SPACE THREAT WARNING: FOUNDATION FOR SPACE SUPERIORITY, AVOIDING A SPACE PEARL HARBOR

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Disclaimer

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Abstract

Space Superiority is a core task for the USAF, critically enabling US combat operations. As the US becomes more reliant on space-based resources to ensure military and economic success, the need to protect them will increase. A robust space threat warning capability--the ability to detect, assess and respond to hostile actions against space assets--is the foundation for this protection.

Senior leaders in the US government have stated the US must avoid a space Pearl Harbor. This concern is due to the idea that a decrease in the perceived threat to space assets after the demise of the Soviet Union coupled with a competition for space resources has resulted in a corresponding erosion of US space threat warning and attack assessment capabilities.

This paper describes the development and gradual erosion of US space threat warning capabilities, emerging threats, and discusses the implications to national security should the US fail to field a robust space threat warning and attack verification capability. The paper concludes with recommendation to establish a focal point for space defense, institute end-to-end testing of the threat warning process, and to update space threat warning guidance to ensure space is not location of the next “Pearl Harbor.”

Introduction

Space Superiority is a core task for the USAF, critically enabling US combat operations. As the US becomes more reliant on space-based resources to ensure military and economic success, the need to protect them will increase. A robust space threat warning capability—the ability to detect, assess and respond to hostile actions against friendly space assets--is the foundation for this protection.[1]

Leaders at the highest levels of the US government have stated that the United States must avoid a space Pearl Harbor.[2] Some of this concern is due to the idea that a decrease in the perceived threat to our space assets after the break up of the Soviet Union coupled with a competition for space resources has resulted in a corresponding erosion of US space threat warning and attack assessment capabilities.[3]

This paper describes the development and gradual erosion of US space defense threat warning capabilities, potential threats to US space assets, and discusses the implications to national security should the US fail to take corrective action. The paper concludes with actionable recommendations to close these gaps to ensure space does not become the location of our next "Pearl Harbor."[4]

Development and Erosion of US Space Hostile Threat Warning Capabilities

The words space and Pearl Harbor have been used together a number of times over the last 50 years to describe an actual or potential warning failure involving space systems. The first use in 1957 when with the Soviet Union put the first satellite, Sputnik I, in orbit. Nearly a month later, the Soviets followed up with Sputnik II.[5] These launches demonstrated the Soviets had an advanced satellite program and the booster technology sufficient to develop intercontinental ballistic missiles to deliver nuclear warheads from one continent to another.[6] The Sputnik

program surprised the American public so much that it was described as having a “Pearl Harbor” effect that dramatically changed American defense strategy to deal with emerging threats from Soviet bombers, long range missiles and orbiting space vehicles.[7]

Generally, threat-based changes to warning and defense doctrine and the funding to operationalize it required a major catalyst to get the ball rolling. Between 1957 and 1960, the Commander-in-Chief, North American Air Defense Command (CINCNORAD), initiated the process to evaluate missile and space threats and warning requirements in response to the threat posed by the Sputnik launches.[8] This effort ratcheted up after Nikita Khrushchev publicly asserted that Moscow possessed the technology to orbit a space vehicle and then land it on a specific target.[9] In response, the US cobbled together a baseline space surveillance radar system called the Space Detection and Tracking System (SPADATS).[10]

In 1968, Khrushchev’s threat became a reality when the Soviet Union tested and fielded a Fractional Orbital Bombardment (FOB) System. The FOB System was designed to counter our missile warning radars by launching an ICBM into low Earth orbit and later de-orbiting the reentry vehicle and warhead over the South Pole for an attack opposite of where US radars were facing.[11] In 1969, the fielded version went on alert with nuclear devices.[12] In the space warning arena, this development left the US scrambling to field a southern facing radar screen and accelerated development of a space-based launch detection capability.[13]

From 1971 through the 1980s the Soviets upped the ante by testing and fielding a co-orbital anti-satellite weapon (ASAT), ground-based high energy lasers, an anti-ballistic missile system with ASAT capabilities, and satellite jammers.[14] These threats pushed the Department of Defense (DoD) to continue work started in the 1960s by building a global space surveillance network of radar and optical sensors to maintain space situational awareness. The DoD located

the hub of this network, the Space Surveillance Center and Space Defense Operations Center, inside Cheyenne Mountain, Colorado under the control of Air Defense Command.

To date, the high-water mark of US space defense capability probably occurred in the mid-1980s with the formal establishment of the Space Defense Operations Center (SPADOC) with a separate but supporting Space Surveillance Center (SSC). The SPADOC functioned as the sole "focal point for national space defense functions" serving as a fusion center for the space control mission responsible for protecting US and allied space systems.[15] To achieve its objectives, SPADOC monitored and reported unusual space activity, analyzed potential threat attack profiles, determined the time and location of the attack, and identified the space systems under attack as well as the method and type of attack taking place using operator inputs and surveillance data provided by its companion center, the SSC.[16] This arrangement identified a single point-of-contact for space anomaly reporting, assessment and threat warning which led to the development of a center of excellence for space defense while allowing the SSC to focus on providing space analysis products to support day-to-day space operations. The result was a well-documented space threat warning process that was robustly trained, practiced and exercised during the many real-world new foreign space launches and anti-satellite weapons testing that occurred during the height of the Cold War. However, a number of events since that time have contributed to the fragmentation and erosion of this threat warning process.

The breakup of the Soviet Union in 1989, the cessation of anti-satellite weapons testing, the signing of the Strategic Arms Reduction Treaty outlawing the use of FOB systems, and a reduction in the number of military space launches helped decrease the perceived threat to our space assets from attack.[17] In 1999, the Commander, US Space Command, General Richard B. Myers, voiced his concern that the end of the Cold War shifted US priorities away from space

defense and the tracking of anti-satellite threats to other DoD issues.[18] This decline in perceived space threat led to a gradual de-emphasis of the space defense mission which resulted in the diversion of personnel and consolidation of resources to other space mission areas, such as space surveillance support to day-to-day satellite operations, and theater space support.[19]

The 1994 consolidation of the Space Surveillance Center and the SPADOC into the Space Control Center (SCC) is a prime example of this shift. The new center no longer included the words "space defense" in its mission statement and gradually shifted away from contingency-based space defense and threat warning to a peacetime space surveillance support role.

This pattern continued after the migration of the SCC from US Space Command (USSPACECOM) control to the Air Force.[20] The intentional threat warning mission was still present but was overshadowed by the demand for more and better space surveillance support and the resources this required. A comparison of the mission statements prior to the mission migration to the SCC with the current focus of the Joint Space Operations Center (JSpOC) highlights this change. In 1999, US Space Command identified the primary role of the SCC as:

> Provides warning to United States' space system operators to protect their satellites from potentially hostile situations or dangerous natural events.[21]

This was the last mission statement that identified space threat warning as a priority.

Today, with the SCC integrated into the JSpOC, the focus is on the critical task of theater space support to the warfighter. The current JSpOC mission statement is:

> Conduct operational-level space combat planning and direct space combat operations across the spectrum of conflict by planning, synchronizing, tasking, integrating, and assessing execution of assigned and attached worldwide space forces to accomplish STRATCOM UCP and theater space support missions.[22]

There is also pressure to distance the SCC from its Integrated Tactical Warning and Attack Assessment (ITW/AA) mission responsibility to focus more on space situational awareness.[23]

This trend, coupled with a planned move of the SCC out of Cheyenne Mountain to Vandenberg AFB, could move threat warning even farther back on the space priority list as the threat warning mission will not only compete with routine space surveillance tasks but also with additional theater space support and the production of the Space Tasking Order (STO).[24]

The promulgation of space operations centers in the form of system-specific satellite support centers, regional operations centers, and component-level operations centers has decreased the chances of important threat information flowing to a common threat assessment center. This is also exacerbated by the lack of clear-cut guidance and training on the space threat reporting process across the services. Part of this problem arises from the Unified Command Plan changes that occurred after 9/11 that resulted in the stand down of USSPACECOM and the expansion of US Strategic Command (USSTRATCOM) to take control of previous USSPACECOM missions.[25]

The final organizational structure for the command and control of space forces is still in the works. However, the Air Force and USSTRATCOM have transitioned back to the idea of a joint operations center manned by joint and inter-agency personnel to support the Air Force's Joint Warfighting Support Concept.[26] As part of this effort, the Air Force's space warfighting headquarters, the 14th Air Force, in conjunction with the USSTRATCOM Commander, Space and Global Strike, are consolidating functions within the JSpOC.[27] This is the organization that is currently tasked with executing the space threat warning and space control mission.

These events added to the gradual erosion of the US space defense mindset that led Secretary Donald H. Rumsfeld to express concern that the US could become a victim of a "space Pearl Harbor".[28] The growing dependence on space capabilities by the US makes this event more likely and has serious national security implications. This is more disconcerting given

incentives for other nations or non-state actors to target US space capabilities.

Hostile Intent

The US is not the only nation that recognizes the implications of current American space dominance. Today, there are no weapons in space; however, the growing US reliance on space for national security and the inherent vulnerability of space assets make them a prime target for potential attack by states like Russia and China, and well-organized terrorist groups or rogue states.

During the Cold War, the Soviet Union aggressively worked to develop an anti-satellite capability.[29] In 1985, the Soviets were the only country to have a deployed capability to attack satellites in near-earth orbit and were working on satellite jammers, high-energy lasers, and anti-ballistic missiles with direct ascent ASAT capabilities.[30] Today, Moscow advocates limiting these weapons and have ceased testing them publicly.[31] However, US fielding of a counterspace communications system and an anti-ballistic missile system may provide the catalyst to change Moscow's position.

China also presents a potential threat to US space forces as senior Chinese military officials openly advocate the importance of developing the capability to counter US dominance in space.[32] Hui Zhang, a Chinese nuclear policy and space weaponization expert, expressed China's fear of US space superiority and stated:

> Given the inherent vulnerability of space-based weapons systems to more cost-effective anti-satellite (ASAT) attacks, China could resort to ASAT weapons as an asymmetrical (defense) measure.[33]

Zhang also implied that China would only adopt these counter-measures if the US pushed ahead with its own missile defense and space weaponization plans first.[34]

There are some indications that Bejing is pushing ahead with space ASAT research. According to Chinese experts, the People's Liberation Army (PLA) revamped its research and development efforts and redirected funds to developing "new-concept weapons". These weapons include directed energy, electromagnetic, microwave, and other new technology weapons.[35] China is also emphasizing that space warfare will be the new and critical mode for waging future wars.[36] Dr. Michael O'Hanlon, a Brookings Institute space policy expert, points out in his book *Neither Star Wars or Sanctuary*, that high-value satellites are few enough in number, and sufficiently valuable, that China (and other adversaries) may well find the means to go after each one.[37]

Non-state actors also pose a potential threat to US space assets, and senior US officials and military leaders have considered the possibility of a terrorist attack on space systems to disrupt the global economy. In 2005, General Lord, Commander Air Force Space Command testified to Congress that:

> Terrorists around the world are not aiming their actions at our military alone. … Our enemies can bring crippling destruction to our nation in a matter of days, or even hours, and our space capabilities are not immune to attack.[38]

Other experts have discussed the possibility of terrorist attacks focused at disrupting space-based services and degrading capabilities[39] to include the possibility of a rogue state or terrorist group detonating a nuclear weapon in low-Earth orbit (LEO)[40] destroying or degrading most commercial satellites in LEO that are not hardened against nuclear effects.[41]

Some policy experts dismiss the threat to US space systems as more paranoia than reality.[42] However, the US dependence on space for its national security coupled with the inherent vulnerability of space systems to attack demands the US develop the capability to detect the testing, development and employment of ASAT weapons to either deter their development

and use or develop an effective counter.[43] The fielding of a robust space threat warning system is essential to detecting and deterring future hostile space weapons development.

Implications of the Erosion of US Space Threat Warning Capability

The erosion of the US ability to execute the space threat warning mission has serious implications for US national security to include: the loss of a key early warning indicator of an attack on the US homeland; the loss of space capabilities which would degrade US warfighting effectiveness; the preventable loss of critical high-value satellites, facilities or services; the increased possibility that adversaries could develop new weapons or covertly conduct probing attacks on US space systems; and the lack of a credible means to execute stated US policy in response to an attack against space assets**.**

One of the most serious impacts of the failure to develop or execute a reliable space threat warning and attack verification system is the loss of a key early warning indicator of an attack on the US homeland or an attack that is part of a major regional action by a near-peer adversary such as an attack on Taiwan by the Chinese mainland. The Japanese attack on Pearl Harbor, whose goal was the destruction of the Pacific Fleet, was not done as an isolated act, but as part of the start of a larger campaign to establish a Japanese Pacific sphere of influence which included the forceful acquisition of US territories. At this time, the Pacific Fleet was viewed as a US center of gravity whose destruction would enable Japan to achieve regional domination and discourage future US intervention. Today, our space-based assets may represent the equivalent of the WWII Pacific Fleet. Further, other nations have stated they view the US reliance on space as a potential Achilles ' heel and a center of gravity whose destruction or disruption is critical to future military success against the US.[44]

Although a major attack on the US is not likely, the loss of US space-based early warning capability and ground-based missile warning radars could undermine nuclear deterrence strategy resulting in a devastating miscalculation that the US was vulnerable to a nuclear first strike. The perception that US space capabilities are vulnerable to a surprise attack also weakens conventional deterrence. In the case of a US-China conflict over Taiwan, the Chinese might seek to disrupt or destroy regional space capabilities as part of a delaying strategy to deny US forces access to the region until their military operations were well underway, making the Chinese takeover of Taiwan a *fait accompli*.[45]

A successful Pearl Harbor-type attack on US space assets would degrade US fighting effectiveness. Today, space represents the ultimate high ground and it is unlikely that a nation, whose military ambitions might provoke US involvement, will willingly cede that high ground. The level of battlespace awareness space-based platforms provide makes any attack using large massed forces difficult to accomplish. The ability to neutralize these platforms would improve the circumstances required to gain a strategic advantage over US and allied forces.

As General Lord stated in his Congressional testimony: "A resourceful enemy will look at our centers of gravity and try to attack them. Our adversaries understand our global dependence on space capabilities, and we must be ready to handle any threat to our space infrastructure."[46] With the increased US reliance on space assets for communication, intelligence, surveillance, and reconnaissance (ISR); and command and control of our deployed forces; a successful space attack could significantly delay US response to regional aggression.

During Operation IRAQI FREEDOM (OIF), over 60% of theater communications traveled via satellites.[47] The Defense Satellite Communication System (DSCS) provided 90% of all protected communications and 70% of all military satellite communications into theater.[48]

These capabilities significantly enhanced command and control of US and allied forces. Further, the employment of the satellite-based Blue Force Tracker system resulted in an unprecedented level of situational awareness which decreased fratricide and facilitating search and rescue operations and reinforcement operations.[49]

The United States also maximized the use of the space-based Global Positioning System (GPS) to enable precision weapons delivery, allowing the use of fewer and smaller weapons to achieve effects; to enhance navigation in featureless terrain; and to aid in the location of both friendly and hostile forces.[50] General Lord testified to Congress: "Space capabilities are no longer nice to have, but are now indispensable to how we fight and win our nation's wars."[51] The failure to develop a credible space threat warning system increases the likelihood that a foreign nation would attack US space assets.

The inability to detect and provide timely warning of a space attack could result in the preventable loss of critical high-value satellites, facilities or services. There are a number of scenarios where the timely detection of a threat would allow space operators to intervene, thwarting the attack. In many instances, the ability to find, fix, target and destroy the threat is currently a viable way to counter the attack. However, this is not always possible. In the case of a co-orbital ASAT attack, which involves the launch and maneuver of a satellite into a closing orbit of another satellite to destroy or disrupt it, the countermeasure require a pre-intercept maneuver of the target satellite. The support countermeasures for an attack on space ground facilities include increased physical and information security. Countermeasures for electronic warfare attacks or jamming of the space link segment exist but there is often a significant bandwidth cost when these measures are in effect.[52]

Degradations to space assets could also occur as a result of unintentional sources such as radio frequency interference or from scientific research such as laser research. In these situations, it is important to locate the source and terminate the activity to prevent loss of the space asset or service. The loss of these capabilities during critical operations could result in operational failure, loss of equipment, resources, and lives.

The inability to rapidly neutralize sources of satellite communication (SATCOM) interference also has national security implications. In the area of airpower employment, successful SATCOM jamming could disrupt the US ability to command and control air assets in theater from geographically separated air operations centers. A delay of even one to two days might jeopardize US ability to support deployed forces. Satellite communication links to world-wide deployed forces are critical capabilities in protecting US security, sovereignty, and military combat capability.

The inability to detect and assess space threats might allow adversaries to develop new weapon systems or conduct probing attacks on US space systems without our knowledge. Although US surveillance technology and systems are more sophisticated today, the US should not assume it will always be able to detect the development of a new weapon. Our experience in post-WW II with the Germans is one example. After the defeat of Nazi Germany, the US and Russia engaged in a race to uncover Germany's scientific secrets. Major General Hugh-Knerr, deputy commander of the US Air Forces in Europe wrote: "The occupation of German scientific and industrial establishments has revealed the fact that we have been alarmingly backward in many fields of research."[53] Supersonic rockets, nerve gas, jet aircraft, guided missiles, stealth technology and hardened armor were just some of the technologies developed in WWII German

laboratories.[54] The Soviet Sputnik launches and the deployment of the FOB system are modern examples of technological surprise.[55]

Today, other nations are working to develop new weapons to counter US dominance and to take the lead in what is termed Fourth Generation Warfare—information war. The current coverage gaps in our space surveillance network, a fragmented intelligence network, a lack of discipline in anomaly reporting, the current inability to rapidly detect an attack on on-orbit systems, and overall erosion over the last decade of the space defense mindset makes it more likely an adversary could develop anti-satellite weapons without our knowledge.

Finally, without a credible space threat warning capability the US will not have the ability to execute stated US policy to counter an attack against US space assets**.** In 1999, President Clinton signed into law DoD Directive 3100.10*, US Space Policy*, which specifically declared an attack on US space systems, to include commercial space systems, an attack on US sovereignty.[56]

One purposes of this policy is to deter an attack on US space assets. However, the lack of a credible space threat warning system undermines this policy. A senior officer in US Strategic Command recently stated that a nation or group could likely interfere with US satellites without fear of retribution.[57]

These implications point to the need to ensure the US can rapidly detect, warn and respond to a hostile threat space systems. In the near term there is no way the DoD can address all the deficiencies with the current budget. However, there are a number of actions that the DoD, USSTRATCOM, the service components can take that do not require extensive funding. The final section identifies these recommendations.

Recommendations and Conclusion

Increased funding for space control is on the way for the space situational awareness capabilities that make space threat warning possible. According to a new Congressional Budget Office Report, the Pentagon has allocated $195 million in 2006 to fund programs such as the Rapid Attack Identification, Detection & Reporting System (RAIDRS) and that funding could increase to $768 million by 2011.[58] However, there are three recommendations that are less dependent on funding to improve space threat warning capabilities. These recommendations are primarily a function of staff work and operational planning to instill a space defense mindset in all space operators and establish a single authority for operational control and management of space surveillance and warning resources consolidated in a joint center. This single authority would oversee the development of a well-documented space threat warning process that is robustly trained and exercised end-to-end.

The recommendations include: (1) The DoD and US Strategic Command should establish and formalize the position of the Global Space Defense Commander which parallels the Combined/Joint Force Air Component Commander responsibility of the Area Air Defense Commander; (2) USSTRATCOM should initiate recurring end-to-end testing of the space threat warning and attack verification system that includes all space operators in the field and appropriate civilian agencies; and (3) USSTRATCOM should update directives that provide guidance on space threat events, assessment criteria, attack verification procedures, and specific guidance on the type, content and format of threat warning messages and the appropriate response across the command.

Establish the Global Space Defense Commander (GSDC) Position

The Air Force has made great strides in developing the command and control doctrine for space forces to provide continuous space support to the warfighter. A centerpiece of this effort is the integration of space into theater air operations centers (AOC) to include the on-going development of a functional "AOC" for the command and control of global space forces and reach back space support for theater AOCs. In this capacity it has closely organized the command and control of its space forces along the lines of the Falconer Air Operations Center and the Joint Force Air Component Commander (JFACC) model.[59]

However, the lack of a formally established space equivalent to the Joint Publication 3.0 Area Air Defense Commander (AADC) is a significant oversight. To rectify this, USSTRATCOM should establish and formalize the responsibility of a Global Space Defense Commander parallel to the responsibilities of an Area Air Defense Commander to protect the three segments of US space systems—ground, link and on-orbit. The most likely candidate for this position is the 14th Air Force Commander, who is dual-hatted as the Commander, Joint Space Operations, reporting to the Space and Global Strike Component Commander of STRATCOM. Table 1 shows the current responsibilities of the AADC as defined in the Joint Forces Air Component Commander Handbook and then applies them to the GSDC position.[60]

Table 1. Application of Area Air Defense Commander Model to Space Defense

Position	***Area Air Defense Commander (AADC)***	***Global Space Defense Commander (GSDC)***
	Joint Force Air Component Commander (JFACC) (Numbered AF Commander)	**Commander, Joint Space Operations (14th Air Force Commander)**
Responsibility	Develop, integrate, and distribute a C/JFC-approved joint area air defense plan (AADP) with the support of service or functional components	Develop, integrate, and distribute a CDRUSSTRATCOM-approved Global Space Defense Plan (GSDP) with the support of service or functional components
	Develop and execute a detailed plan to disseminate timely air and missile warning and cueing information to components, forces, allies, coalition partners, and civilian authorities IAW the joint force J-2, J-3, & J-6.	Develop and execute a detailed plan to disseminate timely space warning information to components, forces, allies, coalition partners, and civilian authorities as appropriate.
	Develop and implement identification and engagement procedures that are appropriate to the air and missile threats	Develop and implement identification and engagement procedures that are appropriate to space threats
	Ensure timely and accurate track reporting among participating units to provide a consistent common operational picture	Ensure timely and accurate space anomaly reporting among DoD space operators to provide a common operational picture
	Establish sectors or regions, as appropriate, to enhance decentralized execution of defensive counterair operations (DCA)	Establish a ground, link and on-orbit space defense regions to enhance decentralized execution of defensive counterspace operations (DCS)
	Prevent fratricide.	Prevent fratricide through robust deconfliction and collision avoidance procedures for electronic warfare, directed energy, on-orbit and space launch systems
	Combined/Joint Area Air Defense Plan (AADP): A prioritized list of friendly vulnerabilities are developed into a critical asset list and incorporated into the AADP. The Defended Asset List (DAL) is the basis of the AADP, and active air defense operations are designed to protect these selected assets. The plan should:	Combined/Joint Global Space Defense Plan (GSDP): A prioritized list of friendly vulnerabilities are developed into a critical asset list and incorporated into the GSDP. Defended Asset List is the basis of the GSDP, and active counterspace operations are designed to protect these selected assets. The plan should:
AADP GSDP	Arrange a layered or overlapping defenses to allow for multiple engagement opportunities	Arrange for coordinated ground, link and on-orbit defenses to allow for prompt response to a space threat
	Include Information Operations strategies for counterair ops.	Include Information Operations strategies for counterspace ops.
	Contain detailed weapons control and engagement procedures integral to a joint counterspace operation	Contain detailed weapons control and deconfliction procedures integral to a joint counterspace operation
	Integrate air and space (aircraft), ground-PATRIOTS, SHORAD), and sea-based (AEGIS) capabilities.	Coordinate with theater AOCs for final threat targeting
Defended Asset List (DAL)	Key political and military assets to be defended-developed for the C/JFC by the C'JTF staff, with inputs from the components.	Key space assets to be defended by GSDC. Includes prioritized list of SATCOM links for RAIDRS monitoring determined by JFCs.[61]

In the mid-1980s, the absence of multiple space operations centers coupled with the clear assignment of the space threat assessment mission to the Cheyenne Mountain Operations Center improved the odds that threat information would flow to a central fusion center in a timely manner. Today, the addition of the component-level operations centers, the Unified Command Plan changes standing down USSAPCEECOM, the on-going development of the JSpOC, the stand up of the Space and Global Strike organization, and the emergence of the Global Operations Center (GOC) in USSTRATCOM has added a level of ambiguity to organizational responsibilities for the space defense and space threat warning mission. In fact, the mission briefing of the new Joint Space Operations Center includes a separate slide that highlights the fragmented nature of space command and control in a slide entitled "Operational Realities: Fragmented C2".[62] This ambiguity decreases the chances that space anomalies will get reported in a timely manner in order to build a common operating picture of the space environment. The GSDC will help rectify this by serving as the focal point to plan, coordinate, prioritize and conduct space defense operations and execute the responsibilities outlined in Table 1.

Establish and Conduct Recurring End-to-End Space Threat Warning Exercises

USSTRATCOM should initiate recurring end-to-end testing of the space threat warning and attack verification system that includes space operators in the field from all services and appropriate civilian agencies. These end-to-end exercises would also include the Cheyenne Mountain Operations Center, the Joint Space Operations Center, the USSTRATCOM Global Operations Center, USSTRATCOM assessors and the National Military Command Center. The exercises should include the range of space threats such as ground attack and sabotage of space ground stations; potential directed energy events both intentional and unintentional;

electronic warfare and radio frequency interference; co-orbital ASATS; a direct ascent ASAT; and high-altitude nuclear detonations in space. Exercise planners should also include events that cross-over geographic unified command and international boundaries such as a cruise missile attack against the Shemya Air Force Station radar or the radar at Vardo, Norway; or a space nuclear detonation over a broad ocean area. These types of events will help senior leaders work through space attack assessment and response policies before they actually occur.

Although there are threat exercises conducted internally within various space organizations, none qualify as a true end-to-end test and none fully integrate the different component space operations centers. This includes the space threat event exercises conducted within the Cheyenne Mountain Operations Center and the JSpOC that are originated in-house and primarily involve organizations at the command echelon and above, not the actual operators in the field who would report threat anomalies.

Recurring end-to-end exercises will enhance familiarity of the threat warning process from personnel in the field to senior leaders making final assessments and response recommendations. More importantly, these exercises will help identify problem areas for resolution and serve as an effective deterrent to convince adversaries that an attack against US space systems will be ineffective and will not significantly impair warfighting capabilities.[63]

Update Threat Warning and Attack Verification Guidance

USSTRATCOM should revise and update the current directives previously found in USSPACECOM Instruction 55-20, *Warning and Verification of Hostile Space Events,* which provided guidance on space attack verification procedures, and guidance on the type, content and format of space warning messages and the appropriate response across the command. This instruction has not been updated in over a decade and is not part of formal space training outside

of the select operators in the SCC. In an interview with the on-duty crew commander in the SCC during OIF when the Iraqis locally jammed the downlink segment of GPS, the crew commander indicated there was confusion as to whether this even constituted a space attack, if so what assessment procedures should be followed, and what warning messages or notifications, if any, were required. Ultimately an advisory message was sent alerting space operators of the event.[64] However, this breakdown in the threat warning process delayed the release of information that, given a different space event, could have negated the ability to effectively respond to the threat.

Clearly, the time to learn how the space threat warning system works and to think through appropriate responses to an attack is not during a crisis. Current, published guidance integrated into the operational training of all space operators and operations center personnel would minimize the chance of this problem reoccurring.[65]

The growing dependence and vulnerability of US space capabilities to attack outweighs the absence of a hard demonstrated threat to space systems in the decision to make space defense and space threat warning a priority. Further, it is probably not in the best interest of future adversaries to develop space weapons capabilities openly that would prompt the US to develop an effective counter. The United States needs to stay ahead of any future adversary to protect space assets which are critical economic and military force multipliers. However, as the US experienced in 1941 at Pearl Harbor, not all of our adversaries are going to forego an opportunity to exercise the element of surprise to gain operational success. A robust space threat warning capability will ensure future adversaries do not execute a successful space Pearl Harbor.

Endnotes

[1] AFDD 2-2.1, 3. DCS operations preserve US ability to exploit space to its advantage via active and passive actions which protect space systems, which include on-orbit satellites, terrestrial space systems such as ground-based satellite control stations, and the communication links between them, from enemy attack or interference
[2] Space Commission. *Report of the Commission to Assess United States National Security Space Management and Organization*. 11 January 2001,100.
[3] Association of Former Intelligence Officers AFIO Weekly Intelligence Notes #18-99, www.afio.com/sections/wins/1999/notes1899.html, 7 May 1999. (accessed 5 February 2006). General Myers said: "Intelligence priorities have over time, migrated to other issues and it leaves us a bit naked in knowing exactly what the threat is."
[4] Space Commission. *Report of the Commission to Assess United States National Security Space Management and Organization*. 11 January 2001,100.
[5] David N. Spires, *Beyond Horizons - A Half Century of Air Force Space Leadership*. (Washington, D.C.: Air University Press, 1998), 51. Sputnik II carried a 1,120 pound payload and the first dog in space "Laika".
[6] Richard F. McMullen, *Air Defense and National Policy 1958-1964*, Air Defense Command Study No.26.,37.
[7] Ibid., 52.
[8] McMullen, *Air Defense and National Policy 1958-1964*, 1.
[9] Spires, *Beyond Horizons - A Half Century of Air Force Space Leadership*, 72.
[10] Ibid.,72.
[11],Richard L. Garwin and Hans A. Bethe. "Anti-Ballistic Missile Systems." *Scientific American*, March 1968, 21-30.
[12] Ibid., 26.
[13] Ibid., 26.
[14] Soviet Military Power, 56.
[15] Spires, *Beyond Horizons - A Half Century of Air Force Space Leadership*, 197.
[16] Ibid., 198.
[17] Spires, *Beyond Horizons - A Half Century of Air Force Space Leadership*, 190.
[18] Association of Former Intelligence Officers AFIO Weekly Intelligence Notes #18-99, www.afio.com/sections/wins/1999/notes1899.html, 7 May 1999. (accessed 5 February 2006)
[19] After the migration of the Space Control Center from US Space Command to the Air Force, the crew positions dedicated to the space threat mission were reorganized to better support space surveillance activities such as space surveillance sensor management tasks and satellite catalogue maintenance. In addition, the center took on the additional responsibility for on-orbit collision avoidance and conjunction analysis support for the Air Force without additional manpower.
[20] Cheyenne Mountain Operations Center Command Briefing, 2005.
[21] USSPACECOM Fact Sheet from the Advanced Space Operations Course Reference Guide, 1999.
[22] JSpOC Command and Control of Space Forces Briefing, 14th Air Force, Vandenberg AFB, CA. December 2005.
[23] Personal interview with Lt Col Mark Vidmar, Commander, 1st Space Control Squadron, 7 December 2005. Lt Col Vidmar wrote in a written response to the author'squestion: "The focus of our efforts are now not on integrated threat warning and attack assessment, but rather on space situational awareness and C2 of space forces."
[24] General Lance Lord, Space Update and Q & A, Maxwell AFB, ACSC,30 Jan 06, ACSC. General Lord stated, "The Space Control Center was definitely moving out of Cheyenne Mountain to the JSpOC at Vandenberg AFB" General Lord indicated the ITW/AA system certification requirements were overly restrictive and were impeding progress in developing space system capabilities.

[25] The New Unified Command Plan, http://www.defenselink.mil/specials/unifiedcommand/, 10 Nov 2004 (accessed 10 Apr 2006).
[26] Joint Warfighting Space (JWS) Memorandum Document, 31 Mar 05.
[27] US Strategic Command Global Operations Center (GOC) Overview Briefing.

[28] Space Commission. *Report of the Commission to Assess United States National Security Space Management and Organization*. 11 January 2001,100.
[29] Nikolai Poroskov, "The Yogurt of Volley Fire," *Vremya Novostei*, February 6, 2003. The Space Troops (ST) ["*Kosmicheskie Voiska"*] are at the center of Russia's system of"military space". They enjoy priority financing and preferential treatment among other branches and services in reflection of their importance for Russia's defense.
[30] Soviet Military Power, 1985, 44, 54-59.
[31] Laura Grego, "A History of US and Soviet ASAT Programs", *Global Security.* http://www.ucsusa.org/global_security/space_weapons/a-history-of-asat-programs.html (accessed 15 February 2006)
[32] Major General Zhang Ling, "Initial Appearance of Informationized Warfare" in Transcript of May 2003 CPC Central Committee Conference, Liaiwang, on 28, July 4, 2—3,9-15.
[33] "China Ready to Counter US Space plans." *China Space Daily.* http://www.chinadaily.com.cn/english/doc/2005-05/23/content_444886.htm, (accessed 7 December 2005).
[34] Ibid.
[35] Mary C. Fitzgerald, Russia-*China Convergence/Divergence on 21st Century Warfare: Volume I and II*, Fall 2003) from Hudson Institute China's New Great Leap Forward, 90)
[36] Major General Zhang Ling, "Initial Appearance of Informationized Warfare" in Transcript of May 2003 CPC Central Committee Conference, Liaiwang, 28 July 4.
[37] Michael O'Hanlon, *Neither Star Wars or Sanctuary*, 100.
[38] Department of the Air Force Presentation to the House Armed Services Committee, Subcommittee on Strategic Forces, United states House of Representatives, Subject: FY06 Defense Authorization Budget Request for Space Activities Statement of: General lance W. Lord, Commander, Air Force Space Command , 9 March 2005, 11.
[39] James A. Lewis, "Responding to Assymetric Threats in Space" House Armed Services Committee, Panel on Asymmetric and Unconventional Threats Center for Strategic and International Studies, 1 November 2005, 1.
[40] J.M. Early, *Telstar I - Dawn of a New Age, SMEC Vintage Electronic Volume #2, 1990http://www.smecc.org/james_early___telstar.htm.* (accessed 29 Dec 2005). The US found out in 1962 that detonating a nuclear weapon in space is an effective means to disrupt and destroy satellites that are not hardened against nuclear effects in low earth orbit and to any satellite which has an orbit through the Van Allen radiation belt. This occurred when the US conducted a test of a space-based nuclear detonation code named STARFISH. The test involved the launch of a 1.5 megaton nuclear device on a Thor rocket that detonated at an altitude of 400km over the Johnston Atoll. The effects in space were significant as it destroyed seven satellites when radiation knocked out their solar arrays, disabled three others, and eventually crippled one-third of all other low earth orbit satellites.
[41] Theresa Hitchens, "Monsters and shadows: Left unchecked, American fears regarding threats to space assets will drive weaponization". http://www.unidir.org/pdf/articles/pdf-art1884.pdf . (accessed 29 Dec 2005).
[42] Theresa Hitchens, "Monsters and shadows", 20.
[43] DoD 2004 Annual Report on the Military Power of the People's Republic of China, 36.
[44] "China Ready to Counter US Space Plans".
[45] Joan Johnson-Freese, Dr., Testimony Before the US- China Economic and Security Review Commission, 15 Sep 2005, 8.
[46] General Lance W. Lord, Commander, Air Force Space Command. "FY06 Defense Authorization Budget Request for Space Activities." Testimony, 10.
[47] General Lance W. Lord, Commander, Air Force Space Command. "FY06 Defense Authorization Budget Request for Space Activities." Testimony, 5.
[48] LTG Larry Dodgen, "Space – Enabling the Potential of Our Joint Warfighter," *Quest for Space Magazine*, 2005. Satellites provided many common services such as Defense Switching Network (DSN) service, Video-Teleconferencing (VTC) capability, access to non secure internet and e-mail services over the Non-Secure Internet Protocol Router Network (NIPRNET), and access to Secret Internet Protocol Router Network (SIPRNET).
[49] General Lance W. Lord, Commander, Air Force Space Command. "FY06 Defense Authorization Budget Request for Space Activities." Testimony, 7.
[50] Ibid., 7.
[51] Ibid., 3.
[52] RAIDRS Briefing. Slide 5.
[53] Project Paperclip, 2.
[54] Project Paperclip, 2.
[55] Spires, *Beyond Horizons - A Half Century of Air Force Space Leadership*, 51.

[56] William Jefferson Clinton, Department of Defense Directive 3100.10, *DoD Space Policy*, 9 July 1999. *This policy states*: It is DoD policy that:

> 4.1. Space is a medium like the land, sea, and air within which military activities shall be conducted to achieve US national security objectives. The ability to access and utilize space is a vital national interest because many of the activities conducted in the medium are critical to US national security and economic well-being.
>
> 4.2. Ensuring the freedom of space and protecting US national security interests in the medium are priorities for space and space-related activities. US space systems are national property afforded the right of passage through and operations in space without interference, in accordance with reference (a).
>
> 4.2.1. Purposeful interference with US space systems will be viewed as an infringement on our sovereign rights. The US may take all appropriate self-defense measures, including, if directed by the National Command Authorities (NCA), the use of force, to respond to such an infringement on US rights.
>
> 4.3. The primary DoD goal for space and space-related activities is to provide operational space force capabilities to ensure that the United States has the space power to achieve its national security objectives, in accordance with reference (d). Contributing goals include sustaining a robust US space industry and a strong, forward-looking technology base.

[57] Reuters News Service, "US Military Role in Space Said to Expand", 8 February 2006, Col Anthony Russo, Col USAF, described President George W. Bush's emerging national space policy as an "evolution" from the current one, issued in 1996 by then-President Bill Clinton. Putting the military squarely in the equation should act as a deterrent to those who would interfere with satellites, Russo said "because right now they can do it and expect to get away with it. "Tens of thousands of incidents involving possible attacks on satellites are reported each year, he said. But only a handful of these turn out to be deliberate efforts to pirate services or interfere for political reasons. "I see that trend increasing," Russo said, adding that he expected the US military to get more resources to carry out the projected space-mission expansion.

[58] Peter Grier, "Curtain Up On Space Modernization," *Air Force Magazine*, December 2005, 62.

[59] JSpOC Command and Control of Space Forces Briefing, 14th Air Force, Vandenberg AFB, CA. December 2005.

[60] AFDC 10-01, *Air & Space Handbook for the JFACC*, 38-39.

[61] AFSPC/XOXC RAIDRS Briefing, 5 January 2006. Air Force Space Command is actively pursuing and funding a program called the Rapid Attack Identification Detection Reporting System (RAIDRS) which is designed to detect attacks on satellite communication (SATCOM), including differentiating attacks from natural/unintentional events, and then locating the source of the attack to enable the timely responses to counter the threat. It will also provide post attack warning for other space systems that could be targeted by the same threat or coordinated attack. Timely event information generated by RAIDRS will provide situational awareness to warfighters using satellite communications, enabling them to take proper countermeasures to ensure critical space communications services are not interrupted. A direct link into the theater Air Operations Centers to provide threat location data would facilitate the elimination of the Electronic Warfare (EW) threat by conventional air assets when required.

[62] Joint Space Operations: Command and Control of Space Forces Briefing,

[63] Air Force Doctrine Document 2-2.1, *Counterspace Operations*, 2 August 2004, http://www.dtic.mil/doctrine/jel/service_pubs/afdd2_2_1.pdf, 3. (accessed 29 Dec 2005).

[64] Maj Brian C. Tichenor e-mail 18 January 2006 described the response to the Iraqi GPA jamming which General Lord recently disclosed in his testimony to Congress.

[65] Interview with Capt Brian Tichenor. 18 Jan 2006.

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