

RUSSIAN MILITARY AND INTELLIGENCE RENDEZVOUS AND PROXIMITY OPERATIONS



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Summary

Since 2014, Russia has conducted several robotic rendezvous and proximity operations (RPO) in both low Earth orbit (LEO) and geostationary Earth orbit (GEO), most of which are related to military or intelligence operations. Most of these missions have been publicly acknowledged by the Russian government but few have detailed public information available. None of the programs listed here are thought to involve co-orbital ASAT testing or deployment, but there are still suspicions surrounding several of these events.

Rendezvous and Proximity Operations

Proximity operations are a series of orbital maneuvers executed to place and maintain a spacecraft in the vicinity of another space object on a relative planned path for a specific time duration to accomplish mission objectives. Rendezvous is a process wherein two space objects (artificial or natural body) are intentionally brought close together through a series of orbital maneuvers at a planned time and place. Taken together, RPO technologies enable a wide range of capabilities to support civil and commercial space activities such as on-orbit inspections, repair, refueling, assembly, and life extension. RPO capabilities can also be used for military and intelligence space activities such as intelligence, surveillance, and offensive weapons such as co-orbital anti-satellites. Over the past decade, Russia has conducted multiple missions practicing close operations and gathering communication intelligence. Most of these missions are suspected to be part of the Nivelir program aiming to strengthen intelligence operations and space situational awareness capabilities.

Russian RPO for Military and Intelligence Missions in LEO

The first known event was on December 25, 2013, when a Russian Rockot launch vehicle from Plesetsk placed three small satellites into LEO in what appeared to be another routine launch to replenish the Rodnik constellation but also included an unannounced fourth payload, Cosmos 2491.¹ From launch through the end of 2019, Cosmos 2491 did not make any significant changes to its orbit and remained in a relatively high LEO altitude of 1500 km. On December 23, 2019, Cosmos 2491 did make a small maneuver of approximately 1.5 m/s, which was accompanied by the release of 30 pieces of orbital debris.² Given the relatively low energy of the event, it is likely that the propulsion system of Cosmos 2491 failed immediately after launch and the orbital change and fragmentation event was caused by the explosive release of the residual fuel.

Once again, on May 23, 2014, the Russian government publicly declared that another Rockot launch carried three military satellites; yet, two days later, hobbyist satellite observers indicated that a fourth payload (Cosmos 2499) was on the launch. By mid-June, hobbyists reported that Cosmos 2499 had begun a series of maneuvers to match orbits with the Briz-KM upper stage that placed it in orbit.³ The process took several months, and it was not until the end of November when Cosmos 2499 passed within a kilometer of the Briz-KM.⁴ Amateur radio operators also reported that Cosmos 2499 appeared to be using the same radio frequencies as Cosmos 2491, suggesting they used the same Yubileiny-2 microsatellite bus.⁵ On March 26, 2016, Cosmos 2499 made another orbit adjustment that slowly brought it closer to the Briz-KM by about tens of kilometers per day in order to perform proximity operations.

On March 31, 2015, a third Rockot launch took place from Plesetsk with what was publicly declared as carrying three Gonet-M satellites and a classified military payload (Cosmos 2504).⁶ Cosmos 2504 began a small series of maneuvers in early April to bring it close to the Briz-KM upper stage that placed it in orbit. At some point during that pass, the Briz-KM's orbit was disturbed by an unknown perturbation, which could have been the result of a minor collision between the two space objects. If it was, the impact was very slight and did not result in additional debris being generated. On July 3, 2015, Cosmos 2504 made another significant maneuver, lowering both its apogee and perigee significantly by around 50 km each, further separating itself from the Briz-KM. On March 27, 2017, after more than a year of dormancy, Cosmos 2504 made a series of maneuvers that lowered its orbit, and on April 20, it passed within two kilometers of a piece of Chinese space debris from their 2007 ASAT test.⁷ This suggests that Cosmos 2504 has a satellite inspection or observation mission. Cosmos 2504 maneuvered again on December 10, 2019, to lower its perigee by 40 km, although the reason is not yet known.⁸

On November 25, 2019, Russia launched a military payload from Plesetsk (Cosmos 2542) to conduct space surveillance as well as Earth remote sensing.⁹ On December 6, Cosmos 2542 released a small subsatellite (Cosmos 2543) publicly announced by Russia.¹⁰ Cosmos 2543 remained within 2 km of Cosmos 2542 for three days before it conducted a series of maneuvers to raise its apogee to 590 km by December 16.¹¹ Subsequent analysis by amateur observers strongly suggests that the purpose of these maneuvers was to place Cosmos 2543 in an orbit where it can observe a classified U.S. intelligence satellite, USA 245. The orbits of Cosmos 2543 and USA 245 are synchronized such that Cosmos 2543 came within 20 km of USA 245 several times in January 2020 and since then periodically came within 150 to 300 km of USA 245 and could observe both sides of USA 245 continuously for up to a week at a time.¹²

Additionally, in June through October 2020, Cosmos 2543 rendezvoused with Cosmos 2535 which was launched in 2019 alongside four other payloads (Cosmos 2536, Cosmos 2537, and Cosmos 2538) and released a small object at high relative velocity.¹³ Cosmos 2535 and Cosmos 2543 remained in close proximity through August 2020, and by August 13th, they were joined by Cosmos 2536. Cosmos 2536 and Cosmos 2535 remained in close proximity to one another again in September 2020 until October, when Cosmos 2536 maneuvered approximately 20 kilometers away, before approaching once more nine days later. This back and forth movement continued into 2021, with reports indicating Cosmos 2536 docked with Cosmos 2535 in March 2021. There is some speculation as to the nature of Cosmos 2535 and Cosmos 2536 due to unexplained particulate clouds and orbital debris generated by their RPO activities. These activities generated by Cosmos 2535 and Cosmos 2536 indicate a possible co-orbital ASAT.¹⁴

In August 2022, Russia launched Cosmos 2558 in LEO. The behavior of the satellite as well as details of its launch seem to be oriented towards shadowing USA 326, a classified NRO imagery satellite.¹⁵ Cosmos 2558 launched into a similar orbital place as USA 326 and periodically came within 60-70km, although not close and synchronized enough to be a formal RPO.

Russian RPO For Military and Intelligence Missions in GEO

Russian robotic RPO activities have also occurred in GEO. On September 28, 2014, a satellite built for the Russian Ministry of Defense and Federal Security Service (FSB) was launched. The name of the satellite is not precisely known, yet often referred to as Luch according to Russian filings with the United Nations or "Olymp" or "Olymp-K" in manufacturer documents.¹⁵

Over the next several months, Luch conducted a series of maneuvers that brought it close to other operational satellites around the GEO belt. During its eight years on orbit, Luch has parked near more than two dozen commercial communications satellites for periods ranging from a few weeks to nine months, and typically close enough to be within the typical ground terminal uplink window.¹⁶ Luch has also parked next to the French-Italian Athena-Fidus military communications satellite, prompting accusations of "espionage" from the French Minister of Defense.¹⁷ The orbital history of Luch is documented in the figure on the following page.

In October 2022, Russia launched Cosmos 2561 and Cosmos 2562 which may be part of the Numizmat program to develop RPO technologies.¹⁸

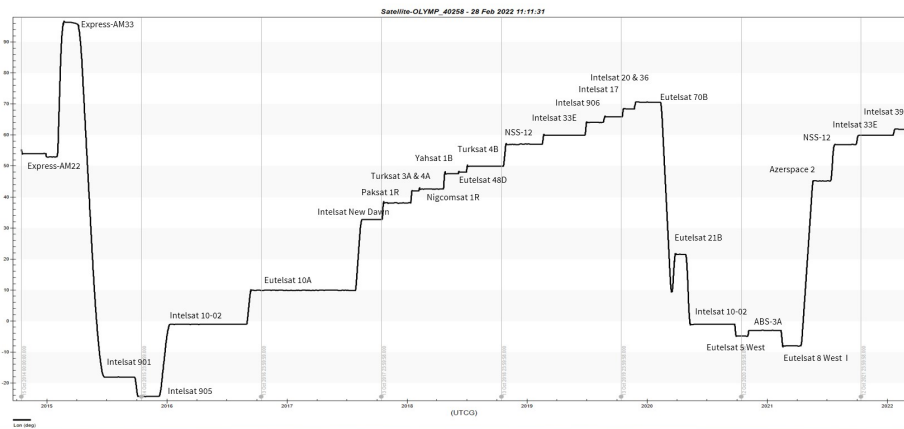
Dual Use Capabilities

The activities of the Cosmos 2499, 2501, 2504, 2535, and Luch/Olymp-K are consistent with the demonstration of RPO technologies for the purpose of satellite servicing, space situational awareness, and inspection. However, they could also be used for aggressive purposes such as co-orbital ASATs. The lack of transparency about these programs and occasional generation of orbital debris has fueled suspicion that they are covert weapons programs. However, the publicly-available evidence to date suggests they are aimed at either broad technology demonstration or military surveillance/reconnaissance missions.

Summary of Known or Suspected Russian Military and Intelligence RPO Activities in Space

Date of Test	Target Satellite	Chaser Satellite	Notes
Jun 2014 - Mar 2016	Briz-KM R/B	Cosmos 2499	Series of maneuvers to approach and retreat from the Briz-KM upper stage
Apr 2015 - Apr 2017	Briz-KM R/B	Cosmos 2504	Maneuvers to approach the Briz-KM upper stage; may have made a slight impact before separating again
Oct 2014 - Feb 2022	Multiple	Luch (Olymp-K)	Parked near several Russian and non-Russian satellites over eight years
Mar - Apr 2017	FY-1C Debris	Cosmos 2504	Close approach test with space debris
Aug-Oct 2017	Cosmos 2519, Cosmos 2523	Cosmos 2521	Cosmos 2521 separated from Cosmos 2519 and performed a series of small maneuvers to do inspections before redocking with Cosmos 2519. Cosmos 2523 separated from Cosmos 2521 but did not maneuver on its own
Mar-Apr 2018	Cosmos 2519	Cosmos 2521	Cosmos 2521 conducted close approaches of Cosmos 2519
Aug 2019 - Mar 2021	Cosmos 2536	Cosmos 2535	Cosmos 2535 and Cosmos 2536 conducted at least 25 individual RPO operations
Dec 2019 - Mar 2020	USA 245	Cosmos 2543	Cosmos 2543 was deployed from Cosmos 2542 and had repeated close approaches with USA 245 within 150 km
Jun-Oct 2020	Cosmos 2535	Cosmos 2543	Cosmos 2543 came within 60 km of Cosmos 2535 after investigating USA 245
Feb-Sept 2022	Cosmos 2558	USA 326	Cosmos 2558 periodically came within 60-70km of USA 326

Overall Mission Profile – Longitude History



COMSPOC
 A compilation of Luch’s orbital history and satellites visited. Credit: COMSPOC Corporation

Endnotes

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