Space Control

This essay focuses on the current fixed surveillance sensor capabilities of the United States. It examines the three mediums of space surveillance—active, passive, and electro-optical (EO)—and their applications and deficiencies.

The following looks at lethal and nonlethal counterspace missions in support of national security or combat operations. It concludes with a discussion of the advantages of mobile surveillance systems and looks at how both fixed and mobile systems support the function of space control for both defensive and offensive counterspace operations.

Why Space Control?

President Dwight D. Eisenhower's Open Skies doctrine set the stage for US space policy. The fear of a nuclear surprise attack on the United States by the USSR drove the United States to acquire reconnaissance information on the activities of the Soviet military. The Eisenhower administration saw the benefit of launching satellites for scientific and military purposes as a means of obtaining information. President Eisenhower's proposal for the concept of freedom of space for all nations for satellite overflight of sovereign countries is analogous to freedom of the high seas.

The Soviets rejected Eisenhower's Open Skies doctrine as a means for both countries to reduce the fear of a surprise attack through the use of both aerial and orbital space systems.[1] Ironically, the Soviets validated the Open Skies doctrine and the concept of freedom of space by launching Sputnik I over international borders without provoking international protests.[2] The Soviet's sputniks and American Explorer and Vanguard launches set the stage for the claim to ownership of military space systems by any country with a space launch capability. The Open Skies doctrine provides the US access and use of space while at the same time allowing the overflight of foreign satellites above the United States. The US established the Space Surveillance Network to monitor the orbits of satellites.

The need to maintain a surveillance system capable of detecting, tracking, and identifying man-made orbiting objects became apparent with the growing use of space by the US and other countries. The surveillance system produces a real-time stellar map of man-made objects orbiting the earth. This system can detect the movement and breakup of satellites. The system also considers whether the changes in a satellite's movement are threatening to the United States or allies.

National Space Policy (NSP), 19 September 1996, details the importance of space to US national security. The NSP focuses on the use of space to strengthen national security and establishes principles governing space activities for military space operations.[3] The *National Space Policy* provides specific guidance for military space operations for national security:

> The United States will conduct those space activities necessary for national security. National security space activities shall contribute to U.S. national security by: (a) providing support for the United States' inherent right of self-defense and our defense commitments to allies and friends; (b) deterring, warning, and if necessary, defending against enemy attack; (c) assuring that hostile forces cannot prevent our own use of space; (d) countering, if necessary, space systems and services used for hostile purposes; (e) enhancing operations of U.S. and allied forces; (f) ensuring our ability to conduct military and intelligence space-related activities; (g) satisfying military and intelligence requirements during peace and crisis as well as through all levels of conflict; (h) supporting the activities of national policy makers, the intelligence community, the National Command Authorities, combatant commanders and the military services, other federal officials, and continuity of government operations.[4]

The *National Space Policy* further defines and directs implementation of the following actions for space control:

> 1. Consistent with treaty obligations, the United States will develop, operate and maintain space control capabilities to ensure freedom of action in space and, if directed, deny such freedom of action to adversaries. These capabilities may also be enhanced by diplomatic, legal or military measures to preclude an adversary's hostile use of space systems and services. The U.S. will maintain and modernize space surveillance and associated battle management command, control, communications, computers, and intelligence to effectively detect, track, categorize, monitor, and characterize

> threats to U.S. and friendly space systems and contribute to the protection of U.S. military activities.
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> 2. The United States will pursue a ballistic missile defense program to provide for: enhanced theater missile defense capability later this decade; a national missile defense deployment readiness program as a hedge against the emergence of a long-range ballistic missile threat to the United States; and an advanced technology program to provide options for improvements to planned and deployed defenses.[5]

The establishment of a robust operational space control infrastructure is the primary task for space operations organizations. An analogy can be drawn between the need for space control and the need for air superiority. When the United States needs to establish air superiority over a specific location, US air forces inhibit or destroy an enemy's capabilities at a time and place of its choosing.[6] A country can attain space control in the same manner except the country does not need to gain control of any adversary air space. The advantage of space control over air superiority is that space control can provide the quickest means to target an enemy's vital centers of gravity without putting pilots and aircraft in harm's way. Space control provides the means of denying an enemy vital information—thus causing friction and increasing the fog of war.

Space control is a valuable asset at any level of the conflict. In wartime, space control can deny any enemy the benefits of weather, navigation, surveillance or warning, reconnaissance, and multispectral imagery data, as well as degrading enemy capabilities to effectively conduct air, land, and sea operations. In peacetime, space control provides a level of deterrence and insurance for terrestrial operations by US forces, allies, and friends. The potential threat of the United States denying a country access to space and the knowledge that the United States will not stand by while attempts are made to deny the US access or use of space are the stabilizing factors of space control.

Space control consists of three elements: surveillance, protection, and negation. Surveillance systems provide the capability to detect, track, and identify orbiting objects and indicate whether the object is a possible threat. Satellite protection ensures that friendly space systems are safe to operate while under attack. Space control negation consists of defensive and offense space operations. Defensive operations can range from confusing or deceiving an enemy about the reliability of his space systems to direct actions against an enemy's ability to deny the use of space by friendly forces. Offensive space control operations use either lethal or nonlethal weapons against an enemy to deny access or use of space systems.

The selection of lethal or nonlethal weapons will impact users of orbiting space systems. Antisatellite (ASAT) capabilities include all weapons, technology, and techniques that can disable, damage, or destroy an on-orbit satellite system.[7] Deploying a US ASAT system to interdict an enemy's ASAT system is an example of using a lethal space control weapon. A major drawback of lethal weapons is that they leave debris in orbit. This debris creates a hazardous area in space for a undetermined period of time and sends small fragments speeding in multiple directions, possibly on intercept paths with other satellites. The use of a destructive lethal space weapon will inhibit not only enemy but also friendly access to space.

The use of nonlethal space weapons provides the greatest flexibility for negating an enemy's space systems. The options could range from destroying ground control stations, jamming an enemy's up-link frequencies, to targeting the specific sensor package on the satellite.[8]

The use of space by other countries and international organizations has steadily increased over the past 30 years. The need to establish and maintain control of space at any time or global location is fundamental in meeting US national security objectives.

New World Threat

In the past the United States focused on the USSR for threats to space systems. While the United States focused on Soviet activities, other countries made rapid gains in the ability to launch satellites into space. The two areas the United States has not monitored closely enough are developing countries' space and missile programs and the transfer of missile technologies to emerging countries.

The second area lacking US attention has been the transfer of technology between countries either by sales or assistance. When the Soviet Union disintegrated, technology and personnel quickly spread among the independent republics of the Commonwealth of Independent States (CIS). The desire of a country to possess an ASAT system may not be based on political objectives, but may be driven by economic shortfalls. Future mercenaries will hold advanced technical degrees and wear white lab coats. To fuel the economies of their respective republics, scientists and technicians will be available to the highest bidders.

The ever-growing number of space lift vehicle (SLV) programs will continue to fog the source of threats to US space systems. The future ASAT threat will proliferate proportionally with the number of countries with space launch capabilities.

The growing number of space users has changed the direction of possible threats from bipolar to multipolar. Some countries may not use space for peaceful purposes. The current objective for certain emerging countries is the development of their own observation or imagery sensoring satellites. During the Gulf War, the United Nations (UN) imposed a data information embargo against Iraq for having purchased data from France and Russia. Since the end of the Gulf War, three emerging countries began or have planned to develop observation or sensoring satellites. This development may or may not be the result of a UN embargo on the transfer or sale of satellite imagery from France and Russia during the Gulf War, but it is clear that a number of countries will still have access to the same type of information that was available under the old Soviet regime.[9] A future number of space users will be willing to attack US, allied, or friendly countries' satellite systems, not out of specific national objectives, but as a regional show of force. The United States must be ready and willing to deter this form of space piracy.

Today's Space Surveillance Network

The US Space Surveillance Network (SSN) consists of a worldwide sensor system consisting of dedicated, collateral, and contributing sensor systems. The sensors of the SSN monitor the near-, medium-, and deep-space orbits around the earth.

The sensors receive their individual taskings from the Space Surveillance Center (SSC) in Cheyenne Mountain, Colorado to track or search for orbiting objects of interest. The SSC is responsible for maintaining and cataloging all orbiting man-made objects in space. The SSC tasks the SSN sensors to monitor and process the data collected and report their findings via data links to the SSC. The information collected by the SSN and processed by the SSC is critical, especially when changes in a satellite's orbit may put other satellites in harm's way.

The surveillance system has three types of tracking systems—active radar systems, passive radio frequency (RF) systems, and electro-optical systems. Each of the sensor systems provides unique information on orbiting objects. The different SSN sensors enhance the space control capability of the United States by providing the flexibility to monitor and predict actions in space which may affect US national security objectives.

Active Sensors

Active radar sensors track all types of objects, such as active satellites, rocket bodies, and debris. They can determine movement of objects day or night and in all types of weather. There are two types of active sensors—mechanical and phased array. Each type has specific advantages for space surveillance.

Mechanical radar provide the best data on small objects because they have a focused beam of radar against the object in track. The data provides a highly accurate definition of the object's physical characteristics. Unfortunately because of the tight radar pattern, mechanical radars take longer to scan and detect objects. This type of search and tracking is analogous to using a high-powered flashlight to find a single person in a stadium instead of using an array of flood lights to accomplish the same task.

Phased array radars can track individual objects, or track multiple objects simultaneously. An additional advantage of phased array radars is their ability to project their radar in specific patterns to optimize detecting objects of interest in specific orbits. A prime example is the tracking of multiple objects from a satellite breakup. This tracking allows for a “quick look” of the orbit of the debris to predict changes in the orbit of each object. In the simplest definition, the active radars are the eyes of the surveillance network.

Passive Sensors

Passive RF sensors detect, track, and discriminate active emitting satellites. These sensors can scan the space environment more quickly than radar systems and provide the fastest means to identify a specific satellite or to determine the operational status or changes in the orbit of a satellite. Passive sensors can provide the quickest means to track and monitor new foreign launches, because they are able to detect the telemetry signal while the payload is still in its initial launch orbit.

In the same manner as new launches, the passive sensors can determine the change of location a satellite has in reference to the earth. This function is critical for satellites in geosynchronous orbits where optimal locations in reference to the position over the equator are limited.

The operating principle is the same as searching through a radio band to find a specific station. The disadvantage is that passive RF sensors can track only objects with active emitters. When a satellite is turned off, passive sensors are deaf to the orbit of the satellite. Passive sensors are the ears of the SSN.

Electro-Optical Sensors

Electro-optical sensors use computer controlled and enhanced optical telescopes to detect, track, and identify orbiting objects. The sensor is similar to astronomical telescopes. These sensors observe both starlight and the light reflected from orbiting objects. The sensor’s computers remove the starlight from the field of view, leaving just the reflective images of orbiting objects.

Early in the space shuttle program, an electro-optical sensor in Hawaii was tasked to determine if any of the critical heat resistance tiles fell off the shuttle during the launch. Within minutes of the overhead pass, the sensor's operators accomplished a visual inspection of the shuttle's underside, then they passed the information to shuttle engineers for evaluation. The sensor's actions were critical in determining the risk to the shuttle and crew upon reentry. In the role of space control, electro-optical sensors can evaluate and record the physical characteristics of possible coorbital antisatellite platforms.

Geographical location is essential to the performance of electro-optical sensors. Electro-optical sensors are limited to nighttime operation from locations free from both light and atmospheric pollution with clear evening skies.

Drawbacks for Tomorrow

Four concerns may affect the SSN. The first is the location of existing sensor sites which focus on maximizing warning and space surveillance coverage from missile threat. The second concern is the rapidly expanding space and missile programs of other countries. The third concern is the cost of operating fixed overseas locations. The fourth concern is the changes in political relationships between the US and countries hosting permanent fixed sensors. Each concern influences the effectiveness of the United States to project space control.

Space surveillance sensors in their current locations have coverage gaps for orbits originating from locations other than the major global space launch centers. A real possibility exists for a space launch to occur and initially be detected by a space-based ballistic missile warning system. The existing SSN configuration will take time to detect, track, collect, and catalog the orbital characteristics of the object. The sooner the SSN tracks an object, the quicker it can identify the object's orbit and determine the intentions of the satellite owners. This development is critical for future access and use of space by the United States, allies, and friendly countries.

The decreasing military budget and the increasing cost of operating fixed overseas space surveillance sites is a concern to military planners. Cost concerns are in two areas—contractor operations of many of the surveillance sensors and the increasing costs imposed by countries for the right to operate a surveillance sensor in their country. An example of imposed costs is associating the country's inflation rate with labor costs the US pays to native workers. The costing method was driving the yearly cost of operating the FPS-79 surveillance radar in Turkey to increase not by thousands of dollars, but by tens of thousands.

The fourth concern is related to the political cost of operating overseas sites. If a country demands more money than the United States wants to pay, or the political climate in the host country changes, the United States may shut down and remove the sensor system. The withdrawal of the US military from the Republic of Philippines is an example of a host country demanding more payment than the facility is worth. Also, the political changes in Turkey caused the Air Force to shut down the Pirinclik site from 27 July 1975 to 26 October 1978.[10]

Rapid Deployable Space Units for Space Control

In the future, rapid deployable space units (RDSU) can be valuable for space control. Mobile sensor systems can aid the United States to anticipate and respond to threats to space operations. Deployable space surveillance units provide the means to counter the drawbacks of the existing SSN. Mobile surveillance systems can fill the gaps in the existing global surveillance coverage. The RDSUs can support friendly countries as well as the United Nations in establishing a tailored space surveillance network for any launch location.

Mobile systems would not have the same cost and political climate considerations as fixed sensor locations. These self-contained systems can deploy to a location using an agreement from the host country similar to aircraft landing rights. Since the operations and maintenance costs of an overseas location for mobile units are less than for a fixed site, this solution provides a great cost savings.

In peacetime, RDSUs can provide more accurate data than a fixed ground station on orbiting objects in a path of an uncontrolled reentry. The deployment of RDSUs to locations directly under the paths of these objects can provide the data needed to predict the impact locations. As more countries gain the ability to launch systems into space, the odds increase for a disaster from the breakup debris to life and property.

Active and Passive Sensors

Active radar sensors needed the capabilities of both phased array and mechanical radars. The specific data need by either the SSC or Space Defense Operations Center (SPADOC) determines the radar's fence. If an organization requires both a large number of objects and refined data on specific objects, then the Air Force could deploy both active and passive RDSUs. As with ballistic missile warning RDSUs, the space control RDSUs need to be cost effective and optimize operational effectiveness by matching appropriate technology to the mission.

Passive RDSUs should be able to detect any satellite frequency band. This capability provides the flexibility for orbital data requirements from any satellite or satellite constellation. RDSUs need the capability to detect RF emissions from satellites in low, medium, and high earth orbits. RDSUs provide the greatest flexibility and coverage at a cost less than operating fixed locations.

RDSUs can be tailored to meet specific mission requirements. An example is the deployment of both an active radar RDSU and a passive RF RDSU to a friendly country to detect and track possible hostile satellite systems. Having both active and passive RDSU sensors at a specific location increases operational effectiveness for surveillance taskings and provides a single command and control point for the SSC and SPADOC. In this scenario, active and passive sensors provide a better performance than an electro-optical RDSU. Environmental factors are the greatest drawback to establishing EO RDSUs.

Future Rapid Deployable Space Units for Negation and Protection

RDSUs are the most valuable assets the US could use to maintain a peaceful use of space. The US must remember that other countries and foreign organizations have the technological means and the desire to gain a military, political, or economic advantage. The United States needs to establish a flexible and responsive system for space control. Using RDSUs for negation and protection provides a deterrence umbrella to all countries and organizations. The ultimate objective of space control is to deter any actions intended to deny or prevent the US from operating in space.

Inhibiting US space operations is a topic of foreign space experts. In October 1992 Russian Maj Gen Yuri Gusev, deputy commander of space forces in the Russian Ministry of Defense, stated that Russia could maneuver the Mir space station to capture another satellite. "This statement may have been made because of the fear of the US negating CIS or Russian satellite systems. Specifically, the capture of a spy satellite concerned the Russians, since the US has used the space shuttle to retrieve and return orbiting satellites."[11]

Summary

In the future, space control will be vital to ensure that the US has free use and access to space. The success of future terrestrial military operations will depend on the ability of the US to operate in space. Within the next 20 years, the reliance on orbiting space systems will increase for a host of countries.

The United States has established a highly reliable surveillance network to track and monitor satellites and other objects. This network was based upon the cold war need to monitor the space activities of the Soviet Union. With the transfer of technology and the growing number of countries racing to own the capability of launching systems into space, the need to track their launches and satellite systems will be critical to the future operations of US-owned space systems. RDSUs can provide a cost-effective means to complement the existing fixed world-wide space surveillance network. RDSUs can meet the future needs of the United States without having the same economic and political liabilities as the fixed surveillance sites.

Notes

1. During this period, the United States routinely flew the high altitude U-2 reconnaissance aircraft over the Soviet Union to provide information on Soviet military activities. This routine provided the catalyst for establishing the principle of freedom of space in international law for future military satellites. The U-2 flights went unchallenged by the Soviets, except through diplomatic channels, until the downing of Francis Gary Powers by the Soviets on 1 May 1960.

2. R. Cargill Hall, "The Origins of U.S. Space Policy: Eisenhower, Open Skies, and Freedom of Space" (Paper presented to the World Space Congress, Washington, D.C., 3 September 1992), 27.

3. The President of the United States, *National Space Policy,* Fact Sheet on National Space Policy (Washington, D.C.: National Science and Technology Council, 19 September 1996), 4.

4. Ibid., 5.

5. Ibid., 10.

6. AFM 1-1, *Basic Aerospace Doctrine of the United States Air Force,* vol. 1, March 1992, 6.

7. Steven R. Petersen, *Space Control and the Role of Antisatellite Weapons* (Maxwell AFB, Ala.: Air University Press, 1991), 37.

8. Joint Pub 3–14, *Joint Doctrine: Tactics, Techniques, and Procedures, (TTP) for Space Operations,* draft, 15 April 1992, III–16 through III–17.

9. *The Emerging Ballistic Missile Threat to the United States, Report of the Proliferations Study Team* (Washington, D.C.: Government Printing Office, February 1993), 5.

10. *Aerospace Defense: A Chronology of Key Elements, 1945–90* (Petersen AFB, Colo.: AFSPACECOM History Office, October 1991), 46, 49.

11. Vincent Fieman, "Russian Space General: Mir Could Grab Satellites," *Space News,* 19–25 October 1992, 11.