “[i]t could be possible in principle to establish a ministry in [the space

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150 Frolov, “Discontent of the Cosmodrome.”
151 Ibid.
152 Cheberko, “Defense Ministry of Russia Accepts GLONASS System for Operation.”
153 Ibid.
154 Frolov, “Discontent of the Cosmodrome.”
156 “GLONASS Will Pass to Satellites of the Third Generation.”
According to Politkom.ru, the creation of a Ministry of Space would strengthen the Federal Space Agency Roskosmos and also Deputy Prime Minister Rogozin, who oversees the military-industrial complex and space. Simultaneously, it would weaken the position of Deputy Prime Minister Vladislav Surkov who was once called the Kremlin’s “puppet master.” Nezavisimaya Gazeta reported that Surkov has proposed the establishment of a special agency that would manage GLONASS’ land-based elements while the space part would remain under the direction of Roskosmos. Politkom.ru concludes that strengthening of Roskosmos (whether by increasing its powers, or by elevating it to a Ministry of Space) would be “a sizeable blow to Medvedv’s government, in which the pro-Putin centre of influence is becoming significantly stronger in the person of Rogozin. It is probable that in such a situation GLONASS, too, may shift to the jurisdiction of the vice premier for the military-industrial complex, which would reduce Vladislav Surkov’s administrative sphere to a minimum. This entirely suits Putin from a reputational perspective too: The theme of the renewal of Russia’s former space glory is potentially advantageous from the perspective of advancing Putin’s domestic political agenda.”

Gazeta.ru reported on the same topic and quoted a government source saying that the talk about Ministry of Space was only a teaser for discussion. According to the source, a governmental working group has concluded that “it is necessary to preserve and strengthen the role of the federal executive organ - Roskosmos - and simultaneously to gradually consolidate the organizations of the missile and space sector into large holdings in the form of open joint-stock companies, the shares of which belong 100 per cent to the Russian Federation.” The effect is supposed to be a milder version of the reform Medvedev will be deciding about.

3.1.4.3. GLONASS As a Tool of International Politics

GLONASS, being Russia’s answer and so far the only viable alternative to the U.S. GPS – the Chinese COMPASS is expected to be launched around 2020 and the EU’s Galileo in 2014 –provides the country with prestige and a substantial degree of independence with regard to precision, navigation, and timing information. Russia’s belief in the need and also the quality of its GLONASS expresses the following statement made by Yuri Koptev, head of the Russian Space Agency, in 2001: “Given Russia’s geographical position, its interests and the tasks facing its defense and other industries, Russia needs to have its own system. Especially since we have already shown that our system is as good as the American one and sometimes even better.”

Russia has used or attempted to use GLONASS to strengthen relations with a number of countries; some have been asked to host GLONASS ground stations (including the USA, Australia, Israel, India, South

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160 Samoylova, “Space ‘Scare Tactic’ for Medvedev.”
161 Ibid.
African Republic), and some have signed agreements with Russia granting them “unlimited and free access” to the GLONASS system (Cuba, India, Kazakhstan, and Ukraine). While trying to sell its product, Russia regularly pledges not to interfere with any of the GLONASS signals and reminds its customers of the wars in Iraq, Yugoslavia, and Afghanistan during which the United States reserved and sometimes used the right to block the high-precision GPS signals as well as some non-high-precision signals.

So far, Russia has consented to provide the GLONASS precision signal only to one country: India. The Kremlin offered India joint GLONASS programs in 2004 for the first time and repeated its offer in 2007. The two countries signed an intergovernmental framework agreement on joint use of GLONASS in March 2010; the agreement granted India access to defense applications of the program, in other words, precision signal. Russian Deputy Prime Minister Sergei Ivanov publicly promised “never to tamper with the high-precision [GLONASS] signal for India” and said that India conceived the desire to receive the high-precision GLONASS signal after the USA disrupted high-precision GPS signal in the wars in Afghanistan and Iraq. Former Army Chief and Director-General of Military Intelligence, General S. Padmanabhan, supported India’s wish for autonomy in strategic communications and recalled his participation in war games, in which the USA attacked India over Kashmir. Given the “propensity of the U.S. to act unilaterally against other countries in disregard of the United Nations,” he considered such a scenario plausible and advocated India’s preparation for “aggression by any developed country, including the U.S.A.”

It remains uncertain, however, to what extent the Russian-Indian agreement has been implemented. On one hand, India tested the GLONASS navigation system during its January launch of the sea-based BrahMos supersonic cruise missile; on the other, it is likely that the Indian military’s infrastructure does not allow for a full utilization of GLONASS services. Nevertheless, Russian-Indian relations have been gaining strength: apart from the conclusion of several military agreements during the past few years, in late 2012, Russia offered India to equal participation in the GLONASS program, meaning that

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164 Belarus, Russia Discussing Agreement on Use of Navigation Satellite System,” Belapan, April 30, 2013.
165 Russia Pledges Not to Tamper with Satellite Signal for Indian Army - Deputy PM,” Interfax, October 27, 2010. “Transcript. Interview with Yuri Koptev.”
166 Cheberko, “The Government Ordered Export of GLONASS.”
167 Russia Pledges Not to Tamper with Satellite Signal for Indian Army - Deputy PM.”
India would not only use the system but also have its share in GLONASS modernization and upgrading. Understandably, Indian leaders were enthused by Russian proposal.

In fall 2010, Russian Deputy Prime Minister Ivanov said that Russia was ready to consider providing Ukraine with high-precision GLONASS signal. However, no agreement has yet been concluded and reports do not suggest that Russia and Ukraine are actively discussing this issue.

3.1.5. Communication

Russian scholars and military members view satellite communication as “one of the most important directions to ensure troop and weapon command and control stability and the timely transmission of required volume of information at minimal incurred costs.” The backbone of Russia’s satellite communications is the so-called Unified Satellite Communications System (ESSS, or ISSS, or YeSSS) established under the Russian Defense Ministry.

Initial research on satellite communication began in the late 1950s. In the 1970s, Russia started to research system integration issues related to the establishment of a defense satellite communications system and concluded that the ESSS satellites should be deployed in highly elliptical (HEO) and geostationary orbits (GEO). The satellites of the first phase of the ESSS (ESSS-1) were put into operation in the 1980s. The military-technological experience from the first Persian Gulf War in particular stimulated demands in the Russian military for the extension of satellite communications to tactical command and control echelons (TCCE). Due to its financial situation, Russia could not afford to build a separate system for TCCE. Therefore, Russian TCCE satellite communication networks began to use the transponders of the existing and evolving communication space vehicles. Among the technological adjustments that enabled such expanded use were, for example, increasing of the number of stations that operated on radio-ATS channels and the design of small-size low-energy satellite communication stations.

The first phase, the ESSS-1, comprised the Raduga satellites in GEO, the Molniya satellites in HEO, and the Kristall-type earth stations. In his 2008 article in Military Thought, Col. I.V. Shinkarev of the Russian Ministry of Defense described the ESSS-1 as a system that “proved itself a highly reliable troops command and control facility.” Currently, Russia is deploying and developing satellites of the second phase (ESSS-2). The first stage of the second phase was accepted for operation in September 1999 by President Yeltsin’s decree. The ESSS-2 comprises the Kristall, Liven, Zerkalo, Tsentavr, Start earth


173 Ibid.

174 Ibid.

175 Ibid.

176 Ibid.
complexes,\textsuperscript{178} the Raduga’s follow-ons (the Raduga-1 satellites, also known as Globus-1, and the Raduga-1M or Globus-1M spacecraft), and the Molniya’s follow-ons (the Meridian satellites). While Shinkarev praised the ESSS-1 and wrote in 2008 that “[b]y established performance characteristics, the ESSS-2 system is as good as the most advanced foreign military counterparts,” Col. V.A. Grigoryev and Lt. Col. I.A. Khvorov criticized the ESSS-2 in their 2007 \textit{Military Thought} article for lacking “sufficient interference immunity and stability.” They described the ESSS-2 as “morally and physically obsolescent in an environment characterized by intentional interference.”\textsuperscript{179}

In November 2012, \textit{Izvestia} reported that the ESSS is “a reserved channel of the so-called ‘Judgment Day’ system.”\textsuperscript{180} A Russian official revealed that ‘Judgment Day’ is only a name for the public; the actual name remains classified. \textit{Izvestia}’s source also said that the system is Russia’s most closely guarded secret, and that it is managed by a special directorate established within the Defense Ministry. However, according to \textit{Izvestia}, “[t]he source refused to talk on what principles the signal is being transmitted to the intercontinental ballistic missiles, to the strategic bombers and the submarines with the nuclear missiles that comprise the nuclear triad.”\textsuperscript{181}

According to the information provided by an Aerospace Defense Forces’ representative, the full constellation of the ESSS consists of about ten Raduga-type satellites and three Meridians.\textsuperscript{182}

3.1.5.1. \textbf{The Raduga Satellites}

The Raduga family is believed to provide well-protected communication channels among the Russian military leadership.\textsuperscript{183} The first Raduga satellite was launched as Cosmos-637 in 1974 and it was also the first satellite the Soviet Union deployed in GEO.\textsuperscript{184} Known also as the Gran, the Raduga satellites were presented as civilian only. Their military mission was disclosed after the Soviet Union disintegrated. From 1974 up until today, the USSR/Russia has launched thirty-five Raduga satellites, of which six were launched after the USSR’s dissolution. The last two Raduga satellites were launched in 1996 and 1999 with the latter launch ending in failure.\textsuperscript{185} Since 1989, Russia has been launching an upgraded variant of the original Raduga satellites, known as the Raduga-1 or Globus-1. The Raduga-1’s service life is three years, the same as its predecessor. So far, Russia has put eight satellites of this class in orbit (GEO), the last one in February 2009.\textsuperscript{186}

\begin{itemize}
  \item \textsuperscript{178} “Sixth Meridian.”
  \item \textsuperscript{180} Denis Telmanov, “Russia Updated Its Judgment Day System,” \textit{Izvestia}, November 17, 2012.
  \item \textsuperscript{181} Ibid.
  \item \textsuperscript{182} Ibid.
  \item \textsuperscript{183} Podvig, Pavel, “Russia and Military Uses of Space,” 15.
  \item \textsuperscript{185} Zak, “Raduga (Gran) Comsat (11F638).”
  \item \textsuperscript{186} Ibid.
\end{itemize}
In December 2007, Russia successfully launched a Raduga-1’s follow-on, known as the Raduga-1M or Globus-1M. The satellite was reported to have stopped operating in May 2013 and seemed to be moved to a “graveyard” orbit in June 2013.187 The second Raduga-1M satellite was launched in January 2010 and remains operational. The third Raduga-1M is expected to be launched in August or September 2013.188 According to Space Forces Commander Maj.-Gen. Oleg Ostapenko, the Raduga-1M “is a new project that will help significantly increase the capabilities of the space communication system.”189

3.1.5.2. The Molniya Satellites

While the Raduga satellites represent the “stationary subsystem” of the ESSS, the second ESSS subsystem is “mobile” and consists of satellites deployed in HEO that move parabolically with the highest point in the Northern Hemisphere.190 These satellites were the Molniya general-purpose military and civilian communication satellites. The highly elliptical orbits are also known as the Molniya orbits as they were named after the satellites. They allow better coverage of the Russian territory than GEO.191

From 1964 onwards, the USSR/Russia launched nearly 200 Molniya satellites. Russia launched the prototype of the latest variant, the Molniya-3K or Molniya-M, in 2001. The Molniya-3K’s service life was reported to be five years.192 In 2005, Russian launched the Molniya-3K again, however, without success because of a failure of the third stage rocket engine. The next launch was scheduled for 2007 but it was eventually cancelled and the whole Molniya program closed.193

3.1.5.3. The Meridian Satellites

The Meridian satellites replaced the Molniya satellites and were the first Russian spacecraft deployed in HEO that was not designed on the basis of the Molniya platform KAUR-2.194 Besides the Molniya satellites, the dual-purpose Meridians are intended to replace the Parus Navy communications and navigation satellites.195 Reportedly, the Meridian satellites provide communication between ships, reconnaissance aircraft, and coastal stations in the Northern Sea Route, and expand satellite communication in the northern part of Siberia and the Russian Far East.196 Compared to their

188 Compare: Gorbenco, “The Russian Military Space Program of Tomorrow: What Will This Be?” and Zak, “Raduga-1M Satellite.”
190 Telmanov, “Russia Updated Its Judgment Day System.”
191 Podvig, Pavel, “Russia and Military Uses of Space,“ 15.
193 Ibid.
196 Ibid.
predecessors, the Meridian satellites offer more frequencies, increased reliability and improved daily availability. Their operational lifetime is seven years.\textsuperscript{197}

Russia launched the first Meridian in December 2006. In early 2009, the head of NPO PM (now renamed ISS Reshetnev) said that the Meridian-1 collided with space debris and ceased to operate before the end of its lifetime.\textsuperscript{198} So far, Russia has launched six Meridian satellites, in December 2006, May 2009, November 2010, May 2011, December 2011, and November 2012 respectively. The launch of Meridian-7, expected in July 2013,\textsuperscript{199} was not carried out. With the exception of the 2011 launch that ended in failure because of a malfunction in the rocket’s third stage, all Meridians were successfully delivered to orbit.\textsuperscript{200} Open sources indicate that four out of the six Meridians launched are currently operating.\textsuperscript{201} Given that the full Meridian constellation was reported to comprise of three satellites,\textsuperscript{202} the currently deployed constellation leaves Russia with one satellite to spare.

Besides the above-mentioned ESSS satellites, Russia deploys two other families of communication satellites: the Strela and Gonets families.

3.1.5.4. The Strela Family

The Soviet Union/Russia launched the first Strela satellites in the 1960s. The Strela family consists of store-dump communication satellites only, i.e., satellites that receive data as they fly over the sender and store them until they fly over the recipient.\textsuperscript{203} The early 1990s witnessed the last launches of the satellites from the Strela-1M and Strela-2M series. In mid-1980s, the Soviet Union/Russia began to launch the Strela-3 satellites that became the main military store-dump satellites. Russia improved the Strela-3’s design and in 2005 launched the first upgraded spacecraft under the designation Strela-3M, also known as the Rodnik-S.\textsuperscript{204}

Since 1986, the Soviet Union/Russia has launched 143 Strela-3 satellites. The Strela-3 was designed to be launched in sextuplets but since about 2000s, it was launched in pairs or trios.\textsuperscript{205} In the 1990s, Russia launched Strela-3 space vehicles once or twice a year. After the failure of the first out of two Strela-3 launches in 2000, Russia conducted only one Strela-3 launch (of two or three spacecraft) per year, namely in 2002, 2003, 2004, 2008, and 2009. The last two launches took place in September 2010 and July 2012; each time, only one spacecraft was placed into orbit.\textsuperscript{206} The Strela-3 has a lifetime of about


\textsuperscript{198}Ibid.

\textsuperscript{199}Gorbenko, “The Russian Military Space Program of Tomorrow: What Will This Be?”


\textsuperscript{201}“Russia to Launch Meridian Dual-purpose Satellite Wednesday.”

\textsuperscript{202}Telmanov, “Russia Updated Its Judgment Day System.”

\textsuperscript{203}Podvig, Pavel, “Russia and Military Uses of Space,” 15.


\textsuperscript{206}Krebs, “Strela-3 (17F13).”
three years.\footnote{207} Its full constellation comprises of twelve satellites in LEO (about 1,400km) deployed in two orthogonal orbital planes.\footnote{208}

The Strela-3 is being replaced by its upgraded variant, the Strela-3M or the Rodnik-S, which is being deployed in LEO (about 1,500km). The Strela-3M was reported to have a design life of five or seven years,\footnote{209} and to cost about 239.5 million rubles (nearly $7.5 million) each in 2013 prices.\footnote{210} The Strela-3M successfully premiered in December 2005. Further launches followed in July 2009 (one spacecraft), September 2010 (one spacecraft), and January 2013 (a trio).\footnote{211} Although the Roskosmos website reported no complications in the last launch, Izvestia recently reported otherwise. According to Izvestia, the 2013 Strela-3M’s launch “went disastrously.”\footnote{212} As a result of the Briz-KM payload assist module’s abnormal operation, the spacecraft did not reach the designated orbit and was moving at a higher speed than it was planned. Russia was apparently well aware of possible Briz-KM’s deficiencies since it had delayed the launch for six months due to a malfunction of a similar Briz-M upper stage during some previous launches.\footnote{213} A source in Roskosmos disclosed in May 2013 that out of the three Strela-3Ms launched in January this year, two space vehicles “are under the monitoring of the control centre, and the third can be considered lost.”\footnote{214} Given that no official information about this mishap had been disclosed until recently, Izvestia reporter Ivan Cheberko suggested the return of the Soviet practice of hiding launch accidents. Former Roskosmos’ head Yuriy Koptev, however, rejected Cheberko’s speculation.\footnote{215}

According to Jane’s, there were twelve Strela-3 series satellites operating in orbit in October 2010.\footnote{216}

3.1.5.5. The Gonets Satellites

Russia also deploys the Gonets-M communication satellites that are civilian counterparts of the Strela-3Ms. The Gonets satellites operate in LEO in the interests of commercial users and the Russian government. They can provide communication in a real-time or the store and forward mode.\footnote{217}

\footnotesize{\textsuperscript{207} “Spacecraft Outlook,” \textit{Aviation Week & Space Technology} 168, no. 4 (January 28, 2008): 171.}
\footnotesize{\textsuperscript{208} Krebs, “Strela-3 (17F13).”}
\footnotesize{\textsuperscript{210} Cheberko, “Roskosmos Was Silent on the Expenditure of GRU Satellites: As a Result of the January Action the Programme for the Launch of ‘Rokot’ Delivery Vehicles Was Frozen. It Is Hoped to Renew Launches in July.”}
\footnotesize{\textsuperscript{212} Cheberko, “Roskosmos Was Silent on the Expenditure of GRU Satellites: As a Result of the January Action the Programme for the Launch of ‘Rokot’ Delivery Vehicles Was Frozen. It Is Hoped to Renew Launches in July.”}
\footnotesize{\textsuperscript{213} Rodnik/Strela-3M.”}
\footnotesize{\textsuperscript{214} Cheberko, “Roskosmos Was Silent on the Expenditure of GRU Satellites: As a Result of the January Action the Programme for the Launch of ‘Rokot’ Delivery Vehicles Was Frozen. It Is Hoped to Renew Launches in July.”}
\footnotesize{\textsuperscript{215} Ibid.}
\footnotesize{\textsuperscript{216} “Strela Series.”}
\footnotesize{\textsuperscript{217} “Gonets Constellation,” Jane’s Space Systems and Industry, October 5, 2010, sec. Spacecraft - Civil Communications, Russian Federation.}
In December 2001, Russia launched the last trio of the first-generation Gonets-D satellites, a civilian version of the above-mentioned Strela-3. Although the design life was initially reported to be about eighteen months, it turned out that the spacecraft can actually operate for fourteen years.\textsuperscript{218} The follow-on satellite designated Gonets-M was first launched in December 2005. Its reported lifetime is five to seven years. So far, Russia has launched four Gonets-M satellites: one in 2005 and 2010, and two in July 2012. Three Gonets-M satellites are scheduled to be launched this year.\textsuperscript{219} Since at least 2006, Russia has been working on the next-generation Gonets-M1 spacecraft.\textsuperscript{220} Designed to be launched in quartets to reduce launch cost, the Gonets-M1 will reportedly have a new satellite bus, ten times broader bandwidth than the Gonets-M, and thirty times higher data transmission rate, so the Gonets-M1 will be much faster than its predecessor.\textsuperscript{221} According to the designer, the Joint-Stock Company Reshetnev, the Gonets-M1’s operational life will be ten years.\textsuperscript{222} The first Gonets-M1 satellite is expected to be launched in 2014; a trio of Gonets-M1s is scheduled to follow in 2015.\textsuperscript{223} Russia’s Federal Space Program envisions launches of sixteen Gonets-M1 satellites within the period of 2012-2015.\textsuperscript{224}

By 2015, Russia plans to have deployed the full constellation of twenty-four Gonets-type satellites (twelve Gonets-Ms during the first phase, and twelve Gonets-M1s during the second phase) that will be arranged in a way that will focus on servicing near-polar orbits.\textsuperscript{225} The satellites will be deployed in sextuplets in each of four orbital planes.\textsuperscript{226} The full constellation was said to provide Russia with an uninterrupted global communication capability.\textsuperscript{227} According to Anatoly Zak, by the end of July 2012, Russia was reported to have five operational Gonets satellites: two first-generation Gonets-D and three Gonets-M satellites.\textsuperscript{228} Given that the Gonets-D were launched twelve years go, their service life might expire soon.

In the fall of 2012, the former General Director of the Gonets satellite company Aleksandr Galkevich put forward a proposal to create a global low-orbit space internet system that would be jointly developed by China’s Xinwei and Russia’s National Institute of Radio and Info-Communications Technology.\textsuperscript{229} The system would employ communications satellites currently used by the Russian Foreign Intelligence


\textsuperscript{220} Zak, “Gonets/Strela Satellites.”


\textsuperscript{222} “Gonets-M1.”

\textsuperscript{223} Zak, “Gonets/Strela Satellites.”

\textsuperscript{224} Ibid.


\textsuperscript{226} “Gonets Constellation.”

\textsuperscript{227} “Russia to Roll Out Its Gonets Satellite Telecommunication System in Two Stages.”

\textsuperscript{228} Zak, “Gonets/Strela Satellites.”

Service (SVR), the Federal Security Service (FSB), the Main Intelligence Directorate (GRU), the Navy and the FSB’s combined Arctic unit. Russia’s Defense Ministry, the Ministry for Signal and Mass Communications and Roskosmos reviewed Galkevich’s proposal, but finally rejected it, although the Chinese side reportedly agreed to finance the whole project. According to a Kommersant’s source: “In early October [2012], Chief of the General Staff General Nikolai Makarov vetoed the project, since joint use of the Gonets-D1 M system frequencies by the Chinese could not guarantee the security of our data being transferred.”

3.1.5.6. Relay Satellites

Until 2009, Russia used the GEO Geizer satellites for the relay of military data sent out from the above-mentioned Neman electro-optical reconnaissance satellites deployed in LEO. The Geizer satellites were also known as Potok and the last three of them were launched in 1994, 1995, and 2000. In early 2009, the last spacecraft stopped working.

In September 2011, Russia delivered the first of Geizer’s successors, the Garpun satellite in GEO. The next launch of the Garpun is expected in 2013. The satellite’s mission is believed to be identical with Geizer’s, i.e., real-time data relay from reconnaissance satellites to the ground.

3.1.6. New Ground Stations: The Akvarel Global Intelligence System

In January 2013, Izvestia reported that the Russian Defense Ministry and Roskosmos began the development of a global satellite intelligence system that is “Russia’s most grandiose intelligence system in its entire history.” The experimental design was named Akvarel; the main work will reportedly start in June 2013 after the TsNIIRTI who won the classified competition defends the Akvarel project. According to Izvestia, “[t]he system is based on a complex of receiving and transmitting stations dispersed throughout the entire territory of the country.” The stations will act as a “motherboard” that will be subsequently equipped with military radar, radio-technical and visual intelligence systems as well as other advanced systems. The initial plans for the Akvarel system include five ground stations, but given the expected increase in Russia’s orbital grouping, the government required universality “that will take future levels into consideration.” The total cost of the ground station was reported to be 900 million rubles (about $27 million).

Izvestia’s report suggests that a special orbital grouping will be developed as a part of the Akvarel system. However, the report focuses on the ground component that appears to be planned to become operational earlier than the space component. In addition, the above-mentioned Liana network is being

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230 Ibid.
235 Ibid.

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developed in parallel with the Akvarel system, which might reduce the need for a fast deployment of new intelligence satellites in Russia. The first customer of the Akvarel was reported to be the Russian Navy that will receive data from the Liana signal intelligence network as well. In addition to large ships, the Akvarel terminals will be installed on aviation bases.\(^\text{236}\)

### 3.2. Russia’s Launch Capabilities

Russia produces all three classes of launchers to deliver light, medium and heavy payloads to orbit. Russia’s current launch vehicles, the Proton, Soyuz and Zenit rockets, are all based on Soviet designs. Proton, Soyuz and Zenit launches from Baikonur are planned to be maintained at least until 2015,\(^\text{237}\) although the July failure of the Proton rocket resulted in an indefinite suspension of all scheduled Proton launches from Baikonur.\(^\text{238}\) So far, retirement plans have been announced for the Proton launchers only. In March 2013, the Director of the Federal Space Agency Vladimir Popovkin said that the Proton launch vehicles will phase out after 2020, adding that it will happen “as soon as the Angara launch vehicles are put into operation.”\(^\text{239}\) The Angara rockets represent a new family of heavy-lift and lightweight launch vehicles, the first produced by the Russian Federation.

#### 3.2.1. The Angara Launch Vehicle, Vostochny and Accommodations at Plesetsk

Russia is approaching the first launch test of its new Angara rocket. The Moscow-based Khrunichev company won the Defense Ministry’s tender in 1994 and has been Angara’s prime developer ever since. After almost a decade in development, the first flight model of the lightweight Angara rocket was shipped from Moscow to Plesetsk in late May 2013 to prepare for its inaugural launch next year. The first model of the heavy-lift Angara is expected to be shipped in November this year.\(^\text{240}\) In May 2013, Russian Deputy Prime Minister Dmitry Rogozin specified the dates of inaugural launches for the lightweight and heavy-lift Angara’s variants as May 2014 and by the end of 2014 respectively.\(^\text{241}\)

The Angara rocket will be equipped with new oxygen-kerosene RD-191 engine which is more environmentally-friendly than its heptyl counterparts. The RD-191 is based on the engines used in the Zenit and Energia rockets.\(^\text{242}\) It is expected to be installed in all Angara rockets as well as in Angara’s

\(^{236}\) Ibid.
\(^{241}\) “Heavy Angara to Be Launched by End of Next Year,” Russia & CIS Military Daily, May 27, 2013.
future modifications. The heavy-lift Angara will be equipped with five engines, while the lightweight version with one only. The current price tag of an RD-191 is 240 million rubles ($7.3 million). The General Director of Khurunichev Center, Alexander Seliverstov, said that the final price needs to be (and will be) lower. Quite surprisingly, Russia decided to move the production of RD-191 from the Khimki-based Energomash that built the first two RD-191s to the Proton-PM company based in Perm. The Energomash Company had already invested billion of rubles to develop the RD-191 and expected to receive significant orders for the engine in the future. Energomash protested strongly but vainly against this move.

The importance of Angara transcends the launcher modernization aspect, however. Angara will be launched from a new launch facility in the Plesetsk spaceport in northwest Russia and from a new cosmodrome in Vostochny in the Russian Far East. Both facilities are currently being built and are expected to be ready by 2014 and 2018 respectively. These new domestic launch possibilities will reduce Russia’s dependency on the Baikonur cosmodrome in Kazakhstan. The disadvantages of the current situation are not only that Russia has to pay about $200 million per annum for the use of a foreign spaceport ($115 million annual rental fee + $50 million annually for maintenance), but also that it cannot fully determine the number of launches conducted from Baikonur. Kazakhstan’s decision to approve only twelve out of seventeen Proton-M launches that Russia requested for the year of 2013 heated up debates in January 2013. Although the dispute was later resolved by the two countries by compromising on at least fourteen launches in 2013, the incident once again reminded Russia of the detriment its dependency on Baikonur has to its national pride and prestige.

The work on the Plesetsk launch facility for Angara began in 1992, but it remained limited until early 2000s when the government finally provided necessary funding. Although work has continued ever since and Russia provided additional funds in 2010, the facility was still not ready at the end of 2013, even though unofficial estimates had suggested that the pad would be ready in spring 2013. In a recent interview, the director of the Plesetsk cosmodrome Nikolai Nestechuk said that the infrastructure for Angara’s testing is still being created at the 41st pad of the cosmodrome. The importance of the Plesetsk launch site for Angara is underscored by the high-level attention it receives. Not only does the chief designer of the system, Vladimir Nesterov, report personally to the Defense Minister on a weekly basis, but there are also observation cameras installed at Plesetsk that broadcast images of Angara-related work to the situational center of the Armed Forces.

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245 Kazakhstan, Russia Compromise on New Space Port,” RIA Novosti, February 13, 2013.
249 Ibid.
The second launch site for Angara will be the Vostochny space center that is currently being built on the site of a former spaceport, Svobodny. Its completion is scheduled for 2018. Russia plans to build not only a cosmodrome with multiple launch pads, but a whole town in Vostochny that will eventually be inhabited by 40,000 people and that is supposed to stimulate the development of the entire Russian Far East. The Vostochny space center represents first and foremost a step towards self-sufficiency with regard to satellite launches. The side effects, however, are not marginal either. The project is expected to cost about 300 billion rubles ($9 billion) and given its location, there are obvious opportunities for Russo-Chinese cooperation. The population and especially the working force in the Russian Far East have been becoming increasingly Chinese. Through the creation of the Vostochny scientific center, Russia might be seeking to reverse this trend. Although Russia will likely use Vostochny to strengthen relations with its southern neighbor, major contracts will be awarded to domestic companies to boost industry and, equally importantly, national pride – assuming successful completion of the center.

### 3.3. Anti-Satellite Weapons Programs

Since 1983, Russia has abided by the unilaterally declared moratorium on orbital satellite interception declared by then-Soviet Communist Party leader Yuri Andropov. By submitting the draft Treaty on the Prevention of the Placement of Weapons in Outer Space, the Threat or Use of Force against Outer Space Objects (PPWT) to the Conference of Disarmament in 2008, Russia and China attempted to outlaw (among other things) co-orbital anti-satellite weapons (ASAT) systems. In its current form, the PPWT would not apply to any ground-, air- or sea-based ASAT weapons so long as they would meet the treaty criteria of “weapons in outer space.” The Article I of the PPWT defines “weapons in outer space” as “any device placed in outer space, based on any physical principle, specially produced or converted to eliminate, damage or disrupt normal function of objects in outer space, on the Earth or in its air, as well as to eliminate population, components of biosphere critical to human existence or inflict damage to them.”

While Russia opposes the deployment of weapons (including ASAT systems) in space, its actions indicate support of airborne ASAT systems. So far, Russia appears to have revived two Soviet aircraft-based ASAT systems. Russian officials referred to the country’s accomplishments in ASAT technology especially in the aftermath of the Chinese and U.S. satellite intercepts in 2007 and 2008 respectively. Talking about then-recent U.S. and Chinese actions, Russian Deputy Defense Minister Vladimir Popovkin said in March 2009: “We cannot just sit and watch when others do it. I can only say that work of this kind is being

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conducted in Russia.”\textsuperscript{253} Three months later, Popovkin assured journalists about Russia’s capability to destroy a satellite by stating that “[s]hooting down a spacecraft is not a big problem. In essence, Russia has demonstrated since the 1960s, since the first docking of two spacecraft, that one spacecraft may approach another spacecraft.”\textsuperscript{254}

Besides the U.S. and Chinese satellite intercepts, Russia linked its renewed interest in ASAT technologies to the development and deployment of U.S. ballistic missile defenses (BMD). In 2011, Deputy Foreign Minister Sergey Ryabkov listed ASAT systems among possible Russian responses to the U.S. BMD: “Additionally, the anti-satellite complexes capable of neutralizing the space echelon [of the U.S. BMD] would be completed ready for deployment.”\textsuperscript{255} Earlier, State Duma deputy and former Secretary of the Russian Federation’s Security Council Andrey Kokoshin said that Russia’s development of anti-satellite weapons is completely justified, especially because the USA has accelerated exploration of space-based strike weapons after it withdrew from the ABM Treaty (\textit{Treaty Between the United States and the Union of Soviet Socialist Republics on the Limitation of Anti-Ballistic Missile Systems}, Moscow, 1972).\textsuperscript{256} In 2009, Popovkin hinted at Russian terrestrial ASAT capability when he said that should weapons be placed in space, Russia would respond more appropriately than with a symmetrical action.\textsuperscript{257}

\subsection*{3.3.1. The Co-Orbital ASAT System}

The Soviet Union was the only country that actually deployed and operated a co-orbital ASAT system, the IS system. It used the Tsylkon 2 (SL-11) carrier vehicle with HE-fragmentation warheads that were placed into the same orbit as the target. The warheads were then gradually drawn closer to the target and eventually destroyed it.\textsuperscript{258}

The original IS system achieved full operational capability in 1979 and received an upgrade nine years later.\textsuperscript{259} The modified system became known as the IS-MU and was declared operational in April 1991.\textsuperscript{260} The first two IS-variants were designed to destroy satellites in low Earth orbit; the third IS-variant, known as the IS-MD (sometimes referred to by the name of its platform “the Naryad”), was intended to destroy satellites in geostationary orbit. Work on the IS-MD started in 1988.\textsuperscript{261} The Soviet Union/Russia

\begin{thebibliography}{99}
\bibitem{253}Russia Developing Its Own Anti-satellite Systems - Deputy Minister,” \textit{Interfax-AVN}, March 5, 2009.
\bibitem{254}“Russia Can Respond Appropriately If USA Deploys Space Weapons - Deputy Minister,” \textit{Interfax}, June 17, 2009.
\bibitem{257}“Russia Can Respond Appropriately If USA Deploys Space Weapons - Deputy Minister.”
\bibitem{261}Zak, “IS Anti-satellite System.”
\end{thebibliography}

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deployed only its ground-based component, the Okno ground tracking station that remains operational and can detect and track objects at altitudes between 2,000 and 40,000 km.\textsuperscript{262}

The current status of the IS system is not entirely clear. Officially, the IS system was decommissioned in August 1993, twelve years after its last test.\textsuperscript{263} However, the system’s ground-based components, including the Okno ground-based satellite tracking facility, the 224-B facility for command calculations and measurements, and the launch complex at Site 90 in Baikonur, remained active even after 1993.\textsuperscript{264} The Soviet Union planned to deploy four Okno and four Okno-S outer space control stations. However, only one Okno station was eventually built near Nurek, Tajikistan, and although work began in 1980, the Okno station was not put on combat duty until July 2002, mainly due to the Tajik civil war in the 1990s.\textsuperscript{265} The Soviet Union began construction and commissioned one Okno-S system in Primorye territory in eastern Russia in 1980. The facility was still under construction in 2009 and might not yet be completed.\textsuperscript{266} In 2011, Russia was reported to be working on improvements for the Oknos (and Kronas - see below) technical and detection capabilities.\textsuperscript{267}

Russia remains silent on the strike component of the IS system. Nonetheless, continued upgrades of the Okno complex which was officially identified as the IS-MD ASAT system’s component in 2009,\textsuperscript{268} raise the question whether the real purpose of Okno’s improvements is indeed enhanced space situational awareness, or if it represents a hedging strategy or even an actual preparation for a future ASAT system’s deployment/revival.

### 3.3.2. Air-Based ASAT Systems

Reports suggest that Russia has revived two Soviet air-borne ASAT programs: the Sokol Eshelon and the Kontakt.

#### 3.3.2.1. The Sokol Eshelon Laser ASAT System

Work on the Sokol Eshelon ASAT system began in 1965 and included the 1LK222 laser installed on the Beriev A-60 jumbo-jet.\textsuperscript{269} The Soviet Union built only two Beriev A-60s: one was lost in a fire in 1989, and


\textsuperscript{264}Zak, “IS Anti-satellite System.”

\textsuperscript{265}O’Connor, “Soviet & Russian Space Surveillance Facilities.”

\textsuperscript{266}Ibid. Zak, “IS Anti-satellite System.”


\textsuperscript{268}Zak, “IS Anti-satellite System.”

the other one is currently being tested.\textsuperscript{270} The laser reportedly completed tests in early 1990s but was shelved because of a lack of funding.\textsuperscript{271} In mid-2011, amateur pictures of the A-60 resurfaced and provided two pieces of interesting information. First, the A-60 aircraft has the words “Sokol-Eshelon” and a picture of the U.S. Hubble Space Telescope being shot by a red beam painted on the side. Second, in contrast to its predecessor, this A-60’s variant has its laser mounted up and directed toward space which indicates where the laser’s targets will be.\textsuperscript{272} Moreover, in 2010 Interfax quoted a source in the defense industry who revealed that the airborne laser system “is designed to transmit laser energy to remote objects in order to counter the infrared opto-electronic means of the enemy.”\textsuperscript{273} Russian expert Ruslan Pukhov, the head of the Centre for Analysis of Strategies and Technologies, was even more specific about the system’s purpose when he said that the Sokol Eshelon system “gives the opportunity to blind American satellite [sic] that would guide the missile defense system.” Pukhov also said that the system “is being tested at present [November 2011] and will be deployed by the troops in the foreseeable future.”\textsuperscript{274}

Russia tested the airborne laser in the first half of 2010.\textsuperscript{275} In the same year, the A-60 flying laboratory was reported to have received full funding from the State Armaments Program.\textsuperscript{276} However, in 2011 work on the A-60 reportedly stopped due to insufficient financing.\textsuperscript{277} The situation was reversed again in November 2012 when, according to Izvestia, Russian Defense Ministry ordered the development of combat lasers capable of burning through the hulls of aircraft, satellites, and ballistic missiles. Three companies were said to have received the Ministry’s order: the Almaz-Antey concern, the Beriev Aviation Science and Production Concern (TANTK), and the Khimpromavtomatika Company.\textsuperscript{278} The spokesman of the TANTK said that the new laser will be created to destroy airborne targets. It will be a more powerful version of the 1LK222 laser completed in 2009 that was designed to blind and temporarily disable the optical systems of satellites.\textsuperscript{279} Its range was reported to be 300-600km.\textsuperscript{280}


\textsuperscript{271}“Наука и Техника: Россия Создаст Лазер Для Подавления Разведки Противника [Russia Creates a Laser to Suppress Enemy].”


\textsuperscript{273}“Наука и Техника: Россия Создаст Лазер Для Подавления Разведки Противника [Russia Creates a Laser to Suppress Enemy].”

\textsuperscript{274}“Anti-Satellite System.”

\textsuperscript{275}Russian Pundit Pukhov Says US ABM Ultimately Aimed Against Russia, China.”

\textsuperscript{276}Anti-Satellite System.”

\textsuperscript{277}Mikhailov and Voloshin, “The Ministry of Defense Will Resume the Development of a Combat Laser: Russian ‘Death Rays’ Have Been Ordered Not To Blind but to Destroy Enemy Missiles.”

\textsuperscript{278}Ibid.

\textsuperscript{279}Ibid.

\textsuperscript{280}Ibid.
Further reports about the Sokol Eshelon system could emerge later this year. In November 2012, the spokesmen of the Almaz-Antey concern and Khimpronavmatomatika design bureau told Izvestia that the 1LK222 laser’s ground-based prototype was ready. With regard to the aircraft, a TANTK spokesman said that “jointly with Almaz-Antey, we will begin the installation of new units of laser equipment. I hope that the aircraft will take off and begin research already [in 2013].”

### 3.3.2.2. The Kontakt Kinetic ASAT System

The Kontakt was a Soviet aircraft-based ASAT system that was approved in 1984 and reportedly suspended in 1989. The air-based component of the Kontakt system consisted of high-altitude kinetic interceptors (designated 79M6 Kontakt) and carried by a modified version of the MiG-31 aircraft (designated MiG-31D). All three MiG-31Ds the USSR produced were stationed in Kazakhstan and were lost due to the USSR’s dissolution. The Kontakt’s ground-based component consists of a radar-optical complex known as Krona. Originally, three Krona satellite identification stations were planned to be built, but only one and a half were finally constructed.

The fully completed Krona complex is located near Storozheva and Zelenchukskaya in southwestern Russia. It consists of two main components: the radar complex designated 20J6 and the optical complex designated 30J6 that combines an optical telescope with a laser system. The Krona system provides Russia with a detection capability of up to 40,000km and has a range of 3,200km. Mainly due to insufficient funding, the facility did not become operational until November 1999. Its optical-laser component was completed later, some time between 2003 and 2007, and seemed to have acquired at least a limited operational capability by 2008. The whole complex appears to have been upgraded at least two times with a major upgrade conducted in 2009-2010.

In April 2011, Vladimir Popovkin, then-commander of the Russian Space Forces, disclosed some information about the status of the Krona complexes. Popovkin said that the Krona complex in southwestern Russia had received a laser-optical locator that started to operate in an experimental mode. According to Popovkin, “the locator will make it possible to expand the Space Forces’ combat capabilities in the area of space surveillance because it will help in tracking satellites in a geostationary

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280 “It’s Once Again Time to Worry About Russian Lasers [Cold War Retro],” Newstex, June 14, 2011.
285 Ibid.
286 Ibid.
orbit and in observing objects in deep space.” He also mentioned the second Krona complex that has been being built near Nakhodka in the Far East since the 1980s. The second Krona complex, also referred to as the Krona-N, consists of the 2016 radar only. According to Popovkin, the Krona-N was still under construction in April 2011. Pavel Podvig, the Director of the Russian Nuclear Forces Project, reported in January 2013 that the complex has not been fully deployed yet. According to Anatoly Zak, the Krona-N will be capable of tracking satellites taking off from the Vandenberg Air Force Base in the U.S. west coast.

In January 2013, Izvestia reported that testing of a new Krona anti-satellite system will start at the end of 2013. It is unclear if Izvestia misused the designation when it called the whole ASAT system “Krona,” or if Russia is actually building a system that will become known as such. More importantly, however, the report does not mention which one of the Krona complexes will be tested. According to the newspaper’s source from the General Staff, the testing will focus on the interworking of the ASAT system’s components, especially interceptors, with the ground-based satellite tracking station. The source also stated that the military does not have any complaints about the radar-optical complex itself. As for the interceptors, Russia currently does not have any MiG-31Ds. According to Izvestia, regular MiG-31s will be used for the announced testing. It is unclear how difficult and costly (and tempting) it would be for Russia to turn the regular MiG-31 jets into the anti-satellite “D” version; according to Russian defense-industrial sources, such a modification would not represent a particular problem. Russia continues upgrading its MiG-31 fleet, while at the same time it has already announced plans to retire the MiG-31s by 2028. The development of the replacement has started and deliveries of the new plane are scheduled for the end of the decade. The compatibility of the new interceptor with the Kontakt system’s design has not been publicly addressed yet.

Because of the lack of information about work being underway on the MiG-31D or its equivalent, Izvestia speculated that in reality, Russia is not developing the air-based component of the Kontakt ASAT system at all. Besides, according to Dmitriy Kornev, a military expert and editor of the MilitaryRussia website, “[a] fundamental change of the entire system is possible - for example, reorientation towards ground-based missiles.” While surely conceivable, Izvestia’s speculation contradicts a statement made by then-Commander-in-Chief of Russian Air Force Colonel-General Aleksandr Zelin in August 2009: “A version of the MiG-31 was being created for space defense missions in USSR times. This system is being

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293 Balburov and Mikhailov, “Tests of Antisatellite Complex Will Begin at the End of the Year: Revived Soviet Krona Will Down Satellites With Ground-Based or Air-Launched Missiles.”
294 ibid.
 revived for performing the very same missions." While Russia indeed remains silent on the MiG-31D question, it is known that the Fakel design bureau that specializes in space rocket technologies is developing a replacement missile for the 79M6 Kontakt. The 79M6 interceptor was designed to destroy objects at altitudes of up to 1500km and to attack up to twenty-four satellites within a thirty-six-hour period.

4. Conclusion: Russia, the United States, and Competition in Outer Space

Undoubtedly, the use of outer space is associated with prestige and power. Both are extremely important to Russia, a former empire and currently a nuclear great power. While Russia pursues a highly ambitious space exploration program, the military value of its space program prevails – a continuity from Soviet times. While the differences between the U.S. and Russian approach to most issues in international politics remain apparent, the states’ approach to military space is in a surprising congruence. The United States and Russia concur in first, the understanding of the importance of space assets in contemporary warfare, second, the desire to assure an independent access to space, and third, the desire to assure undisturbed use of space assets.

First, the U.S. and Russia both view military space as a force multiplier, and aerospace and information superiority as keys to winning a war. Already during the Cold War, the United States was talking about the air-land battle, a concept virtually identical to what Soviet military scientists previously developed and explored as the so-called reconnaissance-strike complex. The lack of funding that prevented proper implementation of the advances of Soviet military science continued in the years following the USSR’s break-up and hinders Russia’s military rise even today. While Russian military circles seem to comprehend the importance of the C4ISR integration in today’s conflicts, the country’s military modernization proceeds only slowly. Besides the insufficient, though ongoing, adjustment of operational plans, manuals, and other guiding documents to new realities, the Russian military presently lacks the necessary infrastructure for timely dissemination of the information acquired through space systems from higher to lower levels of the military, such as brigades and individual soldiers. To catch up with the United States, Russia does not seem to need brains, but time and money.

Second, both Russia and the United States seek independent access to space in the sense of a sufficient domestic industrial base that provides space launch vehicles, launch centers, and satellite payloads. While Russia has its own cosmodromes, produces its own launch vehicles and also a majority of payloads, it has to rely on foreign suppliers due to the backwardness of some of its technology and on

296 Balburov and Mikhailov, “Tests of Antisatellite Complex Will Begin at the End of the Year: Revived Soviet Krona Will Down Satellites With Ground-Based or Air-Launched Missiles.”
297 Ibid.
the Baikonur space center to sustain the number of its space launches. Its launch vehicles are all based on Soviet designs, which, as the July Proton rocket failure demonstrated, are not fully reliable. Russia’s investments in the Angara launch vehicle and the Vostochny cosmodrome should move it closer to the goal of self-sufficiency but both might take longer than expected to be built, given Russia’s long tradition of delays, corruption, and engine and control systems failures.

Third, Russia, like the United States, wishes to assure undisturbed use of its space assets. Therefore, Russia builds and in some cases maintains in orbit reserve satellites, relies on multiple satellite families, creates redundancy through the inherent dual-usability of space-based assets, and continues to invest in new designs and solutions that allow for enhanced survivability of the satellite and increased protection of the satellite signal. Simultaneously, Russia works on counterspace capabilities that should provide it with the option to blind the enemy, or at least to offset enemy’s advantage should Russian “eyes” be attacked. The intensified work on counterspace capabilities, of which this paper considered only one kind, the ASAT systems, suggests that Russia anticipates the need for counterspace capabilities in a future war, i.e., it anticipates dealing with an enemy that has its own satellite networks and relies on them substantially.

Last but not least, the Russian approach to outer space must be considered in the context of Russian strategic culture and identity. Given the military importance of space and prestige associated with it, Russia’s militarized strategic culture, its identity as a leading military great power, and its constant fear of being attacked, all of which point to the need for unchallenged superiority, we should not be surprised that Russia views outer space as an arena of strategic competition with the United States, the one nation that Russia cannot catch up with. While Russia would compete with any nation that would bar it from superiority in outer space, its history with the United States intensifies its desire to win the outer space race and adds a Cold War-like edge to the U.S.-Russian relationship with regard to outer space. This is demonstrated by, first, the clearly anti-American orientation of at least one of the Russian ASAT programs (recall the picture of the U.S. Hubble Space Telescope on the Sokol-Eshelon aircraft); second, accusations by Russian experts and indirectly also by Roskosmos’ head Popovkin that the United States caused failures of Russian satellite missions (radical voices in Moscow blamed even the February meteor fall on the USA: the leader of the Liberal Democratic Party Vladimir Zhirinovsky commented on the incident with “[I]n those aren’t meteors falling; it’s the Americans testing new weapons”); third, the portraying of GLONASS as an answer to the U.S. GPS and the use of GLONASS as a tool for countering U.S. influence abroad (recall Russian offers of the GLONASS high-precision signals to foreign customers); and fourth, the exploitation of the unverifiable PPWT as an alleged proof of the


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U.S. unwillingness to cooperate in outer space and ultimately, of the U.S. intent to dominate outer space.  

The traditional Russian desire, so far unsatisfied, to achieve self-sufficiency and superiority permeates all its military space activities. Russia has not yet managed to fully take advantage of its space-based systems, mainly due to the lack of supporting infrastructure and rigidity within its military. Nevertheless, the reform of Russian army slowly continues and its military space and counterspace capabilities gradually improve. It remains to be seen how much Russia’s military assertiveness will increase after the country masters the concepts of network-centric warfare and reconnaissance and information strikes not only in theory but also in practice.

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