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The Russian Satellite Reconnaissance Capabilities – Political and Strategic Assessment

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Ground observation has been one of the primary missions of satellite systems since the beginning of the Space Age. The development of this capability was the most important reason behind the American space effort at its nascency. The Eisenhower administration badly needed reliable information about Moscow's nuclear potential, which was very scarce due to the seclusion of the Soviet Union. The novel technology promised to lift the veil of secrecy, at least to an extent, but the Americans were wary that the Russians would start shooting at satellites overflying their territory. This problem was resolved by the Soviets themselves when on October 4th, 1957, Sputnik-1 was launched. Until its orbit finally decayed, it had made 1440 circles around the globe, overflying every country in the world at least several times. The crucial precedent was made, so less than three years later, on August 19th, 1960, the U.S. Air Force's Discoverer-14 optical reconnaissance satellite completed an entire mission circle for the first time. It gathered more information than all previous U-2 strategic surveillance planes had obtained to date in a single, one-day flight. Since then, a steady flow of priceless data has streamed continuously from imaging satellites to the U.S. decision-making circles. The access to the Soviet secrets via Earth's orbit had undeniably become one of the most important strategic assets which formed the American political and military strategy.

In the following decades, satellite reconnaissance capabilities have evolved, and the range of available missions widened. Optical imagery was supplemented by electronic and signals intelligence

as early as the 1960s, followed by infrared and radar observation. Since the 1980s, satellite military missions were not only of strategic relevance but also have been implemented on the operational and tactical levels. Thus, the notion that satellite systems have profound significance for any military activity, particularly as far as the United States is concerned, is both prevalent and absolutely true.

The Soviet Union, contrary to the common view, was always backwards with regard to the practical space applications, both military and, even more profoundly, civilian. Even though Moscow appeared to have led the Space Race in its first decade, it was true only in a propaganda plane. The Soviet space programme suffered the same shortcomings as the other high-technology projects: overpoliticization, economic ineffectiveness, petrified technology-creation system, lack of coherent vision, and infighting within the industry. Consequently, the Soviet-made space applications were always much less effective and fewer in numbers than the American counterparts. The overarching crisis of the Soviet state, which started as early as the 1970s and significantly accelerated in the 1980s, resulted in extensive turbulences in the space industry as well. As a consequence, the newly formed Russian Federation inherited an outdated space industry base which was also reduced in size after the collapse of the USSR. In the 1990s, the crisis persisted, resulting in a drastic reduction of the capabilities of the Russian space systems. The situation started to improve in the 21st century, but as of 2022, Russian satellite capabilities remain highly limited, specifically in relation to the needs of the nation which considers itself a world-class power. Russia's deficiencies are particularly striking with regard to space surveillance architecture which remains vastly inferior to the main competitors like the United States and China. Moreover, western commercial companies are also way ahead of the Russian military regarding space-borne imaging systems.

The Inventory of Russian Space Surveillance Systems

The space surveillance capabilities include optical/infrared, radar, and electronic surveillance craft. The most reliable open-source information about active satellites is a database maintained by the Union of Concerned Scientists (UCS). According to that source, as of January 1st, 2022, of 162 active satellites registered in Russia, 99 were indicated as belonging to the Aerospace Forces of the Russian Federation or the Ministry of Defence and labelled "military" or "military/commercial". Among the military satellites, 16 were categorised as "earth observation". Until May 29th, 2022, two more satellites belonging to this category have been launched with apparent success, what makes a total inventory of 18 military reconnaissance spacecrafts. The composition of this architecture is as follows.

Optical imaging

The Bars-M space system includes three satellites, with three more to follow in the unspecified future. The first two were launched in 2015 and 2016, and they have already exceeded their expected 5-years lifespan. The third was launched on May 19th, 2022, and should become operational in the coming months. The Bars-M's mission is to provide military cartography with the use of an optical sensor with 1-meter resolution and other instruments. In theory, the constellation may also provide tactical and strategic information for the combat forces, but it is doubtful if they are used for that purpose.

The Persona space system entails two orbiters, launched in 2013 and 2015, which feature a 0,5-meter resolution optical sensor and operate in 700 km orbit. The lifespan of Persona satellites has been exceeded as they were supposed to operate for 3-5 years. This constellation is a typical space surveillance system that provides tactical and operational information for the armed forces. However, having only two crafts in orbit, the constellation cannot provide constant surveillance due to individual satellites' relatively long revisit time.

On April 29th, 2022, the new-generation optical reconnaissance satellite MKA-R was launched, but it apparently remained unfunctional and deorbited on May 17th, 2022. It was the third satellite of this type launched unsuccessfully since 2018.

Radar imaging

In 2013 and 2014, Russia launched two Kondor series radar observation satellites, the second one was built with the financial support of the government of South Africa, but some sources hold that it is unclear if Pretoria still owes it. According to the UCS database, one Kondor satellite launched in 2013 remains in the Russian inventory, and one Condor-E2 launched in 2014 belongs to South Africa. But World Meteorological Organization's observation satellite database does not indicate any craft dubbed Condor and shows Kondor-E and Kondor-E1 instead, launched in 2013 and 2014, respectively. According to this source, the former craft was lost in 2014, and the latter was presumably inactive since 2019. Due to inconsistency in available information, we can only conclude that Russia may or may not operate radar reconnaissance craft of 1-2 m resolution. But even if it does, the vehicle in question has exceeded its 5-year expected lifespan.

On February 5th, 2022, the Neitron-1 was launched. Little is known about this satellite, but it is believed that it is a radar imaging satellite which may be about to enter service in the coming weeks or months.

Early warning

The Kupol space system comprises of five EKS (aka Tundra) early warning satellites, one more is planned for launch in an unspecified future. Satellites belonging to this system reside in highly elliptical orbits designed to enable constant coverage of the United States territory and its vicinity. They are equipped with ultraviolet, optical and infrared sensors up to 1-meter resolution, which may detect ballistic missile launches, strategic bombers in-flight, hypersonic weapons and satellites in low orbits. Tundra craft were launched between 2015 and 2021, and there is no information about their expected lifespan.

Electronic intelligence

The Liana space system features one Pion-NKS and five Lotos S1 satellites, of which the last one was launched on April 7th, 2022; three more are supposed to follow. It is designed to provide electronic intelligence (ELINT) missions for the Russian military, specifically for naval intelligence. The vehicles belonging to this system were launched between 2014 and 2022. Additionally, the last satellite of the older generation ELINT system, Tselina-2, is still indicated as operational, although it has greatly exceeded its expected lifespan.

Civilian assets

The Russian Federal Space Agency, dubbed Roscosmos, operates the constellation of five Kanopus observation satellites. One was launched in 2012, the other four in 2018, and their projected lifespan is five years. They were built to conduct ocean, weather, natural disaster, mapping and land survey civilian missions, although a 2-meter resolution optical sensor may be used for military purposes but with great limitations. The long revisit time, 15 days for a single craft, is also an obstacle to using this constellation for military purposes.

Another space system belonging to Roscosmos contains three Resurs-P satellites normally used by the Ministry of Agriculture, which feature 1-meter resolution optical sensors. The satellites were launched in 2013, 2014 and 2016 and have exceeded their 5-years projected lifespan. The individual satellite has a 3-day revisit rate what makes it much more usable for military surveillance purposes than Kanopus, but still the usefulness of Resurs-P constellation is limited to observation of fixed targets.

The abovementioned list does not cover meteorological or ocean observation satellites belonging to the Russian government agencies as they feature low-resolution sensors or are placed on orbits not suitable for military surveillance purposes.

It is worth comparing Russian space reconnaissance capacity with other entities, particularly as Russia underlines its status as the global superpower. The capabilities in space are certainly important indicators of the country's strength and global status of its economy and technology-creation sector. According to the UCS database, there are 2581 satellites registered in the United States, 43 of which are labelled as military earth observation satellites. China has a total of 319 satellites, of which 52 are earth observation craft belonging to the ministry of defence; some of them may be land survey or weather satellites, but most of them are certainly reconnaissance vehicles.

As we may see, as far as satellite surveillance is concerned, Russia can be compared neither to China nor to the United States. Moreover, and it is a very important fact, numerous private space companies' space imagery capabilities greatly exceed those of the Russian military. For example, according to the UCS database, the California-based Planet Labs PBC owes 88 optical and multispectral imaging satellites, some of which feature 0,5-meter resolution. Another company, Maxar, boasts 15-cm resolution of its optical imaging satellites, reportedly second only to the U.S. military, which uses sensors of 5-cm resolution. Another commercial company, Finnish ICEYE, currently operates 12 radar imaging satellites with a maximum resolution of 0,5-meter. It is worth noting that the U.S. National Reconnaissance Office has recently decided on a multi-billion-dollar cooperation program with commercial entities that will provide imagery for the military purpose.

Strategic and Political Assessment

As it has been stated above, the Russian space surveillance capabilities are highly limited. The strategic early warning system is the only one which is able to conduct its mission to the full extent. ELINT constellation is also relatively well-developed, and even though it is believed to be a naval intelligence, it probably can be used for other purposes as well. However, Russian abilities are almost non-existent when it comes to imaging satellites, particularly important for observing

ground infrastructure and force movements. The architecture suitable for that purpose consists of an ageing optical imaging constellation with just two orbiters supported by a single radar satellite that may not be operable, plus the new radar satellite expected to come online soon. These meagre capabilities do not provide the constant multispectral coverage needed for combat purposes. Other observation systems, particularly civilian ones, cannot fill the existing capabilities gap.

Contrary to the Russian military, many modern armies are able to use detailed real-time or near-real-time information to assist warfighters on the ground on a permanent basis. They either possess their own capabilities or use information obtained from more advanced allies or contract images at the commercial market. This way, an adversary with wide access to satellite data has an advantage over Russia in the information sphere, which translates into advantage on the battlefield. It is clearly visible in the course of the war in Ukraine. The Russian military does not possess earth observation capability to aid combat units in their day-to-day tasks significantly. Instead, Russian space assets are suitable only for planning the deep strikes against fixed targets and assessing the damage inflicted on infrastructure. Furthermore, this capability does not allow immediate assessments since the revisit time of imaging satellites is long. Conversely, the Ukrainian forces execute combat missions with constant aid of the information obtained from the American satellite surveillance systems and commercial sources. This information is probably not provided in real-time due to obvious lags between the American agencies or commercial entities and the Ukrainian military. However, the information flows constantly and is relatively up-to-date, giving Ukrainian forces a critical advantage in planning and executing combat missions. If Moscow decided to fight a more advanced adversary, like the United States or NATO, the capabilities gap would adversely impact the Russian military even more profoundly, as the U.S. can provide real or near-real-time satellite surveillance information to the units on the ground.

Generally speaking, the lack of key space surveillance capabilities hampers the Russian war effort and diminishes the ability to effectively use the combat forces at the disposal. It also makes the deterrent function of the Russian armed forces less credible. Certainly, Russia might resort to counterspace measures and try to destroy, jam or blind adversary's satellites. But in this case the adversary would certainly do the same to Russians, hitting not only surveillance assets but also the whole space communications and positioning infrastructure which is also critically important for the military.

From the political point of view, the lack of surveillance capabilities, together with limited space communication capabilities and a positioning system of questionable quality and uncertain future, translates to the diminished international prestige of the Russian Federation. Lagging behind the U.S., China, and commercial entities in space exposes Russia's general technological and economic weakness. Since space technology is the most sophisticated of all, states that wield it are believed to be the world's leading powers. Thus, indigenous space capabilities represent one of the crucial features of a nation's strength. From this vantage point, Russia's status as a world power is highly questionable.

The abovementioned issues should also be put into perspective regarding likely future developments. Before Russia went to war with Ukraine and became subject to tremendous sanctions, it could have been expected that it would be able to sustain or maybe gradually improve its space

capabilities, including space surveillance. Now, further development and, in a perspective of several years, the very existence of the Russian space program in general and military capabilities, in particular, is debatable. There are several impediments to the development of the whole Russian military space.

Firstly, economic constraints will be even bigger in the coming future than they were before the war. Punishing sanctions will continue hitting the Russian economy and will result in the necessity to make very difficult choices. It is mostly because contracting revenues of the state will yield a smaller budget which will have to accommodate growing needs. The underfunded social sphere, the industry that is struggling with import replacement problems and the military that will have to fund the war and replace tremendous losses in combat equipment will all need great investments. The last of these problems will be aggravated by likely changes to the Russian security policy. Drastically increased securitisation of the international environment will probably lead to ramping up of the military posture. It means that Russia will probably try not only to rebuild its military after it has suffered appalling losses in Ukraine but also to expand it while simultaneously addressing shortcomings unveiled by this conflict. Certainly, satellite reconnaissance will be identified the area where critically important improvements are necessary. But space systems will have to compete with many other pressing needs and, being the most expensive, will most probably experience problems securing enough funding. Simply speaking, in the coming future, Russia will have much less money for more needs compared to the situation prior to the war. The necessity to develop the satellite surveillance architecture will have to compete with the requirements for more tanks, planes, missiles, more industrial capacity, and an improved social welfare system. It is impossible to say for sure if the military space programme is prioritised in such a situation, but we expect it is not.

Secondly, there is a growing technological gap between the Russian military-grade technology and the achievements of the western manufacturers that governments and commercial entities use. It was obvious even before the war, as so many western-made components were used in Russian military production. For example, the Kanopus constellation satellites are made up primarily of British-made parts. Lack of import of the high-end components will surely hamper the capability of the Russian systems, as is purportedly the case with regard to delays of expansion of many Russian space systems. For example, the already mentioned civilian Resurs-P constellation comprises of three orbiters launched in 2013-2016. They were supposed to be quickly followed by three more which never materialised, possibly due to a lack of imported components.

Owing to expanding sanctions regime, Russia seems to be compelled to use substandard Chinese copies or clones of western equipment and invest in its own R&D and production capacities to substitute exports. As the former solution may rectify some immediate problems, the latter will take a lot of time and resources and most probably will produce components inferior to the western counterparts. Note that the western manufacturers will keep developing space technologies, so the capabilities gap will, most likely, grow.

Conclusions

1. Moscow's space surveillance architecture does not match ambitions regarding the world-class power status of the country. The declining industrial base and insufficient funds for developing

the new technologies result in the dwindling capabilities of space systems, including earth observation satellites.

2. The extent to which Russia can use its satellite surveillance systems for military purposes is greatly limited by their quantity and quality. Except for strategic early warning, Russian capabilities do not allow the use of satellite imagery as a meaningful aid for the warfighting effort. Existing space systems can provide only limited support for the planning of combat missions and assessing damage to the opponent's infrastructure.

3. The important political consequence of the Russian weakness in space is a significant loss of international prestige. The nation, which is still bragging about past achievements in the course of the Space Race, is now a third-rate space power, lagging not only behind other states but also commercial entities.

4. This bleak picture is probably here to stay, as there is no reason to believe that Russia will be able to significantly augment its capabilities in space in the foreseeable future. It is more plausible that Russia will become even more technologically backward compared to the West. This situation will most likely persist, even if the Russian space industry scores some incremental successes in import substitution. It is also possible that the Russian space program will fall into another technological dependence, this time on China.

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