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The US-China Reconnaissance-Strike Competition: Anti-Ship Missiles, Space, and Counterspace

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This research brief examines strategic competition between China and the United States in the fields of missiles, space, and counterspace. In particular, it looks at Chinese military advances in anti-ship missile (ASM), space, and counterspace technologies and the response of the US military to these developments. China and the United States find themselves in a security dilemma characterized by a competition that could easily turn into an arms race. Both sides have developed new operational concepts and are emphasizing joint, networked approaches to command, control, communications, computers, intelligence, surveillance, and reconnaisance (C4ISR); investment in technologies and new organizations to ensure the survivability of space capabilities; and development of counterspace capabilities to deny the other side the use of space.

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INTRODUCTION

China and the United States are in a security dilemma characterized by an arms competition in space, counterspace, and missile technologies that shows the early signs of turning into an arms race. This "reconnaissance-strike competition" represents a move away from platform-centric warfare to missile-centric and space warfare. The emerging competition is characterized by an action-reaction dynamic in which both the United States and China are developing new operational concepts, establishing new organizations to lead space operations, investing in long-range ASMs, and developing operationally responsive capabilities to deny each other the use of space.

This competition imposes both operational and budgetary costs on the US military. Operationally, the US Navy has had to change its surface fleet concept of operations from land attack to naval warfighting with a focus on long-range ASM and counter-C4ISR capabilities. The US Air Force, which once regarded space as a sanctuary, is now developing a concept of operations to "fight through" attacks on space assets. In terms of budget, in the current era of static or shrinking defense budgets, the need to develop technologies to carry out these new operational concepts requires a reprioritization of US Department of Defense (DoD) funding that will inevitably take away from other priorities.

CHINA'S PROGRESS IN SPACE AND COUNTERSPACE

To build up a C4ISR system capable of supporting long-range precision strikes, China's military is developing capabilities to provide an operationally responsive space force that provides access to space while at the same time denying space capabilities to adversaries.

To better integrate space capabilities with its operational forces, in 2015 the Peoples' Liberation Army (PLA) created a new organization, the Strategic Support Force (SSF), to conduct space operations. Although little official information on the SSF exists, its purpose appears to be to enable the PLA to better use the C4ISR aspects of space to foster joint operations. This includes leading China's space launch centers, satellite control centers, and at least some of the PLA's intelligence organizations.

Operationally Responsive Space

"Operationally responsive space" is a US concept that involves assurance of capabilities and timely delivery. This includes reconstitution of lost capabilities, quickly filling unanticipated gaps, exploiting new technical or operational innovations, and enhancing the survivability of space systems.

To achieve such a capability, China is developing a variety of systems to launch satellites into all orbits and to rapidly reconstitute or "plus up" satellite constellations. This includes a new generation of liquid-fueled rockets and road-mobile solid-fueled rockets that can launch satellites from expedient sites.

China is also deploying a diverse set of remote sensing satellites with a variety of sensors and imagery resolutions that can image targets during the day, at night, and during inclement weather. This includes micro- and nano-satellites that can be launched more quickly than their larger, more capable counterparts to replace destroyed satellites or fill in coverage gaps. The Chinese global satellite navigation network Beidou, similar to GPS, will provide positioning, navigation, and timing functions.

Counterspace

China is also developing a wide range of counterspace technologies to threaten adversary satellites and support infrastructure from the ground to geosynchronous orbit. Its most prominent counterspace technologies appear to be direct-ascent kinetic-kill vehicles. China has also performed close proximity operations where one satellite bumped into another and has conducted tests in which one satellite equipped with a robotic arm closed with and grappled another satellite.

China is also developing directed energy weapons such as lasers that can temporarily or permanently blind the imagers on remote sensing satellites or damage other components. It has the ability to jam satellite communications and GPS signals. Finally, China is believed to have conducted cyber operations against US space facilities. These include a 2012 attack against NASA's Jet Propulsion Laboratory that is assessed to have enabled the perpetrator to achieve full control over the lab's networks and a 2014 attack against the National Oceanic and Atmospheric Administration that resulted in an outage of meteorological coverage.

THE US MILITARY'S RESPONSE TO CHINA'S SPACE PROGRAM DEVELOPMENT

China's development of operationally responsive space and counterspace capabilities has generated a counter-response from the US military. The five-part strategy involves: 1) enhancing the resiliency of satellites; 2) developing counterspace technologies; 3) improving space battle management/command and control; 4) partnering with allies; and 5) exploiting commercial space capabilities.

Enhanced Resiliency

The DoD is moving toward more resilient systems and system architectures that employ a multi-layered approach to deter attacks on space systems by making satellites harder to locate and destroy. This includes the use of different orbits, mobility, deception, and distributed architectures; for example, breaking up capabilities across a large number of smaller satellites instead of concentrating them into a small number of larger satellites.

Counterspace

Little information is available on what, if any, counterspace technologies are being developed by the United States, but the US government is increasing the budget for space protection activities by $5 billion over the next five years, including $2 billion for space control.

The United States has developed a number of related technologies in the past that provide it with a latent counterspace capability. For example, in 1985, the US Air Force destroyed a retired satellite with a missile launched from an F-15 fighter. The United States again demonstrated direct-ascent technologies in 2008 when it used a modified SM-3 missile interceptor to destroy an errant satellite. In 1997, the United States tested a high-powered laser against a satellite, simulating both inadvertent lasing and a hostile attack.

The United States has also tested co-orbital capabilities. In 2005, the United States launched the XSS-11 satellite to test on-orbit servicing and maintenance.

Improved Battle Management/ Command and Control (BMC2)

The US military has made a major structural change in its BMC2 architecture to allow it to "fight through" attacks on space assets. It created the Joint Interagency Combined Space Operations Center in October 2015, as an "experimental platform" to test how to provide space-based support to warfighters while under attack. The goal is to clarify division of mission responsibilities between the military and the intelligence community in case of a "space war."

International Partnerships

The United States is partnering with other countries to add redundancy and resiliency to its systems. Japan and the United States have agreed to "strengthen the resilience and interoperability of critical space systems" such as space-based positioning, navigation, and timing; space situational awareness; and the use of space for maritime domain awareness. The United States is also cooperating with Australia on military-related space projects. The United States relocated a telescope to Australia that can observe objects in space out to 36,000 km and search an area the size of the United States in seconds. The United States will also relocate a C-band space surveillance radar to Australia that can identify objects in low Earth orbit and track up to 200 objects a day.

Commercial Capabilities

To further increase redundancy, the DoD is looking to commercial space providers for low-cost rockets and smaller, but increasingly capable, satellites. For example, the DoD is reaching out to Terra Bella, a manufacturer of small satellites with a mass of less than 100 kg, to provide still and video images with resolutions better than 90 cm. The DoD is also reaching out to Planet, another manufacturer, which is planning a constellation of 150 miniaturized satellites to continuously image the Earth with resolutions of 4 to 5 meters, providing a continuous and near real-time catalog of changes on the Earth's surface.

CHINA'S PROGRESS IN ASM TECHNOLOGIES

China's improved space-based C4ISR system is intended to support its increasingly capable arsenal of anti-ship ballistic and cruise missiles. The PLA has fielded the world's first anti-ship ballistic missile (ASBM) with a range of 1,500–2,000 km, giving it the ability to attack ships east of Taiwan. The PLA has also developed the DF-26, which is reported to include a naval attack variant. With a range of 3,500–4,000 km, the DF-26 can be used to strike targets as far away as Guam.

In addition, China is developing a large inventory of long-range anti-ship cruise missiles (ASCM), some capable of reaching supersonic speeds, that can be launched from a variety of air, surface, and subsurface platforms. Each major PLA Navy surface combatant, for example, is equipped with ASCMs, and more than half of the PLAN's submarine force is capable of firing ASCMs.

US DEFICIENCIES

China's growing inventory of ASMs presents a number of challenges to the US military. These include insufficient numbers of ASCM-capable ships, missiles, and missile interceptors; an inability to target supersonic missiles; the shorter ranges of US missiles; and a cost ratio that favors offensive over defensive systems.

The US military is outgunned by the PLA when it comes to numbers of ASCMs and ASCM-capable ships, giving the PLA the ability to suffer a higher number of losses yet still come out victorious. According to a 2012 study of one conflict scenario, the PLA Navy could deploy up to 80 ASCM-capable ships against the 50 ASCM-capable ships available to the US Pacific Fleet. This disparity in ships is exacerbated by the total number of ASCMs available to each side: the US Pacific Fleet possesses 280 Harpoon ASCMs, or just 40 percent of the PLA Navy's ASCM inventory.

Moreover, current US missile defense systems lack the technological sophistication to adequately counter China's ASCMs. ASCMs can travel just meters above the water surface, not only below air defense radars, but also below the minimum vertical range of air defense missiles. Some Chinese ASCMs can close in on their target at supersonic speeds and make 10g turns to evade defenses. The Vulcan Phalanx 20-mm cannon point defense system deployed on US Navy ships cannot effectively track missiles performing evasive maneuvers at supersonic speeds.

US efforts are further complicated by the relatively short range of US air and missile defenses when compared to the range of Chinese missiles. Chinese ASBMs can be fired from well within Chinese territory, out of range of most US attack platforms and well protected by Chinese air defense systems. Moreover, the longer range of Chinese ASCMs gives PLA Air Force and PLA Navy aviation units the ability to launch their missiles from beyond the defensive ranges of US military air defense systems. In addition, because most China ASMs have a greater range than the US Harpoon does, Chinese ships can fire in relative safety from distances well beyond the range of US surface-fired ASCMs.

The final challenge for the US military is cost. The SM-3 and SM-6 interceptors used for missile defense on US ships have a unit cost of approximately $10 million and $4 million, respectively. Although costs for Chinese missiles are unknown, they are likely to be much less than one SM-3 or SM-6, making it much more expensive for the United States to defend its ships than for China to attack them. Because these missile defenses are not 100 percent effective, several missiles may be required to defeat each incoming Chinese missile, potentially raising the cost of defeating each Chinese missile into the tens of millions of dollars.

THE US MILITARY RESPONSE

The DoD recognizes the challenges posed by China's missile developments and has begun to address them. The first step taken by the US Navy has been to redress its surface fleet doctrine. "Distributed lethality," the Navy's new concept of operations for its surface fleet, has the goal of making "every ship a shooter." It re-emphasizes offensive action and increases surface force lethality. This change in doctrine is intended to cause the adversary to shift its defenses to counter US Navy actions and to complicate targeting by an adversary.

The US Navy is also modifying existing weapons to provide near-term offensive and defensive operations and developing new, potentially revolutionary weapons. Some of the modifications will address the disparity in ranges between Chinese and US ASCMs. The SM-6 missile, originally designed for defense against aircraft and cruise missiles, has been enhanced with maritime strike and ballistic missile defense capabilities. This will give US ships two types of interceptors, and thus increased numbers, able to defend against ballistic missile attacks: the SM-3 to strike missiles during their mid-course phase and the SM-6 as a terminal phase defense system. The modification of the SM-6 missile to have a maritime strike capability provides additional flexibility, and its 370 km range and speed of Mach 3.5 will allow it to strike targets at greater ranges and speeds than the Harpoon ASCM.

The US Navy will also modify 245 Tomahawk land attack cruise missiles to have a maritime attack capability. This upgrade will allow the Navy to target ships at ranges up to 1,852 km, well beyond current Chinese ASCM range. The US military is also developing the Long Range Anti-Ship Missile, with a range of 926 km and a 1,000 pound warhead.

Finally, new missile defense technologies will help the US Navy defend its ships against the Chinese ASM threat. Recognizing the limitations of its point defense system against cruise missiles, the Navy is working to replace its Vulcan Phalanx system with the SeaRAM, an anti-ship missile defense system that uses missiles instead of cannon to intercept incoming cruise missiles, including high-performance, supersonic cruise missiles.

The United States is also developing a number of potentially revolutionary missile defense systems. These include lasers, electromagnetic rail guns (EMRG) that use electromagnetic pulses to fire projectiles at speeds up to Mach 6 and ranges of up to 177 km, and hypervelocity projectiles (HVP) that can be utilized either in rail guns or the traditional 5-inch and 155-mm powder guns found on US naval ships.

Laser, EMRG, and HVP will help the US Navy solve its inventory deficit and cost ratio challenges. Lasers can be fired at a cost of less than $1 per shot and can be fired indefinitely as long as the ship can generate electricity. HVP can be stored by the hundreds on ships at a unit cost of about $25,000, compared to the multi-million-dollar cost of the SM-3 and SM-6 missiles.

CONCLUSION

The strategic competition between the United States and China is intensifying on the seas and in space. US responses to Chinese advancements in space and counterspace include enhancing the resiliency and redundancy of its satellite networks by partnering with allies and exploiting commercial space capabilities; developing space control technologies; and improving space battle management/command control. US responses to the Chinese ASM threat include modifying existing missile and missile defense technologies and the development of new missiles and radical new missile defense technologies that will help the US Navy better defend its ships against the Chinese ASM threat at a lower cost.

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