

## “HIT-TO-KILL” AND THE THREAT TO SPACE ASSETS

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Discussions about anti-satellite (ASAT) weapons often emphasize the motives for attacking space assets and the likely implications of doing so. Such discussions may overlook the role that technological factors play in the development of new military capabilities, as well as obscure measures that might be useful in managing the spread of such capabilities.

Although discussions about ASATs often focus on a variety of capabilities including direct-ascent weapons, lasers and microsatellites, the principal threat to satellites arises from missiles that use their kinetic energy to destroy an object in orbit—a technology called “hit-to-kill.”

I want to argue for three premises. First, once uncommon hit-to-kill technologies are now at the early stages of spreading around the world. Second, the broad focus on space weapons and ASAT technologies, many of which are quite unrealistic and exotic, distracts from the technological challenge posed by the proliferation of hit-to-kill systems. Third, partial arms control measures, such as a ban on kinetic ASAT testing, may mitigate the most threatening aspects of hit-to-kill technology while avoiding some of the difficulties associated with more comprehensive agreements.

### THE SPREAD OF HIT-TO-KILL TECHNOLOGIES

China’s January 2007 ASAT test was very different from the Soviet ASAT system tested during the Cold War. The Soviet system was a co-orbital anti-satellite that gradually manoeuvred into the same orbit as the target satellite, destroying it with a explosive charge.

The Chinese system, in contrast, used a technology similar to US ASAT and missile defence programmes where an interceptor strikes a target, using the kinetic energy of the impact to destroy the target. This was a tremendous technological achievement—only a few decades ago, hit-to-kill technologies were seen as extremely exotic.<sup>1</sup>

My account of the Chinese test is based on open source accounts largely provided by the US intelligence community, which US policy makers believe successfully monitored the development of the Chinese system.

Shortly after the test became public, National Security Council spokesman Gordon Johndroe told reporters the ASAT test used “a ground-based medium-range ballistic missile” that might have been a DF-21 (known to NATO as the CSS-5) or another missile developed specifically for the mission.

According to the National Air and Space Intelligence Center, the DF-21 has a range of about 1,800km with a 600kg payload.

We have very little information about the kill vehicle itself. Geoffrey Forden at the Massachusetts Institute of Technology has calculated that the mass of the kill vehicle, payload fairing and whatever structure held the interceptor to the missile was less than 600kg, possibly much less.

Given the challenges associated with hit-to-kill interception, Forden believes that the Chinese system would have used an optical tracking system to guide the kill vehicle to its target. Assistant Secretary Paula DeSutter stated that two previous Chinese ASAT tests did not result in an intercept. In earlier Chinese tests, the interceptor may have merely flown by the target, which may have been used to test the optical tracking system.

The target was FY-1C, an obsolete meteorological satellite launched by China in 1999. The satellite was typically in an 870km sun-synchronous orbit.

The intercept occurred approximately 700km north by northwest of the Xichang Satellite Launch Centre at 22:26 GMT, 11 January 2007. The satellite was travelling in excess of 7km/s; the interceptor at nearly 2km/s. The closing speed, therefore, would have been in excess of 8km/s.

The technology associated with the Chinese ASAT system is essentially similar to the technology that the United States has pursued for its ASAT and missile defence programmes. These programmes include the Ground-Based Midcourse Defense system in Alaska, which has not yet been declared operational. Although the Chinese and US systems have very different missions, the underlying technologies are identical. In 1999, John

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Peller, then programme manager for what was called the National Missile Defense programme at Boeing, testified before the US Congress that the US anti-satellite and missile defence programmes used “the same type of vehicle, same type of intercept velocities.”

Moreover, the United States and China are not the only countries developing hit-to-kill technology. In November, India used a kinetic interceptor mounted on a Prithvi missile to intercept another Prithvi missile at 50km. India’s Defence Research and Development announced the test as the first step in developing an exoatmospheric interceptor. Although India’s kill vehicle intercepted the Prithvi at a much lower closing speed than the Chinese or US interceptor, if India were to develop a more capable interceptor and mate it to the Agni missile, it would be a system essentially similar to the Chinese ASAT. In addition to China, India and the United States, many US allies including Israel, Japan and our European partners are conducting research on hit-to-kill technologies in the context of cooperative missile defence programmes with the United States.

Interest in kinetic technologies in China, the United States and other states reflects a basic interest in developing a militarily relevant technology, but it is a technology in search of a mission. In the United States, we have variously emphasized ASAT missions and missile defence, moving money between programmes as our rationale evolved. Missile defence supplanted ASAT missions as the primary use of hit-to-kill technologies, in large part because of the debris risk that exoatmospheric kinetic intercepts might pose to US assets.

Whereas the United States has emphasized missile defence, it is understandable that China has emphasized ASAT applications that might be used to counter space-based components of a US missile defence system. It is possible that states such as India and Israel will reposition their hit-to-kill capabilities for ASAT missions.

Discouraging states from investing in kinetic technologies may be very difficult because many will want to master an advanced military technology, if only to understand how to counteract it.

### FOCUSING ON THE THREAT FROM HIT-TO-KILL TECHNOLOGIES

Despite provocatively named programmes and the enthusiasm of a few die-hards, the United States is not moving to develop space-based strike weapons or destructive ASAT weapons. In any case, the technical and operational challenges facing the current Ground-Based Midcourse Defense system suggest that the United States remains very far from deploying space-based missile defence interceptors.

Moreover, few countries are interested in developing ASATs. In the most recent assessment for the US Congress, the Defense Intelligence Agency concluded that only China and Russia are likely to invest in ASAT weapons due to the financial and technical barriers.

However, some countries, including China and the United States, are developing hit-to-kill programmes that could support ASAT programmes. These technologies will largely threaten reconnaissance satellites in low Earth orbit. The most valuable assets—for navigation, communications and missile warning—are at much higher altitudes, between 20–40,000km and will remain invulnerable for a somewhat longer period.

If we change the way we think about this problem to emphasize the spread of hit-to-kill technology and the challenges it poses, I think the challenge facing the international community becomes much more straightforward. The spread of such technologies could result in very destabilizing relationships among states with nuclear weapons and space assets—a dynamic that I worry is emerging between China and the United States.

An effective US missile defence system would be destabilizing if Chinese leaders were to worry that defences would be used to shield the United States in the event of a strike against China. Similarly Chinese ASATs would be destabilizing if US leaders believed they were part of a strategy to blind the United States at the onset of a crisis.

The US military will not respond to the Chinese ASAT test by developing its own ASATs or emphasizing defensive measures. I believe the primary result of the deployment of a significant number of capable ASAT weapons would be to press the United States further toward pre-emptive strategies. General Cartwright, head of US Strategic Command, recently stated quite clearly that the United States did not need to respond “in space” to the Chinese

test, but rather discussed using conventionally armed Trident missiles to strike launch facilities in China in a crisis.

This opens the possibility of a very dangerous escalation scenario—indeed, unclassified descriptions of US wargames suggest that efforts to mount a limited conventional strike against Chinese ASATs in an effort to discourage escalation may actually further escalate a crisis.

A second, less dramatic, but perhaps more everyday threat from the development of ASAT weapons is the opportunity cost. This is to say that efforts to mitigate the creation of debris, control traffic and manage the development of other space activities will be much harder to manage in a situation where states are pursuing ASAT weapons. Although China and the United States are central actors in this scenario as well, our colleagues in India, Russia and other states have a role to play in building a more stable, orderly environment in outer space.

Emphasizing space weaponization or other ASAT technologies distracts from the principal threat posed by the spread of hit-to-kill technologies—crisis instability—which will initially manifest itself the relationship between Chinese and US strategic forces.

### RESTRICTING ASAT TESTING?

Several partial measures have been proposed which would mitigate the danger to space assets from the spread of hit-to-kill technology without attempting to prevent what appears now to be an inevitable development in military affairs.

- One proposal, under discussion at the Union of Concerned Scientists, is a ban against debris-creating kinetic energy tests, which would limit hit-to-kill testing against sub-orbital objects.
- A second proposal, raised initially by Donald Hafner and Bhupendra Jasani in the late 1980s, would be to ban “high-altitude” ASAT testing.<sup>2</sup>
- A third proposal, by Geoff Forden, would place limits on the speed at which one object in orbit may approach another.<sup>3</sup>

These proposals might not eliminate latent ASAT capability, but they could improve the security of the most vulnerable assets—reducing the escalatory

potential of any Chinese–US crisis. An agreement would very likely require a parallel discussion between Washington and Beijing on broader issues concerning the relative impact of strategic modernization programmes in both states.

These agreements have three other practical advantages that are worth considering:

- First, each proposal avoids the problem of restricting US missile defence programmes. Just as ASAT technologies were once seen as a way to circumvent the now-defunct ABM Treaty, prevention of an arms race in outer space (PAROS) negotiations have become seen in the United States as a way to resurrect the ABM Treaty and block the deployment of missile defences. Although I believe the United States should take steps to address concerns among China’s leaders about our missile defence programmes, using PAROS as an agenda item is likely to result in agreements on neither the military uses of outer space nor missile defence.
- Second, a ban on debris-creating ASAT tests would be verifiable without intrusive measures. Indeed, US policy makers believe that the US intelligence community was able to monitor the development of China’s ASAT programme quite effectively.
- Third, a ban on debris-creating ASAT tests avoids thorny problems of definition that emerge when we conceive of the problem much more broadly.

Although such an agreement resembling one of the proposals listed here would do little to address the underlying security dynamics that often prove decisive in such matters, even a partial agreement would initiate the process of dialogue upon which we could work together to build a more sustainable space environment, perhaps in the form of a code of conduct or “rules of the road”.

## Notes

<sup>1</sup> This section is based on Geoffrey Forden, “An Analysis of the Chinese ASAT Test”, *Jane’s Intelligence Review*, April 2007.

<sup>2</sup> Donald Hofner and Bhupendra Jasani, “An Arms Control Proposal Limiting High-Altitude ASAT Weapons”, in John Holdren and Joseph Rotblat (eds),

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*Strategic Defenses and the Future of the Arms Race: A Pugwash Symposium*, MacMillian Press, 1987, pp. 226–39. See also Ashton Carter, “Satellite and Anti-Satellite: The Limits of the Possible”, *International Security*, Spring 1986, pp. 46–98.

- <sup>3</sup> Geoffrey Forden, “After China’s Test: Time For a Limited Ban on Anti-Satellite Weapons”, *Arms Control Today*, April 2007, pp. 19–23.