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Jana Robinson
European Space Policy Institute, JanaRobinson@edu.edu

Michael Romancov
Charles University, michaelRomancov@edu.edu

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Space Crisis Management: Filling the Gaps

Jana Robinson
European Space Policy Institute, Vienna, Austria
Michael Romancov
Charles University, Prague, Czech Republic

The geopolitical influence of countries is most often measured by their economic strength, government stability, technological achievements, defense capabilities and overall international standing. For the United States and other select countries, space offers major strategic advantages and many nations are now competing to derive greater civilian, commercial, and military benefits from their presence in space. Protection of space assets and ensuring a stable and safe space environment are the responsibility of those that operate them, as well as those that formulate space policies. The quest for a workable space regime is appearing more often on the agendas of national and international security gatherings, and misconduct in space could have profound implications for terrestrial geopolitics. The reverse is also true, and the most likely threats to space, at least in our time, will be connected to heightened terrestrial tensions or conflict.

One of the operational and political challenges is the ability to assess accurately situations in space, and to respond effectively to emergencies and disruptive activities there. In this sense, space presents a unique challenge for crisis management. This article will explore the status of the security debate as it pertains to collaborative space crisis prevention and management as well as specific actions to avoid disruptive incidents or conflicts in space. It will first seek to define space crisis management, review potential causes or catalysts, compare the approaches of the United States and the EU, and provide achievable policy recommendations. This conceptual analysis of the fundamental issues at play will hopefully contribute to ever-more effective space crisis management.

This paper stems from cooperation between the European Space Policy Institute (ESPI) and the Department of Political Science at the Faculty of Social Sciences' Institute of Political Studies (IPS) at Charles University in Prague. It is part of a broader ESPI project on Space Crisis Management, which, in turn, originated from a major international conference entitled "Space Security through the Transatlantic Partnership", co-organized by ESPI and the Prague Security Studies Institute (PSSI) in June 2011.[1] As part of the Space Crisis Management project, ESPI convened a roundtable in March 2012 to: 1) identify available tools for space crisis prevention; 2) delineate essential ingredients of effective space crisis management; and 3) provide realistic scenarios that could trigger crisis management responses.[2]

THE SPACE CRISIS MANAGEMENT REQUIREMENT

The growing volume of orbital debris, increasing number of space-faring nations and aspirants, new and emerging space technologies, and their proliferation to a large number of state and non-state actors all point to an increasing potential for a space-related crises. At the same time, management of such a crisis is a complex endeavor requiring a well-crafted vision and architecture for global space security as well as a

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[1] More information about the conference can be found at the following link: http://www.pssi.cz/conferences-and-roundtables/1 .

[2] More information about the roundtable can be found at the following link: http://www.espi.or.at/index.php?option=com_content&view=article&id=797:29-march-2012-space-crisis-management-roundtable-convened-at-espi&catid=39:news-archive&Itemid=37 .

strategic approach to contextualizing and responding to challenges in this environment.

It is useful to note that there are two broad categories of space-related crises: natural and man-made. The public perception of the negative effects caused by the first type of crisis would likely be fundamentally different than the second. While the public response to a terrestrial natural catastrophe is generally positive and generous, the reaction in case of man-made space trauma would probably be swift and harsh, especially as the harmful knock-on effects were calculated. Such complex and uncertain situations could be manipulated, rather than controlled, by certain political elites and public opinion. The unexpected outbreak of World War I in 1914, in reaction to a political crisis, serves as a sober reminder of unintended escalatory spirals.

Beyond natural hazards (e.g., space debris, space weather), the growing dependence on space assets and the limited capability to protect them, compounded by the problem of verifying activities in space, all present daunting challenges to managing a space crisis. The high level of integration of space assets into military operations, particularly in the cases of the United States and Russia, make these assets tempting targets. Indeed, any meaningful disruption of essential space functions or operations would likely require extensive political and technical damage control.

While the United States is, without question, the most advanced space power, several other space-faring nations are seeking to increase their influence in world affairs via space. This competitive, and increasingly contested, environment is not particularly conducive to efforts to establish rules of the road for space and new forms of cooperation. In short, space is still perceived as an ideal arena for demonstrating a nation's pride, independence, and capabilities.

Accordingly, the ability of Washington and its allies (e.g., the EU) to be accepted as the "rule-maker" is diminished and often regarded as suspect by those space actors that view space as a sphere of opportunity to enhance their strength and even challenge U.S. primacy. Communication among these actors, and achieving consensus among them, under such circumstances is difficult, if not impossible.

In tackling these challenges, it is helpful to examine some of the key causes of a possible space crisis. Patrick Lin, Associate Professor at the California Polytechnic State University, for example, reflected on a seemingly remote aspect of a potential space crisis. In his 2006 article on "space ethics", he pointed out: "… relevant lessons from history may include our recent development of cyberspace, or the Internet frontier. Without planning ahead for related intellectual property issues as well as online sales tax, Internet crimes, and other areas, the rush into cyberspace has been messy at best."[3]

With regard to space exploration and exploitation he added: "What is to prevent problems on Earth from following us into outer space, if we have not evolved the attitudes, and ethics, which have contributed to those problems? ... We have already littered the orbital environment in space with floating debris that we need to track so that spacecraft and satellites navigate around, not to mention abandoned equipment on the Moon and Mars."[4] The intention of several countries to exploit lunar elements and minerals may also one day lead to a crisis should the legal status of the celestial bodies not be adequately clarified.[5]

In the United States, the Department of Defense (DOD) views the space environment as having fundamentally changed and describes it with the so-called "three Cs" (i.e. congested, contested and competitive). Space is increasingly congested due primarily to space debris, contested by a growing array of foreign counterspace capabilities, and competitive as more and more countries and companies operate in space.

If one accepts that the space backdrop is shaped by the "3 Cs", an issue becomes how to best delineate the "international relations" arena where all actors in a potential conflict should be involved in its resolution. Another well-known category of "3 Cs" -- cooperative, competitive and

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[3] Patrick Lin, "Viewpoint: Look before Taking another Leap for Mankind – Ethical and Social Considerations in Rebuilding Society in Space," *Astropolitics* Vol. 4 (2006): 281-294.
[4] Ibid.: 285.
[5] Andrew Brearley, "Mining the Moon: Owning the Night Sky?" *Astropolitics* Vol. 4 (2006): 43-67.

confrontational -- has also been used to describe world affairs more generally and assumes that each stage of a potential conflict involves different behavior on the part of rational actors. That said, it is currently difficult to anticipate the reactions of many members of the international community to a crisis in space, as different actors attach varying levels of importance to space capabilities.

Terrestrial Crisis Management

The concept of terrestrial crisis management has largely been associated with the U.S. – USSR Cold War competition and prominently involved ensuring the non-use of nuclear weapons and supporting technologies (e.g. strategic bombers, ballistic missiles, etc.). "Nuclear" crisis management consists of structuring nuclear forces to provide a sufficient deterrent against their use by a rival (including via arms control arrangements) as well as advancing strict control of nuclear forces in a crisis to prevent unauthorized or accidental use of nuclear weaponry.

The 1962 Cuban Missile Crisis is considered one of the most acute Cold War clashes that involved intense interaction between the two powers and careful policy decision-making. This crisis represented "a period of acute tension between states that threatened the prospect of major war".[6] Three conceptual models of Graham Allison from the 1960s, using the Cuban Missile Crisis as a case study, have been widely applied to address terrestrial crisis management solutions. These models were "rational policy" (I), "organizational process" (II), and "bureaucratic politics" (III). Model I portrays a state as a single rational policy decision-maker. According to Model II, the sub-units of the government follow established procedures and produce a policy option consistent with these pre-determined steps. In Model III, a policy decision is a negotiated bargain between individuals in charge of various responsibilities within the Executive Branch of government (e.g. Secretary of State, Secretary of Defense, etc.) which often concentrate on different angles of the same issue.[7]

After the Cuban Missile Crisis, unilateral and bilateral measures were adopted to assist in streamlining political processes and prevent a dangerous escalatory spiral between the two powers that could ultimately result in a large-scale military conflict. These measures included, for example, improved nuclear command and control arrangements, the U.S. – Soviet Hotline, and the 1972 Agreements on Measures to Reduce the Risks of Nuclear War.

Today, crisis management focuses on strategic questions involving a variety of international actors. Accordingly, the connection between a crisis and the use of force is more subtle. In this environment, the term "crisis" can be defined as "a perception by the highest level decision-makers of a threat to one or more basic values, along with an awareness of finite time for response to the value threat, and a heightened probability of involvement in military hostilities".[8]

In the post-Cold War era, an example of crisis prevention was the June 2000 Memorandum of Agreement between the United States and the Russian Federation on the Establishment of a Joint Center for the Exchange of Data from Early Warning Systems and Notifications of Missile Launches. In the Memorandum, the United States and Russia agreed, for the first time, to a permanent joint operation involving U.S. and Russian military personnel to enhance strategic stability between the two counties. It established a Joint Data Exchange Center (JDEC) in Moscow for the sharing of information derived from each side's missile launch warning systems on the launches of ballistic missiles and space launch vehicles. In December 2000, the United States and USSR signed a Memorandum of Understanding establishing a Pre- and Post-Launch Notification System (PLNS) for ballistic and space launch vehicles launches. It is envisioned to be an Internet-based system operated as part of the JDEC. Both JDEC and PLNS make provisions for

[6] Carnes Lord, "Crisis Management : A Primer," Institute for Advanced Strategic and Political Studies, IASPS Research Papers in Strategy No.7 (August 1998): http://www.iasps.org/strategic7/crisis.htm.

[7] Graham Allison, "Conceptual models and the Cuban Missile Crisis." *American Political Science Review* Vol. 63, No. 3 (September 1969): 689-718.

[8] Lord (1998).

voluntary notifications of satellites diverted from their orbit and space experiments that could adversely influence the operation of early warning radars. These agreements represent a rare example of detailed and comprehensive space-related confidence-building measures designed to enhance stability through transparency.[9]

In a crisis, difficult trade-offs between various response options need to be made at the highest-levels of government. Crisis management considerations involve, besides diplomacy and use of force, the adequacy of available intelligence and how much is secret versus public. This calculus can have both important domestic and international implications, including economic, financial, legal and command and control dimensions. Successful crisis management seeks to minimize damage/costs and maximize stability/benefits. The challenge lies in the ability to react correctly and quickly when the crisis arrives.

Defining Space Crisis Management

In defining space crisis management, the main focus is on efforts to identify those situations that are produced by threats to space assets and related services. In this sense, the goal of space crisis management is to preserve a peaceful and stable space environment. There are clear space-related implications stemming from heightened terrestrial tensions or mishaps. Those terrestrial circumstances that can result in damage to, or disruption of, space-based and ground-based assets have not been fully explored. For example, many satellites are dual use, making it difficult to differentiate between friend and foe.[10] Unlike space safety and sustainability, which have received significant attention in various venues, including the United Nations Committee on the Peaceful Use of Outer Space (UNCOPUOS), space stability and deterrence is a more sensitive challenge and requires closer examination.

In an actual crisis, it is unlikely that Allison's above-mentioned Model I alone, where happenings are a result of "purposive acts of unified national government"[11], will apply. Model II, where a multiplicity of organizations follow standard operating procedures (SOP) appears to be the best solution. However, the limited number of incidents and crises involving space has not yet catalyzed the establishment of such procedures, perhaps with the exception of the U.S.-Russian relationship. It may well take a future crisis to persuade the international community to implement suitable processes, organizations and understandings regarding space security. Accordingly, Model III may also apply, as was the case during the Cuban Missile crisis, and individuals within the involved governments will divine the outcome.

In addition to obstacles connected with configuring domestic space crisis decision-making procedures, crisis prevention on an international level represents an even more challenging task given the limited exercise of space "rules of engagement". This undertaking should involve the promotion of behavior that maximizes the utility and stability of space and minimizes the prospects for misconduct and misperceptions. This process has been underway via seeking to advance codes of conduct/rules of the road, debris mitigation, transparency and confidence-building measures (TCBMs), and other modalities. Reducing the incentives and stepping up the disincentives associated with space-faring nations taking destabilizing actions is the proverbial "name of the game".

This task is becoming increasingly complex with the growing number of space-faring nations and the nature of their ambitions. As democratic countries face periodic changes of leadership, it is crucial that well-defined national priorities and procedures are firmly in place to achieve successful international negotiation and/or action (military or otherwise). This has proven elusive

[9] Peter Hays, "Military Space Cooperation: Opportunities and Challenges." *Monterey Institute of International Studies* (July 2002): 37.

[10] An interesting question is, for example, who would be responsible for space tourists – citizens of certain states – if those individuals would be forced to stay in space for a longer period of time because a commercial spaceport, located for example in the United Arab Emirates, would be unable to recive them back due to political/military crisis tensions or conflict in the Persian Gulf.

[11] Allison (1969: 690).

even among allies, much less all active members of space community. The connectivity between terrestrial military hostilities and space is likely the most problematic (e.g., GPS signals jamming during the Iraqi conflict and other such circumstances).

To conclude, there is a marked difference in behavioral norms when dealing with peacetime versus crisis and conflict. A key objective of an effective space crisis management regime should be preventing crises before they mature, in part through the ability to gain international agreement on a set of rules governing responsible space behavior, along with effective verification and enforcement measures.

POTENTIAL SPACE CRISES

Crises in space could be triggered by natural causes (e.g., space weather and debris), technical issues (e.g., satellite malfunction, unintentional interference, inaccurate orbital prediction) or intentional disruption of satellite services and even the attack of space assets. Space Situational Awareness (SSA), a fundamental element of space operations, is required to detect various anomalies, including those connected with a satellite's designated flight path. Due to the gaps in SSA capabilities, it can be difficult to detect and attribute potentially irresponsible or hostile actions in space. This makes space crisis management more complex than the terrestrial variety. Although space crises caused by natural hazards or technical issues are of high concern, the intentional disruption of, or damage to, space assets will generally involve larger – sometimes far larger – geopolitical stakes.

Natural Hazards, Uncontrolled Re-Entries, Collisions and Unintentional Radiofrequency Interference

Space debris, the main contributor to "congested space", has received substantial attention from the space community at national as well as international levels. A number of space-faring nations have adopted strict space debris mitigation guidelines, including the United States, Russia, Japan, and a number of European nations. The need for steps beyond debris mitigation, such as active debris removal (ADR), have also been acknowledged and pursued. Large damage to, or destruction of, a significant space asset (e.g., the International Space Station) would not only trigger an immediate need for crisis management steps, but would also have a potentially debilitating effect on the near-term pursuit of human space exploration.

Effects from space weather (i.e., the Sun and the solar wind) are also considered significant threats to space operations. Although satellite components are partially protected against high total doses of radiation, it is nearly impossible (and costly) to design and manufacture a satellite completely immune from space weather variations. Solar activity, occurring during all phases of the solar cycle, needs proper monitoring and assessment, especially given the lack of an ability to predict accurately space weather.

The re-entry of shut-down or malfunctioning satellites, such as the U.S. Upper Atmosphere Research Satellite (UARS), Germany's ROentgen SATellite (ROSAT), or Russia's Phobos-Grunt, have not been considered high-level risk events, but have drawn attention to the need for better communication between all involved parties, as well as with the public.

The UARS, decommissioned in 2005, re-entered the atmosphere while tracked by the U.S. Joint Space Operations Center (JSpOC). The process was managed by the National Aeronautics and Space Administration (NASA). Besides the United States, other space-faring nations were also monitoring the satellite's descent in the last two hours as the natural forces affecting the satellite made the prediction of re-entry difficult.[12] The ROSAT's re-entry, handled by the German Space Agency (DLR), followed a similar re-entry procedure and ROSAT underwent an uncontrolled re-entry into the atmosphere in October 2011.

The case of Russia's Mars probe, Phobos-Grunt, was somewhat different from the previous two examples as Russia failed to provide timely information concerning issues it was experiencing with the satellite. After the Russian side finally

[12] http://www.nasa.gov/mission_pages/uars/index.html.

announced technical problems, the United States set up a task force to assist the management of the re-entry. The whole process, as well as the Russian explanation of the cause of the failure, lacked the desired level of accuracy and transparency.[13]

Although thus far the only one of its kind, the 2009 collision between Iridium 33 and Cosmos 2251 also demonstrated the existence of a real threat of collision between two intact satellites. In short, although there have not, as yet, been any serious injuries (i.e., at least confirmed reports) resulting from the re-entries of the above-mentioned satellites, or other space objects, these events have highlighted the need for not only establishing domestic, national procedures, but also diplomatic processes that would facilitate the smooth and efficient management of these types of events internationally, including adequate public reporting.

Radiofrequency interference can undermine key functions of a satellite (i.e., telemetry, tracking, and command information, or TT&C) and compromise the satellite's altitude control system and propulsion system, leading to deterioration of orbit, loss of core mission capability, or complete loss of communication. Unintentional radio frequency interference can originate from faulty equipment, the reduction of orbital spacing between satellites, and the unauthorized use of satellite space segments by carriers. Intelsat's Chief Technical Officer, Thierry Guillemin, noted: "in our experience, episodes of signals from unauthorized carriers and of cross-polarization make up 70 percent to 75 percent of radio frequency interference cases plaguing satellite operations…to this number you should add a 15 percent to 20 percent of cases caused by adjacent satellite interference."[14]

Intentional Disruption/Attack

As satellites (travelling in predictable orbits) collect, transport and deliver critical information and services to users on Earth, including national militaries, intentional disruption of the information/services they provide is an attractive option to some. Add to that the physical disruption of space infrastructure (e.g., satellites or ground-based facilities).

Intentional jamming (e.g., active jamming of radar imaging satellites, GPS location and timing information, etc.) could bring damaging military implications as well as potential political estrangement. Jamming the uplink for commercial and communications satellites is easier than military satellites due to their tendency to receive a broad range of signals for multitudes of users over a large geographic area. As commercial communications satellites are used heavily by the U.S. military (as well as the militaries of some other countries), this vulnerability is relevant to the security community and allied collaboration efforts.

Besides the challenge of GEO-locating the source of interference in an area covering hundreds of thousands of kilometers, satellite operators are sometimes confronted with a policy challenge, such as the case of the jamming of a Eutelsat satellite by a source located on Iranian territory. In 2009, several major broadcast stations were jammed for many months by systems based in Iran, raising significantly the costs to the broadcasters and satellite owner-operators involved. Although formal complaints were filed with the International Telecommunication Union (ITU), the situation has not been resolved, and the Government of Iran has made no acknowledgement of this issue.

The incidence of intentional jamming has increased in recent years due to its utility in accomplishing military, political, and even social objectives. As state-sponsored jamming becomes increasingly prevalent, there is likely to be increased interest internationally in scripting appropriate responses to these kinds of "temporary" actions. At present, this is an underdeveloped area of security policy as well as economic policy and diplomacy.

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[13] James Oberg, "Open Issues with the Official Phobos-Grunt Accident Report," *The Space Review* (February 27, 2012): http://www.thespacereview.com/article/2035/1.

[14] Giovanni Verlini, "New Efforts to Mitigate Satellite Interference," *Satellite Today* (March 1, 2010).

A crisis could also be caused by: directed energy (laser or microwave) attack (e.g., using an Earth-based laser to dazzle the optical arrays of an electro-optical imaging reconnaissance satellite; or use of satellites with active, high-powered radars to degrade the electronics of an adversary satellite); kinetic energy anti-satellite (ASAT) attack (e.g., direct-ascent, co-orbital); or cyber attacks (e.g., capturing or corrupting the data streams to or from a competitor's satellite).

Cyber attacks against satellites and ground stations are a growing problem and stand out as a key vulnerability that can be added to the current array of political and budgetary obstacles to enhanced cyber security and space security. Cyber attacks permit anonymity and can be far lower cost with regard to spying, denial of service, or otherwise incapacitating an adversary's satellites. There are already a number of known examples of cyber attacks against satellites resulting in degradation or loss of control.

COMPARATIVE ASSESSMENT: THE UNITED STATES AND THE EU

United States

The United States is the leading space power and, arguably, the most reliant on highly-integrated space capabilities. Given the vulnerability of these assets, the country is active both in promoting the responsible use of space (e.g., collision prevention, engagement in International Space Code of Conduct negotiations, etc.), and in research and development related to the protection of these assets (including counterspace measures). The U.S. Air Force (USAF) is responsible for military space activities and charged with ensuring "freedom of action and from action in space" as well as denying, if necessary, those same freedoms to an adversary.[15]

Beyond promoting norms of responsible behavior, the United States pursues other deterrence-related efforts. They include: the threat of retaliatory measures (although not limited to a response in kind); escalation; redundancy and quick replacement capability; ability to operate in a degraded environment/resilience; robust Space Situational Awareness (SSA) and space-related intelligence capabilities that enhance attribution[16]; and a healthy level of strategic ambiguity over its response to any intentional disruption/attack on U.S. or allied space capabilities. Declaratory policies also come into play, when deemed appropriate (e.g., an attack on U.S. space assets as part of a regional conflict is declared to be a broader attack on the United States).

The National Security Space Strategy (NSSS), published by the Obama Administration in January 2011, forthrightly acknowledges the relevance of a contested space operating environment, not only to the security of the United States, but also to U.S. relations with key allies and partners. In addition, the National Space Policy, issued in June 2010, instructed the Secretary of Defense and Director of National Intelligence to "assure critical national security space-enabled missions" through options, such as "leveraging allied, foreign, and/or commercial space and non-space capabilities to help perform the mission" and augmenting "U.S. capabilities by leveraging [the] existing and planned space capabilities of allies and space partners."[17]

The outreach of the United States to the international community on these issues includes participation in negotiations on an International Code of Conduct for Outer Space Activities, meetings with a UN-established Group of Government Experts on Outer Space Transparency and Confidence-Building Measures (TCBMs)[18], and work with the Scientific and Technical Subcommittee of the UN Committee on the Peaceful Uses of Outer Space (UNCOPUOS) on the "Long Term Sustainability of Outer Space Activities." These and other efforts seek to mitigate space debris, reduce the likelihood of

[15] Maj. Wallace Turnbull, "Moving Beyond SSA: An Attribution Architecture for Space Control," *High Frontier* Vol. 5, No. 1 (November 2008): 25-27.

[16] In a military engagement, the less that is known about the identity, motives, and scale of the threat (due primarily to the inability to detect and classify), the greater freedom of action that is required to protect the force/assets involved.

[17] "National Space Policy of the United States of America," President of the United States of America, June 28, 2010.

[18] The GGE on Outer Space TCBMs was established by UN General Assembly Resolution 65/68.

collisions, prevent incidents, minimize the risks of potentially harmful interference, and develop "best practices guidelines" for space activities.[19]

SSA is essential to managing space traffic, identifying out-of-the-ordinary activities, irresponsible behavior, and any attack on space assets. The United States collects its SSA data through the Space Surveillance Network (SSN). The SSN, however, cannot continuously track every space object, and it uses the computed orbit to predict an object's future position, which is periodically updated. Still, an object can be unexpectedly "lost" between the updates, and it can take days, or even weeks, to re-establish contact. This operational constraint could be exploited by potential adversaries.[20] Accordingly, the United States seeks to build a more robust SSA capability in coordination with its allies.

In its 2011 NSSS, the United States asserted, as a leader in the SSA field, it "can use its knowledge to foster cooperative SSA relationships, support safe space operations, and protect U.S. and allied space capabilities and operations".[21] The partnerships are to be "consistent with U.S. policy and international commitments and consider cost, protection of sources and methods, and effects on the U.S. industrial base."[22] The United States has shared SSA information since the late 1950s through NASA's Orbital Information Group (OIG). SSA data-sharing data outside of the U.S. government (USG) was originally administered by a pilot program of the USAF Space Command, the Commercial and Foreign Entities (CFE) Pilot Program (launched in 2004). There now exists a permanent SSA Sharing Program operated by the U.S. Strategic Command (USSTRATCOM).[23]

[19] Frank Rose, "2012 Will Be a Defining Year for Space Security," Remarks at the 15th Annual FFA Commercial Space Transportation Conference, Washington DC (16 Feb 2012): http://geneva.usmission.gov/2012/02/17/space-security-2/, accessed October 23, 2012.

[20] Turnbull (2008).

[21] U.S. Department of Defense, *National Security Space Strategy* (January 2011): 6.

[22] Ibid.: 8.

[23] Jana Robinson, "The Role of Transparency and Confidence-Building Measures in Advancing Space Security." *ESPI Report* No. 28 (27 March 2011).

Standing agreements with commercial partners enable cooperation with these entities on a day-to-day basis as well as in case of emergencies. The United States also seeks cooperative partnerships with foreign governments. Besides SSA collaboration with Australia and Canada, the United States has held discussions on SSA with the European Space Agency (ESA), the EU, and individual countries (mainly France and Germany), as well as in Asia (e.g., Japan).

Another partnering potential is represented by the U.S. Air Force's Wideband Global Satellite Communication system in which five allies already participate (i.e., Canada, Denmark, Luxembourg, the Netherlands, and New Zealand). The system currently involves three satellites in orbit and six additional satellites are planned to be launched in the period 2012 -2018. The United States carries the burden of the development, fielding, and operational aspects of eight satellites. The ninth will be a product of this consortium and will be launched and operated by the United States.[24]

Moreover, the U.S. Strategic Command (USSTRATCOM) is in the process of reconfiguring the Joint Space Operations Center at Vandenberg Air Force Base to become a Combined Space Operations Center with the goal of also integrating the capabilities of its allies to better leverage shared information.

The primary venue for advanced collaboration with allies has been the Schriever Wargame, coordinated by the United States annually or bi-annually. The Schriever Wargame consists of a series of exercises that starts with an attack on critical space assets and/or cyber infrastructure. The seventh Schriever Wargame for space, which took place in April 2012, was the first international game to combine the regular participation of Australia, Canada, and the United Kingdom with other NATO allies. The war game, involving combined space operations, focused on ways to boost SSA, improve intelligence-gathering, enhance surveillance and

[24] Tech. Sgt. Chris Powell, "U.S. Coalition Nations Form Wideband Global Satellite Partnership". U.S. Airforce Website, http://www.af.mil/news/story.asp?id=123286621, accessed August 23, 2012.

reconnaissance, and increase communications bandwidth while countering space-related challenges, including debris and the anti-satellite capabilities of adversaries.[25]

In sum, the United States, guided by its 2011 National Security Space Strategy (NSSS), focuses on how the changing space environment can influence national security. Strengthening safety, stability, and security in space is one of three broad objectives clearly defined in the NSSS. Crises could not only reduce the ability to protect benefits that countries derive from space; the stability of the domain itself could be adversely affected. Accordingly, the United States seeks to anticipate the actions and reaction of actors to prevent negative contingencies or crises, as well as promote the responsible use of space via building international partnerships and putting in place effective deterrence measures.

The European Union (EU)

The structure responsible for the EU's Common Foreign and Security Policy (CFSP) is the European External Action Service (EEAS), established by the Lisbon Treaty in December 2009. The EU has a "terrestrial" Crisis Platform under its EEAS, involving various crisis response/management mechanisms (i.e., Crisis Management and Planning Directorate, Crisis Response Department, EU Military Staff, Civilian Planning and Conduct Capability, Situation Centre, EU Situation Room and other relevant EEAS Departments), the EU Military Committee (EUMC), and relevant European Commission services (see Figure 1).

The development and utilization of space assets for terrestrial crisis management is being supervised by the European Commission (EC), in close collaboration with the Member States, the EU and ESA. The EEAS, which defines the coordination and resourcing mechanisms associated with the use of space for terrestrial crisis management and "external action", has not, as yet, systematically integrated space crisis management into its operations.

Institutions that coordinate European space policy include the Space Council (periodic meetings of the Council of the EU and the Council of ESA at the ministerial level), the Joint Secretariat, and the High-Level Space Policy Group (the two latter of which assist the Space Council). The EU's security-related space activities are primarily managed by the European Commission (EC), the European Defence Agency (EDA), and the European Union Satellite Centre (EUSC). The European Space Agency (ESA) acts as the program coordinator and procurement authority for most of these projects.[26] The EU's principal security-related programs, all dual-use in nature, are the Galileo global navigation and positioning satellite constellation, the Global Monitoring for Environment and Security (GMES) and the Space Situational Awareness (SSA) project.

In 2007, the 4th Space Council endorsed unanimously the European Space Policy, demonstrating support for a comprehensive, common way forward. The Fifth Space Council named "space security" among its four priority areas. The EU recognizes its increasing reliance on space-based systems as well as the proliferation of threats to these systems and aims at developing a "European space monitoring capability".[27] The 2008 Space Council resolution, as well as subsequent resolutions, emphasized the need for "a European capability for the monitoring and surveillance of its space infrastructure and of space debris".[28] To develop a pan-European SSA system, the EU recognizes the need to cooperate with ESA and Member States,

[25] Amb. Gregory Schulte, "Protecting Global Security in Space," Presentation at the S. Rajaratnam School of International Studies, Nanyang Technological University, Singapore (9 May 2012), http://www.defense.gov/home/features/2011/0111_nsss/docs/Rajaratnam%20School%20of%20International%20Studies%20on%20Protecting%20Global%20Security%20in%20Space,%20May%209,%202012.pdf, accessed October 23, 2012.

[26] Kai-Uwe Schrogl, et al., *Yearbook on Space Policy – 2009/2010: Space for Society* (Vienna, Austria: SpringerWienNewYork, 2011), pp. 100-101.

[27] http://ec.europa.eu/enterprise/policies/space/esp/security/assets/index_en.htm

[28] 5th Space Council Resolution (September 26, 2008): http://register.consilium.europa.eu/pdf/en/08/st13/st13569.en08.pdf, p. 13.

as well as develop proper governance and data policy to manage highly sensitive SSA data.[29]

The EC's most recent space strategy document entitled "Toward a Space Strategy of the European Union that Benefits its Citizens", acknowledged that space infrastructure is both "an instrument" which can serve the EU's security and defense needs (e.g., GMES, MUSIS), but also as "an asset" requiring protection. The main threats outlined in the document were natural phenomena, collision, and electromagnetic interference.[30]

The current European agenda on space security is dominated by the discussion, debate and diplomacy associated with the proposed Space Code of Conduct referenced above. The Code has also attracted priority attention internationally over the past few years. Although the EU is a relatively recent space actor at a global level, it is striving to establish policies and procedures that protect Europe's space assets, especially at a time when current EU policy heavily emphasizes the development of independent European access to, and use of, space (including Europe's next-generation launching capability, Galileo, space-based crisis response infrastructure, and SSA).

The implications of increasingly sophisticated counterspace systems in the hands of less-responsible actors have not been acted upon to a sufficient degree in Europe. There exists an obstinate political and cultural barrier that, often mistakenly, confuses the defense of space assets with the debates on space "weaponization". Accordingly, the individual Member States are currently better positioned to contribute actual capability as well as political value-added with regard to space crisis management planning. Politically, there are also fewer obstacles to making security-oriented decisions with regard to cooperation in militarily-sensitive space situations. Among them, France is a leader in developing national critical space capabilities, including communications, Earth observation, and space debris detection.

In short, the public space security (sometimes labeled "security of space") debate in a European setting consistently gravitates back toward the challenges posed by incidental or naturally-occurring phenomena, which are less challenging issues to grapple with politically. Movement away from these non-intentional issues as the central agenda items on space security continues to prove difficult, demonstrating the pushback over more formalized and deeper discussions between the United States and Europe on the intentional acts that could jeopardize space stability systemically.

COLLABORATIVE SPACE CRISIS PREVENTION AND MANAGEMENT

The purposeful loss of important space capabilities (both civilian and military) could have a debilitating impact on the world economy and global security as well as exacerbate various terrestrial crises, whether they be humanitarian or military. Advancing the responsible and safe use of space should be the foundation of a more cooperative, predictable environment which enhances national security and discourages destabilizing behavior.

TCBMs, introduced in various venues (e.g., UN General Assembly resolutions; the U.S. 2010 National Space Policy; the draft International Code of Conduct for Outer Space Activities, etc.) are an important element of this effort. They include the sharing of data and information relevant for conjunction analysis, pre-notification of launches, building international partnerships, and creating a common understanding of what constitutes "responsible behavior." While acknowledging their various limitations, including the issue of verification and compliance, TCBMs, in the right circumstances, can go a long way towards preventing space-related crisis. TCBM-related space diplomacy needs to be underpinned by an advanced understanding and commitment to international law.

With the development of sophisticated counterspace capabilities by some countries, the concept of deterrence has also gained traction in debates related to space crisis management. As referenced in the previous section, the U.S.

[29] http://www.consilium.europa.eu/uedocs/cms_data/docs/pressdata/en/intm/122342.pdf.

[30] http://ec.europa.eu/enterprise/policies/space/files/policy/comm_pdf_com_2011_0152_f_communication_en.pdf, p. 5.

Defense Department includes the following four objectives in its deterrence strategy: the development of responsible norms of behavior; the establishment of international partnerships; increasing the resilience and capacity to operate in a degraded environment; and the readiness and capability to respond in self-defense (not necessarily in kind). It has yet to be thoroughly tested how a robust space posture can deter terrestrial conflict and, conversely, how vulnerabilities in space can cause instability in a terrestrial crisis.

SSA is an important contributor to advancing the responsible use of space and there are broader discussions underway on the need to create a more comprehensive SSA picture and share data and information internationally. With regard to America's SSA, although it is the largest system with comprehensive coverage of traceable items in low Earth orbit (LEO), it does have coverage gaps, especially in equatorial orbits.[31] Europe has only one dedicated radar system for space surveillance, but has reasonably well-developed optical coverage in medium to high orbits. A multilateral system of sharing the burden of tracking space objects would offer improved performance (i.e., higher detection frequency, reduced workload for a single system, and better geographical diversity for better coverage), reduced costs for additional surveillance capabilities, superior management of existing redundancies, and improved collision warning against multiple sources.[32]

Should preventive measures fail, the response to any particular crisis will depend on what type of space asset is involved and whether the crisis is connected to military activities. It will also be important to understand if the asset is part of an international partnership (or is supporting coalition activities) and whether the crisis is isolated or occurring among a number of assets. All of these factors will affect how a crisis is managed, by whom, and through what institutional mechanisms. Naturally, the dual-use nature of satellites, and the use of civilian and commercial assets for military operations (thus making them important for national security purposes) compounds the difficulty in configuring the right kind of response.

Not surprisingly, contingency planning is fundamental to effective management of a space crisis. As with responses to major natural disasters, terrestrial accidents (e.g., toxic spills, etc.), or terrorist incidents, allies will need to be able to react flexibly in space. Commercial and military operators deal regularly with space environment-related contingencies involving practical operational procedures. Space crisis procedures are best developed when concentrating on realistic scenarios and case studies.

The U.S. Schriever Wargame described above, or similar allied wargames, could improve understanding with regard to how institutions and technologies will interact in a crisis that requires quick decision-making and to possible interaction of groups that have not worked together before. The 2012 Schriever Wargame, the first international exercise in this series (including some nine NATO nations and Australia, as well as representatives of the commercial space industry) was a step in this direction. Information-sharing has been identified as a critical area for effective combined operations in space.[33] As with terrestrial military exercises, practicing reactions to a crisis scenario should be accompanied by TCBM formulation to prevent dangerous misperceptions.

The U.S. Combined Space Operations Centre is positioning itself to share operational command and control (C2) of space forces with allies, including accepting data from a wide variety of sources, processing it in an environment that enables maximum foreign participation, and providing SSA and command and control products to a select international community.[34]

[31] The Russian Space Surveillance System is well-developed for LEO but is strictly military. Higher orbits are covered by the Russian-sponsored ISON network that relies on collaborative sharing among scientific telescopes around the world (source: www.emmetfletcher.com).
[32] Emmet Fletcher at www.emmetfletcher.com.
[33] For more information, see http://www.act.nato.int/images/stories/events/2012/sw12i/sw12i_report.pdf.
[34] Maj. Michael Morton and Timothy Roberts, "Joint Space Operations Center (JSpOC) Mission System (JSM)," Technical Paper introduced at the 2011 AMOS Conference,

The establishment of such a Centre, however, will likely prove challenging as governments are concerned about the inappropriate release of data. Nonetheless, it would facilitate crisis management as allied governments and the commercial sector would share basic information on space object location and potential interference to prevent, or manage, a crisis.

CONCLUSION

The asymmetric advantages and vulnerabilities of space stand out: Even a small satellite off course or an incident of neglect/misconduct -- let alone intentional disruption of, or an attack on, space assets -- can cause disproportionate damage. Space crisis management needs to be underpinned by strong and persistent diplomacy aimed at preventing crises, encouraging the accelerated development of the operational and technical capabilities to manage a crisis already underway, and ensuring the availability of effective organizational structures to facilitate sound crisis management. Indeed, it is not difficult to imagine a time when a number of responsible space-faring nations appoint their own Ambassador-at–Large for Space to reinforce this new and more urgent brand of space diplomacy.

Collaborative space crisis management needs to embody several methods of crisis prevention; rapid detection and reporting of a threat/attack; accurate assessments of the threat; and high-tempo policy responses. Political will is an essential component of this task at an international level. Present discussions concerning the expansion of coordinated allied counterspace defense arrangements, for example, are still at a fairly early stage of development.

Accordingly, the next few years will be especially important in not only establishing responsible norms of space behavior, but also gaining agreement on clear procedures to deal with escalatory spirals and other unexpected contingencies, particularly of the man-made variety. An actual space crisis will likely elude abstract models and even a set of universal rules, and rather require a tailor-made solution by those actors and individuals involved. That said, there is far more that can be done in the area of pre-crisis planning and closer, more security-minded discussions among key allies. Space, in its many facets, has simply become too important for day-to-day life on Earth; it merits nothing less than the sustained engagement of the highest levels of government, NGOs, and the private sector.

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http://www.amostech.com/TechnicalPapers/2011/SSA/MORTON.pdf, accessed August 23, 2012.

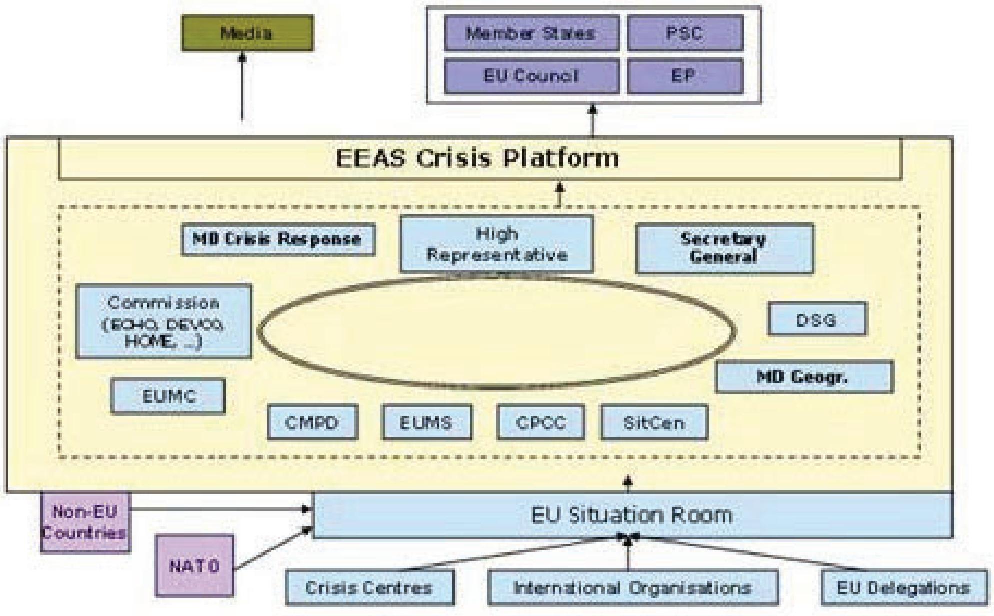

Figure 1: the EEAS Crisis Platform (source: EEAS website)[35]

[35] "The EEAS Crisis Platform." EEAS website, http://www.consilium.europa.eu/eeas/foreign-policy/crisis-response/eeas-crisis-platform, accessed August 23, 2012.