Anti-satellite Tests in Space—The Case of China

Updated August 16, 2013

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Summary

Since the 1960s, the United States and Russia have conducted dozens of anti-satellite (ASAT) systems tests in space, a handful of which created long-lived orbital debris.[1] Over the last several years, China has conducted a series of tests in space of at least one, and possibly two, of their own ASAT systems. While at least three of these tests included the destruction of a target, only one, conducted in January 2007, resulted in the creation of long-lived orbital debris. This fact sheet collates what is known and what is theorized about China's ASAT testing in space, which suggests a multi-year testing program similar to those previously conducted by the U.S. and Russia.

Categories of Anti-satellite Systems

ASAT weapons launched into space generally fall into one of two categories. The first is ***direct ascent*** systems, which use ballistic missiles to put an interceptor on a ballistic trajectory that intersects with the target in orbit without the interceptor entering orbit itself. The second is ***co-orbital*** systems, which use a space launch vehicle to place the interceptor into orbit, after which it maneuvers to either collide with or pass nearby the target.

The direct ascent technique can be done with most medium to long-range ballistic missiles and does not require a larger, more complex space launch vehicle. The flight time to the target is also minimized, reducing the time the defender has to react. Direct ascent systems also tend to use the kinetic energy of the interceptor to destroy the target, a technique that has a very high kill probability, should the impact occur. However, a direct ascent technique requires waiting for the target satellite to pass overhead within a certain distance from the launch site. This can be mitigated somewhat by using mobile launchers. One example of the direct ascent technique include the U.S. ASM-135 missile designed to be launched from an F-15 fighter jet.[2]

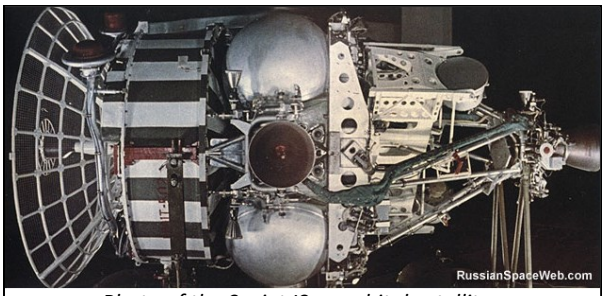

Photo of the Soviet IS co-orbital satellite. Credit: TsNII Kometa

The co-orbital technique requires a bigger rocket to launch the same size interceptor and can take considerably more time to reach the target. However, the interceptor can loiter in space for an extended period of time before maneuvering to intercept the target and a large space launch system can place multiple interceptors into orbit at once. Typically co-orbital ASAT interceptors utilize some sort of explosive charge or fragmentation mechanism, as the relative speed between the interceptors and their target is generally not high enough for a purely kinetic kill. An example of the co-orbital technique is the Soviet Istrebitel Sputnikov (IS) ASAT system which was developed in the 1960s and tested in orbit multiple times between 1962 and 1980.[3]

Known or Suspected Chinese ASAT Systems Tested in Space

SC-19

The SC-19 is a direct ascent ASAT system based on a modified DF-21 (NATO codename CSS-5) road mobile medium range ballistic missile (MRBM).[4] The kinetic kill vehicle (KKV) reportedly weighs 600 kilograms and uses an imaging infra-red seeker to identify and track its target.[5] The SC-19 likely has a range of around 1,000 to 1,500 kilometers in altitude, making it potentially effective against most low Earth orbit satellites.

China has tested the SC-19 system multiple times. On July 7, 2005, the system was tested without a known target, likely to demonstrate the performance of the rocket.[6] On February 6, 2006, the system was tested again, this time with the interceptor passing near a satellite target without striking it.[6] It is unknown if a close approach or collision was intended. On January 11, 2007, China tested the SC-19 again, this time deliberately hitting and destroying one of its own aging weather satellites at an altitude of 865 kilometers.[7] The collision created more than 3,000 pieces of trackable space debris (defined as larger than 10 cm in size) which are expected to remain in orbit for decades.[8]

On January 11, 2010, China conducted a test of what Chinese officials called a "ground-based midcourse missile interception technology" against a ground-launched ballistic missile target, an event confirmed by the U.S. military.[9] A classified U.S. State Department cable made public by Wikileaks indicates that the U.S. military believed the test to be of the SC-19 system.[10] On January 27, 2013, China conducted what officials called a mid-course missile interception test similar to the test conducted on January 11, 2010.[11] This has led to speculation, but not outright confirmation, that this was yet another test of the SC-19 ASAT system.

Image of the January 2010 test (Xinhua)

A New ASAT Capability in GEO?

Little information is known publicly about a direct ascent system referred to by some as the Dong Neng 2 or DN-2 ("Kinetic Energy").[12] It could be based on the DF-21 MRBM or DF-31 intercontinental ballistic missile (ICBM), potentially using a kick motor.[13] If so, it would have a much greater range than that of the SC-19, potentially able to reach geostationary Earth orbit (GEO) near 36,000 kilometers, while still being mobile. Alternatively, it could be based on one of China's space launch vehicles, although this would have the disadvantage of requiring launch from one of their space launch complexes. Either rocket could theoretically use the same KKV as that used on the SC-19, or potentially a new KKV derived from China's original anti-ballistic missile program started in 1964.[14]

On May 13, 2013, China launched a rocket from the Xichang Satellite Launch Center in Sichuan Province in south-western China. The Chinese Academy of Sciences stated that it was a high-altitude scientific experiment that reached more than 10,000 kilometers in altitude before releasing a canister of barium powder.[15] A spokeswoman for U.S. Strategic Command stated that they tracked the launch on a ballistic trajectory "nearly to geosynchronous Earth orbit" and that while the U.S. military tracked several objects from the launch, they all re-entered over the Indian Ocean.[16] Unnamed defense officials said that the launch was the test of a new ballistic missile which could be used in a future ASAT system that would be capable of reaching high altitude satellites.[17]

Timeline of Known or Suspected Chinese ASAT Test in Space

Date	ASAT System	Target	Altitude Reached	Result
Jul. 7, 2005	SC-19[9]	None known	Unknown	Likely rocket test
Feb. 6, 2006	SC-19[9]	Unknown satellite[6]	Unknown	Likely flyby of orbital target[6]
Jan. 11, 2007	SC-19[9]	FY-1C satellite[7]	865 km[7]	Destruction of orbital target, 3,000+ pieces of orbital debris[7]
Jan. 11, 2010	SC-19[9]	CSS-X-11 ballistic missile[9]	250 km[9]	Destruction of target, no orbital debris[9]
Jan. 20, 2013	Possibly SC-19	Unknown ballistic missile[10]	Unknown	Destruction of target, no orbital debris
May. 13, 2013	Possibly DN-2	None known	10,000[13] to 30,000 km[14]	Likely rocket test

Endnotes

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