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Past U.S. Actions: A Source for Foreign Perceptions of U.S. Redlines in Space

Jonathan Mazur

This paper examines the boundaries of possible United States redlines in space. A redline in space is a “marker” that when crossed would result in a military or strong diplomatic response—such as what might occur if a foreign actor temporarily or permanently interfered with any aspect of a U.S. space system. The United States has not published or possibly even defined its redlines in space—as recently noted during the 2010 U.S. Strategic Command (STRATCOM) Deterrence Symposium by the then Commander for STRATCOM’s Joint Functional Component Command (JFCC) for Space in reference to the Schriever 2010 Wargames.¹ The CDR JFCC Space noted the difficulties in addressing questions such as “How does an adversary understand what our redlines are....? Is jamming a satellite a redline? Is destroying a satellite a redline?” and further commenting that “There was a lot of debate that there was no loss of life when we lose a satellite, so what does that mean in terms of how the national policy apparatus would respond....?”

This paper attempts to define possible redlines by exploring public perception of U.S. investments and actions in space. The methodology of exploring these points of focus is used for two reasons. First, foreign actors’ military policies or decisions to disrupt or destroy U.S. space capabilities would almost certainly take into consideration *how the United States may respond to their actions*. Foreign national counterspace strategies, if they exist, or foreign judgments of U.S. reactions are almost certainly not publicly available information. Second, I would contend that the majority of U.S. adversaries that may be capable of disrupting or destroying a U.S. satellite rely on the abundance of publicly available

information discussing U.S. space policies, programs, capabilities, and mishaps to inform, if only partially, their decision-making calculus.

In support of this methodology, this paper introduces three high-level themes and summarizes a likely perception that could be derived from each theme. These summaries inform my assertion of what perceived U.S. redlines might look like to a foreign adversary that analyzes U.S. actions in space. The first theme examines U.S. investments in space, our reactions to losses and delays of these capabilities, and our reactions to foreign disruptions of U.S. space capabilities. This first theme attempts to provide some insight into how important space capabilities are to the United States and to scope what a U.S. reaction to losing a satellite may look like. The second theme looks at perceived U.S. counterspace capabilities, our reaction to foreign counterspace capabilities, and U.S. views of orbital debris that can result from some counterspace capabilities. This second theme provides some insight into what a foreign actor could interpret as what the U.S. views as acceptable norms of provocative actions in space. The last theme covers perceived U.S. space protection efforts, specifically examining U.S. space policy, protection priorities, and investments in attribution capabilities. Perceptions of U.S. space protection priorities could provide the most noteworthy insight into which satellites or space-enabled capabilities the United States considers most important, which if disrupted or destroyed may cross a U.S. redline in space.

The majority of publicly available data providing insight into the three themes noted above cover relative peaceful periods of time. A few data points were established during periods of crisis, and one example of counterspace capabilities used against the United States was during a time of war by a non-space faring nation. Because of the

¹ “2010 Strategic Deterrence Symposium”, *Panel 1 discussion regarding the Schriever 10 Wargame*, 4:50 into video, <http://www.youtube.com/watch?v=ooOwchbjezo>.

relatively small amount of data on U.S. reactions to foreign disruptions and the range of potential foreign actors that could disrupt or destroy U.S. space capabilities, I cannot make a confident argument with any fidelity about how a potential U.S. redline may change during a time of peace, crisis, or war. Or, how the U.S. may react to a disruption in space capabilities by different countries, such as China, Iran, or North Korea.

Therefore, my assertion of possible U.S. redlines in space could be used as a first reference for reaction during a scenario or a real loss of a U.S. space capabilities while the U.S. policy apparatus considers further dynamics such as our state-of-relations with the offending foreign nation or their space or military capabilities.

Finally, an important assertion for this research is that even though U.S. administrations have changed over the decades, and because our redlines are not stated, a foreign actor probably will view the totality of U.S. actions in and statements about space when analyzing how the United States may react to various situations such as the loss of its space capabilities or when engaging in space-related diplomatic exchanges.

U.S. INVESTMENTS IN SPACE CAPABILITIES

The United States has spent over one trillion dollars since the late 1950s on space-related issues, a staggering amount of money that has provided significant advantages to U.S. national security while benefiting the world economy, international relationships, and scientific research.² Our interest and use of space has not gone unnoticed or uncopied. Currently, there are over fifty nations and government consortia operating their own satellite capabilities.³ Having access to space capabilities has become more than a statement of national pride, it has evolved into a literal

² “The U.S. Government Space Budget by Paul Shawcross, October 14, 2008”, *Office of Management and Budget*.

³ “National Security Space Strategy”, http://www.defense.gov/home/features/2011/0111_nsss/docs/NationalSecuritySpaceStrategyUnclassifiedSummary_Jan2011.pdf.

necessity; U.S. space investments provide some insight into U.S. redlines in space.

According to a 2011 report by the Government Accountability Office (GAO), over the past two decades, the Department of Defense (DoD) “has had difficulties with nearly every space acquisition program, with years of cost and schedule growth, technical and design problems, and oversight and management weaknesses. However...DoD continues to make progress on several of its programs and is expecting to deliver significant advances in capability as a result.”⁴ Despite persistent issues with cost, schedule, and complexity lasting decades, the United States continues to lean forward in its space investments, and successive administrations continue to fund new space capabilities.

One notable aspect of U.S. investments in space is the breadth and depth of different capabilities—which far surpass the capabilities of all other countries—and how they have affected practically every part of the United States Government, its policy makers, and its citizens. To say that space is very important to the United States is easily a true statement that has been reinforced over the years monetarily and emotionally, but the public interest has not been consistent. When Apollo 1 and the Challenger and Columbia Shuttles ended in failure, the United States mourned, and exhaustive investigations followed. When Apollo 13 suffered its failure in space, U.S. citizens watched on the edge of their seat. One will be hard pressed to find such an equal reaction by the U.S. Government or its citizens when an unmanned satellite goes out of service that affects the whole country, such as the 1998 PanAmSat’s Galaxy IV communication satellite failure that affected millions of users but resulted in press reactions such as “inconvenience” and “some people rejoiced...others bemoaned”.⁵

⁴ “SPACE ACQUISITIONS: DOD Delivering New Generations of Satellites, but Space System Acquisition Challenges Remain”, *GAO-11-590T*.

⁵ “Satellite Trouble Cuts Out Pagers; Millions Lose Remote Contact”, *Associated Press*, <http://www.thefreelibrary.com/SATELLITE+TROUBLE+CUTS+OUT+PAGERS%3B+MILLIONS+LOSE+REMOTE+CONTACT.-a083823092>; “Out of Touch; Millions Feel Isolated by Pager Loss”, *Daily News*,

Even though we relish our space capabilities, there may be certain satellites or space capabilities that the U.S. Government or its citizens might react to differently if lost or disrupted, and the public reaction to these failures may provide some insight into possible U.S. redlines in space.

U.S. REACTIONS TO LOSSES AND DELAYS

The U.S. Government has suffered a number of satellite losses since 1980, which did not appear to be reconstituted immediately.⁶ A core assumption is that these satellites would not have been planned and launched unless they were needed at some point in the near future. These losses, mostly due to launch failures, have crossed all major capabilities. The United States lost two missile early warning satellites, also known as Defense Support Program (DSP) satellites, which are vital to support our nuclear deterrence posture.⁷ The National Reconnaissance Office (NRO), generally perceived to launch the nation's intelligence, surveillance, and reconnaissance (ISR) satellites, has had multiple launch failures resulting in the loss of at least seven satellites.⁸

<http://www.thefreelibrary.com/OUT+OF+TOUCH%3b+MILLIONS+FEEL+ISOLATED+BY+PAGER+LOS+S.-a083823187>.

⁶ For this research, I assumed a thirty year time span of U.S. satellite launches would be an appropriate duration for an adequate representation of U.S. losses in space.

⁷ "US Still Probing Security Satellite Failure", *Reuters*, <http://www.reuters.com/article/2009/01/06/us-northrop-satellite-idUSTRE5055DW20090106>; "DSP", *Encyclopedia Astronautica*, <http://www.astronautix.com/craft/dsp.htm>.

⁸ "NOSS-1", *Gunter's Space Page*, http://space.skyrocket.de/doc_sdat/noss-1.htm; "KH-11", *Gunter's Space Page*, http://space.skyrocket.de/doc_sdat/kh-11.htm; "KH-9", *Gunter's Space Page*, http://space.skyrocket.de/doc_sdat/kh-9.htm; "Chalet", *Gunter's Space Page*, http://space.skyrocket.de/doc_sdat/chalet.htm; "SLDCOM", *Gunter's Space Page*, http://space.skyrocket.de/doc_sdat/sldcom.htm; "Mercury", *Gunter's Space Page*, http://space.skyrocket.de/doc_sdat/mercury.htm;

A number of military communications satellites have failed to provide services to include a military strategic and tactical relay (MILSTAR)⁹, an ultra-high frequency (UHF) satellite¹⁰, two fleet satellite communication (FLTSATCOM) satellites¹¹, and a NASA tracking and data relay satellite (TDRS)¹². Most recently, the new advanced extremely high frequency (AEHF) satellite, launched in 2010, had trouble getting to its intended orbit, delaying its anticipated use.¹³ These satellites provide communications support for a wide range of customers from the President to the warfighter to manned space missions.

Two global positioning system (GPS) satellites were lost during launch failures, and a recently launched GPS satellite is beset by a permanent signal problem.¹⁴ In addition to the vast commercial applications, GPS has revolutionized U.S. warfare, enabling such capabilities as precision guided weapons.¹⁵ Additionally, two NASA climate observation satellites were destroyed during launch in 2009 and 2011.¹⁶ Climate change is a significant global issue that

"NROL-21", *Gunter's Space Page*, http://space.skyrocket.de/doc_sdat/nrol-21.htm.

⁹ "Milstar", *Wikipedia*,

<http://en.wikipedia.org/wiki/Milstar>.

¹⁰ "Hughes Delays Naval UHF Satellite Launch", *Spacedaily*, <http://www.spacedaily.com/news/satcom-98g.html>.

¹¹ "Fleet Satellite Communications System", *Wikipedia*,

http://en.wikipedia.org/wiki/Fleet_Satellite_Communications_System.

¹² "TDRS-B", *Wikipedia*,

<http://en.wikipedia.org/wiki/TDRS-B>.

¹³ "ULA Atlas V Successfully Launches with AEHF Satellite", *Nasa Spaceflight*, www.nasaspaceflight.com/2010/08/ula-atlas-v-launch-with-aehf-gps-satellite/.

¹⁴ "List of GPS Satellite Launches", *Wikipedia*, http://en.wikipedia.org/wiki/List_of_GPS_satellite_launches; "GPS Satellite Beset by Permanent Signal Problem", *spaceflightnow*,

<http://spaceflightnow.com/news/n0911/02gps/>.

¹⁵ "Information Operations", *Air Force*, Air Force Doctrine Document 2-5.

¹⁶ "Lost Satellite Deals Blow to Climate Research", *MSNBC*,

http://www.msnbc.msn.com/id/41895904/ns/technology_and_science-space/t/lost-satellite-deals-blow-to-climate-research/.

has divided citizens and politicians across the world, and the latest satellite contained advanced capabilities to provide new sources of data to climatologists.¹⁷

From an acquisition perspective, according to a 2011 GAO report, significant schedule delays of as much as nine years have resulted in potential capability gaps in missile warning, military communications, and weather monitoring. These problems persist, with other space acquisition programs still facing challenges in meeting their targets and aligning the delivery of assets with appropriate ground and user systems.¹⁸

Furthermore, according to a 2009 GAO report on GPS acquisition problems, there was an increased likelihood that GPS may fail to provide the level of service that the U.S. Government commits to by 2010.¹⁹

To those not aware of the large numbers of U.S. satellites—though always aging—already on orbit with similar capabilities, these losses or delays could appear quite detrimental. But I cannot find a sense of U.S. public anxiety or significant fallout, such as Congressional investigations or Presidential statements regarding degraded space capabilities, other than GAO reports on space acquisition problems or short news statements citing disappointment with a particular failure or problem. In fact, when the most recent NASA climate satellite was lost during launch, it did not even make the front page of *The Washington Post* or *The New York Times*.²⁰ Furthermore, the only investigation that I found was to evaluate the

cause of the rocket failure, not the effect of losing the satellite's capabilities for scientific research.²¹

There is mention of some redundancy in a few space systems which could explain some of the lack of reaction to losses. Around the time of the most recent DSP failure, experts estimated that the U.S. Government had twice the number of DSP satellites on orbit needed to watch the entire Earth.²² As for GPS, the same 2009 GAO report warning of possible failures of service also mentioned there are measures the Air Force and others can take to plan for and minimize possible GPS service impacts, which was further reiterated by the Air Force command lead for GPS.²³ As of 2009, there were seven more global positioning satellites on orbit than required for optimum operations.²⁴ It does not appear that GPS has failed to provide services resulting in a negative public reaction.

The losses of U.S. satellite capabilities noted above occurred because of actions taken by the United States. There would likely be a noteworthy negative public reaction if they had happened purposefully at the hand of another country, but there is no precedent for that. There is, however, a precedent of foreign disruption of U.S. satellites which, though U.S. reactions were inconsistent, may provide some insight into U.S. redlines in space.

¹⁷ "NASA's Glory Mission Will Study Key Pieces of the Climate Puzzle", *NASA*, http://www.nasa.gov/mission_pages/Glory/news/climate-puzzle.html.

¹⁸ "SPACE ACQUISITIONS: DOD Delivering New Generations of Satellites, but Space System Acquisition Challenges Remain", *GAO*, GAO-11-590T.

¹⁹ "Global Positioning System: Significant Challenges in Sustaining and Upgrading Widely Used Capabilities", *GAO*, GAO-09-670T.

²⁰ Based on a 4 through 10 March 2011 search of the *Washington Post* and *New York Times* and search of worldwide newspapers using ProQuest and Factiva.

²¹ "NASA Creates Glory Satellite Mishap Investigation Board", *NASA*, http://www.nasa.gov/home/hqnews/2011/mar/HQ_11-065_Glory_Board.html.

²² "US Still Probing Security Satellite Failure", *Reuters*,

<http://www.reuters.com/article/2009/01/06/us-northrop-satellite-idUSTRE5055DW20090106>.

²³ "Global Positioning System: Significant Challenges in Sustaining and Upgrading Widely Used Capabilities", *GAO*, GAO-09-670T; "Air Force Responds to GPS Outage Concerns", *PCWorld*, http://www.pcworld.combusinesscenter/article/165305/air_force_reponds_to_gps_outage_concerns.html.

²⁴ "GPS Satellites Not Falling Out of the Sky: Air Force", *Physorg*, <http://phys.org/news162133400.html>.

U.S. REACTIONS TO FOREIGN DISRUPTION OF U.S. CAPABILITIES

In the 1970s, it was suspected that a U.S. maritime communications satellite was turned off by the Soviets when it was outside of the range of U.S. tracking stations.²⁵ There does not appear to be any documented U.S. reaction, and I suspect there was none. In the mid-1990s, satellite hackers in Brazil began hijacking U.S. military communication satellite signals to broadcast their own information, though it took until 2009 for Brazil to crack down on the illegal activity with the support of the DoD.²⁶ In 1998, a U.S.-German satellite known as ROSAT was rendered useless after it turned suddenly toward the sun. NASA investigators later determined the accident was possibly linked to a cyber-intrusion by Russia. The fallout? Though there was an ongoing criminal investigation as of 2008; NASA security officials have seemed determined to publicly minimize the seriousness of the threat.²⁷ In 2003, a signal originating from Cuba—later determined to be coming from Iranian embassy property—was jamming a U.S. communications satellite that was transmitting Voice of America programming over Iran, which was publicly referred to as an “act of war” by a U.S. official.²⁸ Press reporting indicates the U.S. administration was “paralyzed” about how to cope with the jamming that continued for at least a month, even after U.S. diplomatic protests to Cuba.²⁹ In 2005, U.S. diplomats protested to the Libyan government

²⁵ “U.S. favors stealthy anti-satellite strategy”, *MSNBC*, http://www.msnbc.msn.com/id/18023834/ns/technology_and_science-space/t/us-favors-stealthy-anti-satellite-strategy.

²⁶ “The Great Brazilian Sat-Hack Crackdown”, *Wired*, <http://www.wired.com/politics/security/news/2009/04/leetcom>.

²⁷ “The Taking of NASA’s Secrets”, *Businessweek*, http://www.businessweek.com/magazine/content/08_48/b4110072404167.htm.

²⁸ “Iran, Cuba Zap U.S. Satellites”, *WorldNetDaily*, http://www.wnd.com/news/article/asp?ARTICLE_ID=33957; “Cuba Blows the Whistle on Iranian Jamming”, *Asia Times*, http://www.atimes.com/atimes/Middle_East/EH22Ak03.html.

²⁹ “Iran, Cuba Zap U.S. Satellites”, *WorldNetDaily*, http://www.wnd.com/news/article/asp?ARTICLE_ID=33957.

after two international satellites were illegally jammed disrupting American diplomatic, military, and FBI communications.³⁰ In 2006, press reporting indicates that China hit a U.S. spy satellite with a ground-based laser. This action was acknowledged by the then director of the NRO, though the DoD remained tight lipped about the incident.³¹

“We’re at a point where the technology’s out there, and the capability for people to do things to our satellites is there. I’m focused on it beyond any single event.”

– Air Force Space Command Commander, General Chilton, 2006³²

In 2009, a U.S. commercial Iridium communications satellite—extensively used by the DoD—was accidentally destroyed by a collision with a dead Russian satellite.³³ The U.S. company, Iridium, was able to minimize any loss of service by implementing a network solution within a few days.³⁴ As of early 2011, no legal action had been taken by the company either because it is not clear who was at fault or because it might be politically problematic for the United States, which is trying to enter into bi-lateral

³⁰ “Protests to Libya After Satellites Jammed”, *The Guardian*, <http://www.guardian.co.uk/uk/2005/dec/03/politics.libya>.

³¹ “China Jamming Test Sparks US Satellite Concerns”, *USA Today*, http://www.usatoday.com/tech/news/2006-10-05-satellite-laser_x.htm.

³² “China Jamming Test Sparks US Satellite Concerns”, *USA Today*, http://www.usatoday.com/tech/news/2006-10-05-satellite-laser_x.htm.

³³ “DISA Establishes Portal for Telecom Satellite System”, *GCN*, <http://gcn.com/articles/1998/11/09/disa-establishes-portal-for-telecom-satellite-system.aspx>; “Iridium Says Space Collision Risk Low”, *Reuters*, <http://www.reuters.com/article/2011/09/09/us-arms-aero-summit-iridium-idUSTRE78809J20110909>; “US Satellite Destroyed in Space Collision”, *Space.com*, <http://www.space.com/5542-satellite-destroyed-space-collision.html>.

³⁴ “US Satellite Destroyed in Space Collision”, *Space.com*, <http://www.space.com/5542-satellite-destroyed-space-collision.html>.

transparency and confidence-building measures (TCBM) with Russia regarding space activities.³⁵ Since August of 2010, North Korea has been intermittently using GPS jamming equipment, which reportedly has been interfering with U.S. and South Korean military operations and civilian use south of the North Korean border.³⁶ Reportedly, only South Korea and the United Nations International Telecommunications Union—at the request of South Korea—have issued letters to Pyongyang demanding the cessation of disruptive communications signals in South Korea.³⁷

It appears that the only time the U.S. military has responded with force to a disruption in U.S. space capabilities was in 2003, a few days after the start of the Iraq war.³⁸ According to U.S. officials, Iraq was using multiple GPS jammers—which supposedly did not affect military GPS functionality. However, the U.S. military bombed the jammers anyway after a diplomatic complaint to Russia.³⁹ The use of military force against the GPS jamming threat was possibly because the

United States was already intervening in Iraq, and the bombing probably would not have occurred if the United States was not at war.

A foreign actor researching U.S. investments in space and observing that (a) failed U.S. satellites appeared not to be reconstituted immediately, (b) U.S. public reaction to the losses was minimal, and (c) U.S. reactions to foreign disruptions were inconsistent could come to the judgment that **there appears to be some redundancy in capability in the U.S. space architecture and/or a tolerance of loss within the U.S. Government.** The President is still making his phone calls, missiles are still finding their targets, and satellites are still taking pictures of North Korea's nefarious efforts.⁴⁰

U.S. INVESTMENTS IN COUNTERSPACE

According to my review of publicly available information, the United States has *tested* and/or *deployed* a number of counterspace capabilities over the years that could incapacitate or destroy a satellite (see Figure 1). These capabilities go back to the start of the U.S. space program and range from high-altitude nuclear explosions,⁴¹ direct-ascent anti-satellite (ASAT) tests,⁴² directed energy ASAT tests,⁴³ rendezvous operations,⁴⁴ electronic negation,⁴⁵ to radio-frequency

³⁵ "Iridium Satellite Collision: Are Legal Consequences Forthcoming?", *Examiner.com*, <http://www.examiner.com/space-policy-international/iridium-satellite-collision-are-legal-consequences-forthcoming>.

³⁶ "S. Korea Blames North for GPS, Phone Jamming", *Defense News*, <http://www.defensenews.com/story.php?i=5883068>; "North Korea Upgrades its Military Jamming Devices", *MSN*, <http://www.arabia.msn.com/Technology/News/DS/2011/September/8985162.aspx>.

³⁷ "North Korea Upgrades its Military Jamming Devices", *MSN*, <http://www.arabia.msn.com/Technology/News/DS/2011/September/8985162.aspx>; "DPRK Attempts to Block ROK GPS Signals", *North Korean Economy Watch*, <http://www.nkeconwatch.com/2011/03/20/dprk-attempts-to-block-rok-gps-signals/>.

³⁸ "Russian Dealers Provide Iraq with Supplies, Electronics", *Fox News*, <http://www.foxnews.com/story/0,2933,81917,00.html>.

³⁹ "CENTCOM Charts Operation Iraqi Freedom Progress", *Defense.gov*, <http://www.defense.gov/news/newsarticle/asp?id=29230>; "In Iraq, GPS Is Surviving Jamming Threat, Pentagon Says" *Aviation Week*, http://www.aviationweek.com/aw/jsp_includes/articlePrint.jsp?headline=null&storyID=news/gps.xml.

⁴⁰ "Satellite images fuel intrigue over North Korea Intentions", *CNN*, http://articles.cnn.com/2010-11-18/world/north.korea.nuclear_1_yongbyon-siegfried-hecker-new-nuclear-reactor?_s=PM:WORLD.

⁴¹ "High-altitude nuclear explosion", *Wikipedia*, http://en.wikipedia.org/wiki/High_altitude_nuclear_explosion.

⁴² "Bold Orion", *Encyclopedia Astronautica*, www.astronautix.com/lvs/bolorion.htm; "ASM-135 ASAT", *Wikipedia*, http://en.wikipedia.org/wiki/ASM-135_ASAT.

⁴³ Secretary of Defense Approves Laser Experiment to Improve Satellite Protection, US DoD, <http://www.defense.gov/releases/release.aspx?releaseid=1431>.

⁴⁴ "AFRL Space Vehicles Directorate, Fact Sheet", *US Air Force*, http://www.kirtland.af.mil/library/factsheets/factsheet_print.asp?fsID=7873&page=1.

⁴⁵ "U.S. favors stealthy anti-satellite strategy", *MSNBC*, <http://www.msnbc.msn.com/id/18023834/ns/technolog>

jamming.⁴⁶ In 2004, the U.S. Air Force even published its doctrine on counterspace operations that states it will take any action necessary to achieve space superiority to include operations to deceive, disrupt, deny, degrade, or destroy any adversary's capabilities.⁴⁷ This doctrine which is very clear in its intentions certainly comes across as dominating in tone and potentially unpalatable for a U.S. administration in office during peacetime. Additionally, I have yet to see how it has been applied to the previous section's discussion of disruptions of U.S. satellites, except in substance when the United States was at war with Iraq. Furthermore, I would contend that the way the U.S. Air Force implements its counterspace doctrine appears to be influenced by the U.S. Congress, which has publicly expressed its discontent about U.S. efforts to build ASAT weapons.⁴⁸ Additionally, it has been reiterated multiple times by U.S. officials that the United States is focusing its counterspace efforts on reversible capabilities such as jamming. The United States admits to possessing such

capabilities, and they run counter to the Air Force doctrine's concept of destruction.⁴⁹

Though the United States appears to be moving towards less destructive perhaps more reversible counterspace capabilities, the precedent has been set for foreign countries that counterspace capabilities are acceptable to possess.

REACTIONS TO U.S. AND FOREIGN COUNTERSPACE ACTIVITIES

According to open source information, China tested a direct-ascent ASAT multiple times, but the United States did not formally protest until China intercepted a satellite and created the single worst contamination of orbital debris in fifty years, threatening U.S. satellites.⁵⁰ Also, according to press reporting, China, Iran, Libya, Turkey, and non-government organizations (NGO) have used jamming against non-U.S. communication satellites. Taiwan claims to have the ability, and China has proliferated communication jamming technology to other countries, but I could not identify any U.S. official protests.⁵¹ Hackers in England reportedly took

y_and_science-space/t/us-favors-stealthy-anti-satellite-strategy.

⁴⁶ "4th Space Control Squadron, fact sheet", *US Air Force*,

<http://www.peterson.af.mil/library/factsheets/factsheet.asp?id=4707>; "US Deploys Warfare Unite to Jam Enemy Satellites", *Washington Times*, <http://www.washingtontimes.com/news/2005/sep/21/20050921-102706-1524r>.

⁴⁷ "Counterspace Operations", *Air Force*, Air Force Doctrine Document 2-2.1.

⁴⁸ "China Jamming Test Sparks US Satellite Concerns", *USA Today*,

http://www.usatoday.com/tech/news/2006-10-05-satellite-laser_x.htm; "Near Field Infrared Experiment", *Wikipedia*,

<http://en.wikipedia.org/wiki/NFIRE>; "All's Fair in Space War", *Wired*,

<http://www.wired.com/science/space/news/2004/10/65151?currentPage=2>; "China's Satellite Jamming test Creates International Concerns", *Aviation Today*,

http://www.aviationtoday.com/regions.usa/Chinas-Satellite-Jamming-Test_Creates-International-Concerns; "A history of anti-satellite programs "Congress banned ASAT testing December 1985"", *Union of Concerned Scientists*,

http://www.ucsusa.org/assets/documents/nwgs/a-history-of-ASAT-programs_lo-res.pdf.

⁴⁹ "All's Fair in Space War", *Wired*,

<http://www.wired.com/science/space/news/2004/10/65151?currentPage=2>; "US Deploys Warfare Unite to Jam Enemy Satellites", *Washington Times*, <http://www.washingtontimes.com/news/2005/sep/21/20050921-102706-1524r>.

⁵⁰ "China's Anti-Satellite Weapon Test", *CRS Report for Congress RS22652*,

<http://opencrs.com/document/RS22652/>; "Satellite Kill Likely to Have Equal Impact on Terra Firma", *Financial Times*, www.ft.com/cms/s/0/9a943dac-a82a-11db-b448-0000779e2340.html; "China's AntiSatellite Test: One Year Later – Troubling Aftermath", *Newswise*, <http://www.newswise.com/articles/chinas-anti-satellite-test-one-year-later-troubling-aftermath>.

⁵¹ "Firedrake – The Source of China's Radio Jammer Found on Chinasat 6B", *satdirectory*,

<http://www.satdirectory.com/firedrake.html>; "Iran Government Jamming Exile Satellite TV", *Iran News Focus News and Analysis*,

http://www.iranfocust.com/en/?option=com_content&task=view&id=2852; "Protests to Libya After Satellites Jammed", *The Guardian*,

<http://www.guardian.co.uk/uk/2005/dec/03/politics.libya>; "China to Launch its First Anti-jamming Satellite Next Year", *People Daily*,

control of a British military communication satellite in 1999. Though the British Government denied it, they supposedly investigated, with the help of the U.S. Government, to make arrests.⁵² In 2008, Russia used satellite communications jamming during the Russo-Georgian war and reportedly has proliferated GPS jamming equipment to North Korea and Iraq.⁵³

The 2010 U.S. National Space Policy (NSP) states the United States will adhere to a number of principles to include considering the space systems of all nations to have the rights of passage through space without interference and that purposeful interference is an infringement on a nation's rights.⁵⁴ The NSP also promises to "demonstrate U.S. leadership in space-related fora and activities..." so why is there little U.S.

reaction greater than U.S. officials expressing "concerns" over foreign counterspace actions? Either these actions do not meet the threshold for a U.S. diplomatic or military response, or a U.S. reaction may come across as hypocritical with respect to current U.S. counterspace actions.

The public perception of U.S. counterspace capabilities and U.S. *reactions* to foreign counterspace activities is important when considering possible U.S. redlines in space; however, perceptions of the United States using these capabilities *against other countries* is even more insightful. According to my review, the United States has only *used* reversible counterspace capabilities against foreign satellites, specifically jamming, and it appears to have avoided using counterspace capability resulting in the permanent loss of a foreign satellite.⁵⁵

A foreign country following U.S. actions in space may perceive that U.S. counterspace actions are within acceptable norms and, having noted an inconsistent U.S. response to foreign counterspace activities, may come to the judgment that **U.S. actions suggest a foreign adversary could safely test a counterspace system, deploy it and use it, possibly denying some U.S. space capabilities temporarily, but not cause permanent loss of a U.S. satellite.** It should be noted that this perception of a possible U.S. redline runs counter to the 2011 National Security Space Strategy (NSSS), which states that "We seek to enhance our national capability to dissuade and deter the development, testing, and employment of counterspace systems and prevent and deter aggression against space systems...that support U.S. national security."⁵⁶

It is further noted that more recent U.S. counterspace capabilities, the 2010 NSP, and the U.S.A-193 shoot-down appear to emphasize minimizing orbital debris. The U.S. reaction to China's ASAT test only after it created an orbital

http://english.peopledaily.com.cn/200403/04/eng20040304_136475.shtml; "Roj TV, Kurdish Satellite Television in Turkey Signal Blocked by Turkey", *Zimbio*,

<http://www.zimbio.com/World+Politics/articles/-UxEYTATmej/Roj+TV+Kurdish+Satellite+Television+Turkey>; "Military Says That it Can jam China's Signals, but Won't", *Taipei Times*,

<http://www.taipeitimes.com/News/taiwan/archives/2002/10/02/0000170369>; "Ethiopian Satellite Television (ESAT) Accuses China of Complicity in Jamming Signals", *ECADF News*,

<http://ecadforum.comethiopian-news/8661/>.

⁵² "SkyNet Satellite Hacked?", *dailywireless.org*, <http://www.dailywireless.org/2007/05/08/skynet-satellite-hacked/>; "Security: British "Skynet" Satellite Hacked!!!", *Black Falcon Software Technical News*, <http://blackfalconssoftware.wordpress.com/2007/05/09/security-british-military-satellite-hacked/>; "Satellite Hack Raises Security Questions", *CNET News*, http://news.cnet.com/Satellite-hack-raises-security-questions/2100-1033_3-222516.html.

⁵³ "S. Korea Blames North for GPS, Phone Jamming", *Defense News*,

<http://www.defensenews.com/story.php?i=5883068>; "GPS Jammers in Action", *Strategy Page*,

<http://www.strategypage.com/htm/w/htecm/articles/20110913.aspx>; "Georgia Eager to Rebuild Its Defeated Armed Forces", *The New York Times*, <http://www.nytimes.com/2008/09/03/world/europe/03georgia.html>.

⁵⁴ "National Space Policy of the United States of America", *USG*, http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf.

⁵⁵ "Army Official Says U.S. Is Blocking Terrorist Signals", *Space News*,

<http://www.spacenews.com/archive/archive07/campbell10827.html>.

⁵⁶ "National Security Space Strategy", http://www.defense.gov/home/features/2011/0111_nsss/docs/NationalSecuritySpaceStrategyUnclassifiedSummary_Jan2011.pdf.

mess, creates the perception of a possible U.S. redline that a foreign actor should not create extensive, permanent debris in orbit.

U.S. INVESTMENTS IN SPACE PROTECTION

Protecting U.S. space capabilities has been a concern since almost as long as the first satellites were orbited, with early investments being made in anti-jamming for communications and later in nuclear hardening.⁵⁷ Many statements can be found throughout the decades by U.S. officials expressing concern over the vulnerabilities of U.S. satellite capabilities, and a number of U.S. Government organizations have been created to research or implement solutions.⁵⁸ But the overarching issue of protecting the U.S. space architecture has not risen to the highest levels of sustained attention until more recently with the proliferation and use of foreign anti-satellite capabilities, the increasingly visible reliance of the U.S. Government and its citizens on space systems, and the mounting warnings of a coming “space Pearl Harbor”, as noted by the incoming Secretary of Defense in 2001.⁵⁹

⁵⁷ “Thirty Years of Space Communication Research and Development at Lincoln Laboratory, Chapter 8”, *NASA*, <http://history.nasa.gov/SP-4217/ch8.htm>; “Can You Hear Me Now?”, *Talking Shop, US Army*, http://www.smde-armyforces.army.mil/Pic_Archive/ASJ_PDFs/ASJ_VO_L_10_NO_2_011.pdf.

⁵⁸ “C4I For the Warrior – Global Command and Control System”, US Army; “Rumsfeld Commission Warns Against “Space Pearl Harbor””, *Spacedaily*, <http://www.spacedaily.com/news/bmdo-01b.html>; “US Space System Survivability”, *Robert B. Giffen*, National Defense University; “16th Space Control Squadron, Factsheet”, US Air Force, <http://www.peterson.af.mil/library/factsheets/factsheet.asp?id=8403>; “76th Space Control Squadron, Factsheet, US Air Force”, <http://www.peterson.af.mil/library/factsheets/factsheet.asp?id=4808>; “US Air Force, Spy Agency team up for Space Protection”, *Space.com*, <http://www.space.com/5224-air-force-spy-agency-team-space-protection.html>.

⁵⁹ “Rumsfeld Commission Warns Against “Space Pearl Harbor””, *Spacedaily*, <http://www.spacedaily.com/news/bmdo-01b.html>.

U.S. SPACE POLICIES AND PROTECTION PRIORITIES

In 2008, the U.S. Government created a joint DoD/Intelligence Community National Space Protection Program (SPP) to protect all defense, intelligence, civil, commercial, and allied space systems and articulate vulnerabilities and recommend solutions.⁶⁰ This program appears to have recommended funding and tasks according to an FY11 SPP Program Element, which is designed to convey key information about a budget request.⁶¹ The technical assessment study tasks listed in the funding request provide insight into possible high-priority space-related capabilities that the U.S. Government wants to protect.

The tasks were listed as follows:

SPP TASK A

- PNT Recommendations⁶²
- Assured C2 Study Protection⁶³
- Assured C2 Cyber Assessment
- Critical Infrastructure Protection Assessments
- Hosted Payloads on Commercial Satellites Study⁶⁴

⁶⁰ “RDT&E Budget Justification Item, PE 0603830F Space Protection Program”, *DoD*, http://www.dtic.mil/descriptivesum/Y2011/AirForce/0603830F_PB_2011.pdf; “US Air Force, Spy Agency team up for Space Protection”, *Space.com*, <http://www.space.com/5224-air-force-spy-agency-team-space-protection.html>.

⁶¹ “RDT&E Budget Justification Item, PE 0603830F Space Protection Program”, *DoD*, http://www.dtic.mil/descriptivesum/Y2011/AirForce/0603830F_PB_2011.pdf.

⁶² I assume PNT to mean positioning, navigation, and timing, which is usually related to GPS satellites and related systems

⁶³ I assume C2 to mean command and control of U.S. nuclear strategic deterrence capabilities.

⁶⁴ I assume a hosted payload is the *capability* to support secondary payloads to potentially support back-up capabilities for other sensors on orbit as opposed to the commercial satellite itself.

“We’re not trying to save satellites. We’re trying to preserve our national space... imagery, communications networks, and positioning signals the U.S....rely on.”

– Director, Space Protection Program, 2008 ⁶⁵

Additionally, a review of the 2010 NSP provides guidance and key concepts that could provide foreign actors insight into which space capabilities the United States considers most important. The only satellite system specifically noted is GPS, but other capabilities are alluded to such as communications and national security systems—which could appear to be almost any type of satellite. The absence of specific space systems is further noted in the NSP with statements such as “ensure...survivability of space capabilities”, instead of stating something like *ensure the survivability of satellite X*. ⁶⁶

The NSP provides guidelines on how to implement its goals, which are written into different sections. The section header does not provide a description of what it means, so I have provided my own comments (after the *) of what could be interpreted based on what the heading and its section discuss. The following are the most relevant examples of those guidelines relating to possible U.S. redlines in space from the NSP. ⁶⁷

- Foundational Capabilities (**ensure basic capability?*)
 - Mitigate and increase resiliency to harmful interference to GPS...and implement...redundant and back-up systems

⁶⁵ “U.S. space protection strategy emphasizes cooperation”, *Defensenews*, <http://www.defensenews.com/print/article/20081002/C4ISR01/810020301/U-S-space-protection-strategy-emphasizes-cooperation>.

⁶⁶ “National Space Policy of the United States of America”, *USG*, http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf.

⁶⁷ “National Space Policy of the United States of America”, *USG*, http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf.

- RF...Interference Protection (**appears related to communications*)
 - Identify, locate, and attribute sources of RF interference...sustain the RF environment in which critical U.S. space systems operate
- ...Mission-Essential Functions (**are there any missions that can only be done from space?*)
 - Assure space-enabled mission-essential functions
- National Security Space Guidelines (**could be anything but I assume communications, ISR, or weather satellites because allied, foreign, and/or commercial capabilities are limited to only those capabilities.*)
 - ...operate space systems...to support...defense and intelligence operations during peace, crisis, and conflict...ensure... survivability of space capabilities...and the availability of other means to perform the mission...options may include...leveraging ...allied, foreign, and/or commercial...capabilities

Furthermore, the 2011 NSSS states that the United States needs to “fight through a degraded environment...ensure the timely continuity of services...strengthen the resilience of our architectures...achieved in a variety of ways, to include...cross-domain solutions, hosting payloads on a mix of platforms...international and commercial partners, and developing...responsive space capabilities.”⁶⁸

A foreign actor examining U.S. space policies and researching U.S. investments in satellite protection may conclude that the **temporary loss of C2 or the permanent denial or loss of communication capabilities, commercial satellites hosting U.S. Government payloads, GPS, launch facilities and ground stations, and possibly ISR and weather capabilities may represent U.S. redlines**. Both the NSP and the NSSS appear to concede the probable loss of satellites by stating, “ensure... other means to

⁶⁸ “National Security Space Strategy”, http://www.defense.gov/home/features/2011/0111_nsss/docs/NationalSecuritySpaceStrategyUnclassifiedSummary_Jan2011.pdf.

perform the mission” or “fight through a degraded environment...in a variety of ways.”⁶⁹ It appears the United States may accept the permanent loss of some individual U.S. satellites but not the capabilities they provide.

ATTRIBUTION

There would be little use for the United States to have redlines in space if it cannot attribute an attack. U.S. investments in space situational awareness (SSA) indicate an interest in threat attribution and may add credibility to support possible U.S. redlines in space.

The 2011 NSSS notes that “SSA and foundational intelligence will continue to be top priorities, as they underpin our ability to maintain awareness of natural disturbances and the capabilities, activities, and intentions of others.”⁷⁰

The 2010 NSP also acknowledges the need for attribution, as stated by “...develop...use space situational awareness information...to detect, identify, and attribute actions in space”.⁷¹

Furthermore, the U.S. Government appears to be acting on its policy statements by investing in attribution, increasing funding for SSA capabilities (see Figure 2).

Guidance in current space policy documents plus investments in U.S. SSA capabilities indicate an interest in threat attribution, and U.S. investments in attribution may yet add credibility for possible U.S. redlines in space.

⁶⁹ “National Space Policy of the United States of America”, *USG*, http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf; “National Security Space Strategy”, http://www.defense.gov/home/features/2011/0111_nsss/docs/NationalSecuritySpaceStrategyUnclassifiedSummary_Jan2011.pdf.

⁷⁰ “National Security Space Strategy”, http://www.defense.gov/home/features/2011/0111_nsss/docs/NationalSecuritySpaceStrategyUnclassifiedSummary_Jan2011.pdf.

⁷¹ “National Space Policy of the United States of America”, *USG*, http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf.

CONCLUSION: PERCEIVED U.S. REDLINES?

The majority of examples that I cite of U.S. investments, policies, or statements about space, counterspace, and space protection, as well as U.S. reactions to foreign counterspace actions have occurred during relatively peaceful times. As such, redlines based on prior U.S. actions may quickly change in a wartime scenario as suggested by the relatively quick response to GPS jamming during the Iraq war. Additionally, perceived redlines for each type of space capability may become more clear as more incidents and U.S. reactions are able to be analyzed. Based on my research of publicly available data and judging what may be perceived by a foreign actor that analyzes U.S. actions, I would suggest the following possible U.S. redlines in space.

The United States may be tolerant of deployed foreign counterspace capabilities and temporary loss of most types of U.S. space capabilities—except C2—but not tolerant of the permanent loss of GPS; commercial satellites hosting U.S. Government payloads; communications and possibly ISR or weather capabilities; launch facilities and ground stations; or intentional creation of permanent orbital debris.

SUGGESTIONS FOR FURTHER RESEARCH

Some important and perhaps urgent questions remain after this review of open source information. For example, what about missile early warning capabilities? DSP is usually thought of as an important strategic asset, but where is it in current space policy doctrine? Does the United States believe early warning enhances stability – is that well known? Is it just assumed that DSP will only be targeted before nuclear war?

How long is a “temporary” degradation of U.S. space capabilities? Satellite hackers in Brazil illegally used a U.S. military communications satellite for years without attribution, but diplomatic protests were quickly delivered to Cuba after the 2003 jamming incident. The United States may react differently to temporary disruptions if they happen during a military crisis.

Foreign disruptions of GPS were very quickly resolved at the start of the Iraq war, but that was only one capability and the threat was ground-based. How would the United States react if multiple space capabilities were temporarily lost from a space-based threat?

Also, what about commercial satellites without U.S. Government hosted payloads? They appear to be part of the backup plan for the possible loss of national space capabilities, but how will the United States react if a farmer cannot get an overhead picture of his crops; Google Earth cannot be updated in a timely fashion; or U.S. citizens are denied the ability to watch the Super Bowl?

Finally, what about scientific and weather satellites? They generally have low visibility despite how much money has been spent on these capabilities throughout the decades. One notable aspect these satellites have is their unfortunate selection as past ASAT targets for the United States and China.⁷² Have military agencies inadvertently supported the perception that these capabilities are disposable and could be used as ASAT targets for strategic warning?

⁷² “ASM-135 ASAT”, *Wikipedia*, http://en.wikipedia.org/wiki/ASM-135_ASAT; “China’s Anti-Satellite Weapon Test”, *CRS Report for Congress RS22652*, <http://opencrs.com/document/RS22652/>.

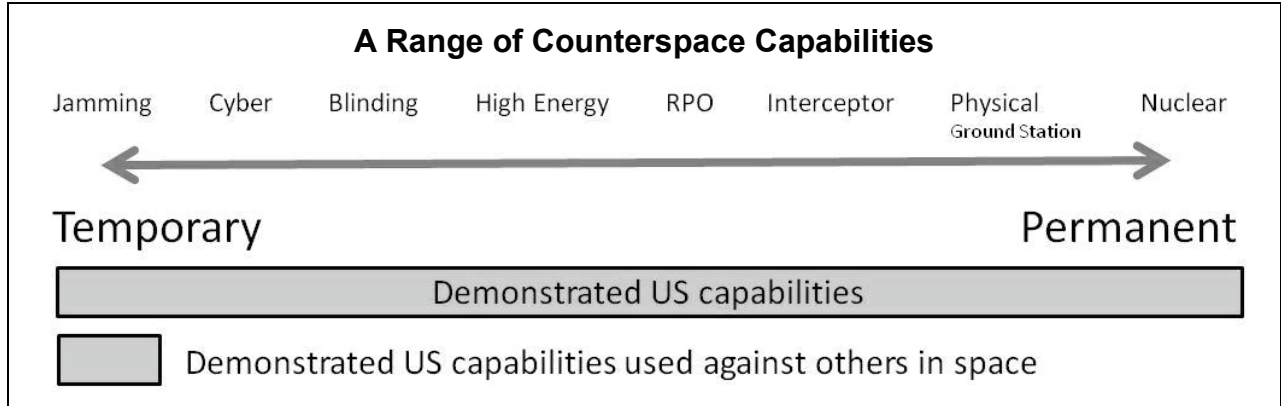


Figure 1: Analysis of the range of demonstrated or acknowledged U.S. capabilities that have been or could be used against satellites or space-related systems.

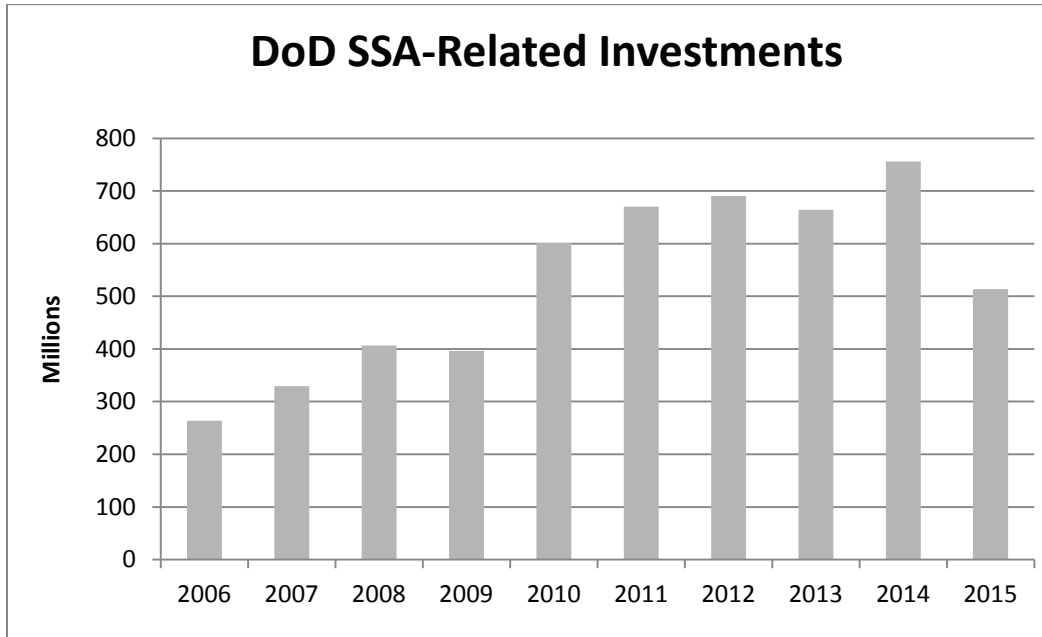


Figure 2: GAO analysis of unclassified DoD budget submission data for fiscal years 2008 through 2011, actual and estimated budget data, GAO-11-545