National Space Policy: The Challenge of Implementation

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Much of the response to President Barack Obama's newly-announced space policy has been focused on the administration's changes to NASA's human exploration program. Lost in the somewhat-emotional debate over the funding of human spaceflight has been the space policy's impact on the Department of Defense's (DoD) relationships with other space-faring nations and the commercial industry. The Obama space policy recognizes that as more and more countries develop space capabilities, the US government (USG)—and the DoD in particular—will need to play a stronger role in defining the rules for responsible behavior in space and strengthening international partnerships.

Space policies are not laws. Although they provide some guidance to agencies, they do not assign budgets, establish programs, or obligate Congress. They are, instead, written to be directional and aspirational, and, in a tradition that goes all the way back to President Dwight D. Eisenhower, serve to focus the nation's thinking about this one area of American expertise. Because of the holistic and ecumenical nature of space policy documents, they also tend to have a 'something for everyone' character that can be confusing and, occasionally, internally inconsistent.

The Obama policy articulates the administration's overarching vision for the future of the US space program. As expected, it provides support for exploration, national security, international cooperation and commercial activities. Overall, the new policy covers much the same ground, and in much in the same manner, as the presidential policies that have preceded it. But the Obama policy departs from its predecessors in a few key focus areas. In particular, the policy emphasizes that:

- ***The space environment is rapidly changing*** and these changes will require a corresponding change in our actions.
- ***Greater international cooperation is desirable***, including leveraging the existing and planned space capabilities of allies.
- ***"Responsible operations in space" are critical*** and this will necessitate improved information collection and sharing to avoid collisions and to protect critical space systems.
- ***The government should increase its reliance on commercial space activities*** and consider innovative approaches such as public-private partnerships, hosting government payloads on commercial spacecraft, and purchasing of data products.

This article concludes that the Obama policy adds an important new dimension to the nation's space policy dialogue but that significant work needs to be done to achieve the articulated goals. In particular, the calls for greater international cooperation, better data sharing, and increased reliance on the commercial sector have yet to be translated into significant programs or initiatives.

Focusing on the Need for Change

For decades, the US and the Soviet Union maintained a near total monopoly on access to and the exploitation of space. Now, many more countries have access to space and new transportation capabilities suggest that the number will continue to expand rapidly. Although vast, near-Earth space is ultimately a finite resource that must be managed. This is particularly true with respect to the more desirable orbits for communication and remote sensing. Radio frequency spectrum, long acknowledged by experts to be a scarce resource, has been under significant pressure lately to accommodate new terrestrial and space actors and applications. The Obama space policy embraces the belief that rapid and significant change in the space environment has created an urgent need for nations to work cooperatively together to ensure that the space environment is preserved for future generations.

The theme of change can be found in the space policy's introduction:

> The legacy of success in space and its transformation also presents new challenges. When the space age began, the opportunities to use space were limited to only a few nations, and there were limited consequences for irresponsible or unintentional behavior. Now, we find ourselves in a world where the benefits of space permeate almost every facet of our lives.… The now-ubiquitous and interconnected nature of space capabilities and the world's growing dependence on them mean that irresponsible acts in space can have damaging consequences for all of us.[1]

Since the release of the policy, the theme of change has been discussed frequently by administration officials. For example, when addressing the United Nations' Committee on Disarmament in July of 2010, Deputy Assistant Secretary of State Frank Rose said:

> "…the new space policy recognizes the transformation of the space environment as well as the evolution of our utilization of space … The transformation of the space environment also presents challenges. The interconnected nature of space capabilities and the world's growing dependence on them mean that

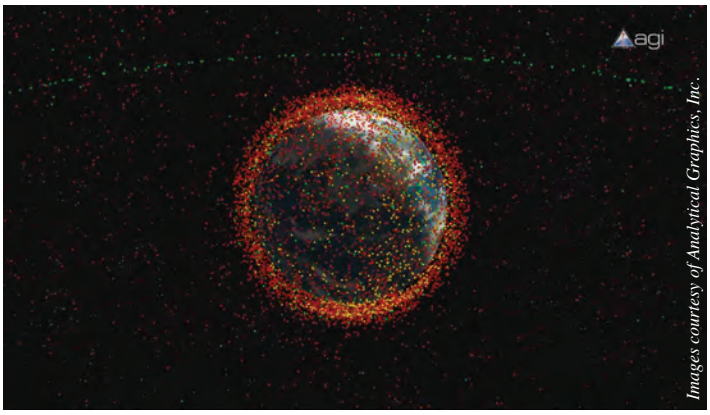

Figure 1. Tracked space debris in Earth orbit.

> irresponsible acts in space can have damaging consequences for all of us. Furthermore, decades of space activity have littered Earth's orbit with debris. As nations and commercial enterprises continue to increase activities in space, the possibility of another collision, increases correspondingly.[2]

In a similar vein, in December of 2009, the European Union issued a draft code of conduct for outer space activities which also is predicated on the assumption that space activities have grown sufficiently complex to warrant additional governmental attention.[3] The code was designed to encompass civilian and military uses of space. Key features of the text include a voluntary commitment to refrain from intentionally harming space objects; measures to control and mitigate space debris; and, mechanisms for cooperation and consultation. The European Union is now holding consultations to encourage other countries to embrace these principles.

Accepting that the space environment is undergoing a rapid transition, it is still unclear what steps countries and the international regulatory community should take in response. US and European officials seem to be taking prudent steps in initiating a broad, international dialogue about this issue while declining to suggest specific bureaucratic or international regulatory solutions. Like the 'rules of the road' that developed to govern the conduct of nations on the high seas, 'rules of the road' for space are best developed, over time, in response to real problems and with the guidance of long experience.

Enhancing International Cooperation

The Obama space policy calls for increased international cooperation and suggests that the US is open to the possibility of leveraging the space assets of allied nations. Today, it is routine for US forces to work and fight alongside the military forces of other nations. As illustrated by our actions in Iraq and Afghanistan, coalition operations in response to global challenges are increasingly becoming the norm. When deploying US forces with those of other countries, the interoperability of communication and information systems becomes a critical concern. Therefore, the "interdependence" of military and intelligence-gathering space systems would seem to be a logical goal. However, history has demonstrated that fostering space system "interdependence" is an exceedingly complex goal to implement. Developing processes to achieve international consensus and funding for select space systems, while maintaining operational constructs that do not constrain national freedom of action, is challenging indeed.

This is not the first time that this idea has been contemplated. Writing over a decade ago, in words that sound familiar, Deputy Under Secretary of Defense Robert Davis, said:

> International cooperative efforts offer a real chance to enhance interoperability, stretch declining defense budgets, and preserve industrial capabilities. The US Department of Defense thus is renewing its efforts at international cooperation. Cooperation can range from simple industrial subcontracting relationships to … bilateral and multilateral programs. It may also include: … operational standards and protocol agreements; basic science and technology research and development projects; product and data sharing; joint system operations; and personnel exchanges.[4]

The goals articulated by Under Secretary Davis were certainly worthy ones; however, the lack of progress on these goals over the last decade—even during a time of enhanced coalition warfare—is evidence of the complexity of their implementation.

Typically, concepts for space system interdependence seem most attractive when budgets are in decline. Recent global financial events, decades of deficit spending, and the cost of fighting multiple wars have placed a great strain on the US economy and defense budget. The defense budgets of our closest allies have also been under considerable strain. Over the next few years, the US and its allies will likely be challenged to do more with fewer resources. In this environment, there will be great pressure to find ways to cooperatively design, development, and acquire new defense space systems. The Obama space policy seeks to respond to this situation by suggesting that the US will seek to "leverage the existing and planned space capabilities of our allies."

Although this is certainly a worthy goal, it is likely to prove difficult to implement. First, savings from joint or multiagency programs are often hard to achieve because collaborative development programs are inherently more complex and often result in higher overall costs than independent projects. This fact was reinforced recently by a study by the National Research Council (NRC). The NRC concluded:

> Multiagency collaboration [is] … often intrinsically complex and, therefore costly, and … developing these missions typically results in additional complexity and cost. Advocates of collaboration have sometimes underestimated the difficulties and associated costs and risks of dividing responsibility and accountability between two or more partners; they also discount the possibility that collaboration will increase the risk in meeting performance objectives.[5]

Second, there is rarely perfect alignment between the strategic and operational objectives of international partners. To date, the US has taken the global leadership role in developing and deploying new military communication and imagery technology. These development programs have been in support of,

and have fundamentally redefined, the way that the US plans and fights in a conflict. Not all of the friends and allies share our operational or warfighting strategies.

Finally, shared management of programs that are essential to the US warfighter raises significant operational questions. A good example of this is the current discussion over the future of the US GPS system and the European Galileo navigation system, which is currently under development. Comments by some Administration officials after the release of the space policy seemed to open the door to possible international cooperation on the existing GPS satellite constellation, which is operated by the US Air Force and serves military and commercial users world-wide.[6] This idea would seem to have some obvious merit in that it could reduce the US financial burden of supporting a peace-time global navigation network. However, it is unclear what operational constraints such a cooperative pact would have should the US ever engage in a conflict with a technologically equal opponent.

There are a number of ways, short of seeking system interdependence, in which a goal of increased reliance on international capabilities might be implemented. First and simplest, the USG can purchase foreign space capabilities and services when they exist, are cost-effective, and meet US objectives. For example, the USG currently buys Radarsat imagery from MDA Corporation of Canada and X Band and ultrahigh frequency (UHF) band communications from Paradigm Communication Systems in the United Kingdom. The US also buys communication services from a wide range of foreign commercial satellite operators. To the extent that such purchases avoid the large and ongoing expense of maintaining additional global networks, they are a prudent investment and, in a limited way, support the overall goal of increased cooperation and interdependence.

Another, more significant way for the USG to engage in collaboration with others countries is to encourage them to invest in the US military systems. The Australian Defense Force's decision to invest the US Wideband Global Satellite (WGS) system is one example of this trend. In 2007, Australia agreed to pay for construction of the sixth WGS satellite in exchange for specified access to the entire WGS system. According to press reports, the US is actively engaged with international allies to replicate the Australian deal with other willing participants.[7] This cooperative approach certainly has merit but has yet to be fully reconciled with the space policy's desired goal of increased reliance on commercial satellite service providers. This subject will be discussed in greater detail below.

In addition to encouraging investment in US satellite systems, the USG can also make reciprocal investment in the space systems of other countries. For example, the US recently entered into a bilateral agreement with the Australian Defence Force (ADF) by which US forces will have access to the ADF's 18-channel UHF payload to be launched on the Intelsat IS-22 satellite in early 2012.[8] In compensation for the near-term access to the ADF payload, the ADF will gain access to DoD's future Mobile User Objective System constellation of satellites.

In summary, the space policy's goal of seeking opportunities for selective space system interdependence with partners and allies is a worthy one. However, past experience would indicate that implementing this goal is likely to be a slow and incremental process. This process, although encouraged by near-term funding constraints, is likely to only be successful where the long-term strategic and operational objectives of the partners are closely aligned.

Data Sharing to Ensure Responsible Operations in Space

Data sharing is a theme that is repeated throughout the space policy. This paper will focus on data sharing as it specifically relates to sharing between the private commercial operators and governments and will examine the sharing of satellite position data to ensure safety of flight.

Major commercial satellite operators routinely share information with each other about their flight operations. The data exchange usually consists of the latest location information, near-term maneuver plans, transmission frequencies, and contact information for further discussion. Intelsat, for example, operates a fleet of more than 50 satellites. In response to business opportunities and changing market needs, Intelsat regularly replaces satellites and relocates satellites in orbit. To change the orbital location of a satellite, Intelsat must delicately move a minibus-sized, multi-ton object, traveling thousands of kilometers per hour, through the crowded geostationary arc, avoiding the potential for collisions with, or disturbing the radio communications of, any of the more than 250 other commercial communications satellites in that orbit.

With the exception of the initial grant of approval by a national regulator, this entire process is managed without governmental regulation or oversight, using rules developed through experience and implemented by consensus among the commercial operators themselves. This process has been used effectively and without incident since the commercial satellite communications era began in the 1960s. This remarkable example of international and inter-company cooperation and self-reliance is premised on a simple realization that the results of a collision could be catastrophic.

Data sharing is possible because operators continuously and accurately track the locations of their own satellites. Most operators also incorporate information from the US Joint Space Operations Center when analyzing potential close approaches between satellites or between satellites and trackable space debris. The basic information (referred to as two-line element [TLE] data) used in this process is available to authorized users of the USG's "spacetrack.org" website.

There are drawbacks to the current close-approach monitoring process. In addition to a lack of standards for TLE modeling, TLE data does not have the required accuracy for credible collision detection. An operator that relies on TLE data must increase the calculated collision margin to avoid potential close approaches, therefore increasing the number of maneuvers. Maneuvers based on inaccurate data can waste fuel, shorten the life of satellites, and in some cases can introduce uncertainties that decrease the safety of space operations. In most cases,

threats identified using basic TLE data are downgraded after coordination with other operators or further evaluation with more precise orbital data. TLE data also lacks reliable planned maneuver information, which limits the usefulness of data for longer-term predictions.

Adding complexity to this problem is the fact that there is no single standard for representing the position of an object in space. Operators characterize the orbital position of their satellites differently depending on the software used for flight operations. In addition, there is no single agreed-upon protocol for sharing information, and coordinating operators must be prepared to accommodate the practices of other operators. To do this, operators must maintain redundant file transfer protocols and tools to convert and reformat information so that it is consistent with other software systems for computing close approaches. Some operators write their own software tools for monitoring and predicting the close approach of other spacecraft, while others contract with third parties for this service. Therefore, separate tools for each operator are necessary to exchange data. The magnitude of the effort to maintain space situational awareness grows quickly as the number of coordinating operators increases. Further, not all satellite companies participate in close-approach monitoring due to lack of financial resources or appropriately skilled technicians.

Since TLE data is relatively imprecise, US Strategic Command (USSTRATCOM) has been working to develop a procedure for granting operators access to information that goes beyond the basic TLEs.[9] USSTRATCOM recently authorized Joint Functional Component Command for Space (JFCC SPACE) to share conjunction summary messages (CSMs) with satellite operators whose satellites have been identified as closely approaching another space object.[10] CSMs contain vector and covariance data computed using Special Perturbations theory and are, therefore, more accurate than the TLE data.

In response to the recognition that better and broader inter-operator information sharing is desirable and to augment the services available from the Air Force, a number of satellite operators recently began a broad dialogue on how to best ensure

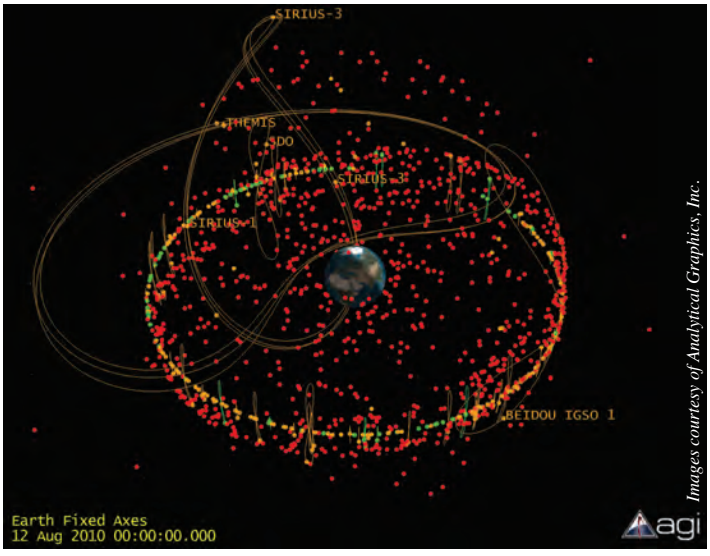

Figure 2. Space Data Association satellites.

information sharing within the satellite communications industry. As a result, the major satellite operators have formed the Space Data Association (SDA), which is an interactive repository for commercial satellite orbit, maneuver, and payload frequency information.[11] The principal goal of the SDA's Space Data Center is to promote the safety of space operations by encouraging coordination and communication among its operator members. Satellite operators maintain the most accurate information available on their fleets in the data center systems; augment existing TLE data with precise orbit data and maneuver plans from the operator's fleets; and retrieve information from other member operators when necessary. As a result, the data center:

- Enhances safety of flight.
- Provides efficient, timely, accurate conjunction assessments for members.
- Reduces false alarms, missed events.
- Minimizes member time and resources devoted to conjunction assessment.
- Establishes common format conversions and a common information repository.
- Provides radio frequency interference geolocation and resolution support, allowing operators to more rapidly find and address interference sources.
- Encourages the evolution of best practices for members.

The SDA has offered to augment USG sensor data with more precise operator-generated data to improve the accuracy of conjunction monitoring. The SDA could also provide a standardized method and focal point for operators to share information and facilitate communications between satellite operators and the USG. At present, because of a range of policy, technical, and security concerns, JFCC SPACE is unable to routinely accept satellite position data from the SDA.

By creating the SDA, commercial industry took a giant step towards accomplishing the Obama space policy goal of "promoting safe and responsible operations in space" and "improved information collection and sharing for space object collision avoidance." The fact that the USG has been unable to fully capitalize on this industry sponsored and funded initiative serves to undercut the goals of the space policy. Solving the problem of government/industry data sharing and the role of the SDA should be a key objective of those seeking to implement the Obama policy goals.

Government Reliance on the Commercial Sector

The Commercial Space Guidelines make up the single longest section of the space policy and certainly one of the most detailed. In pursuit of the goal of "promoting a robust domestic commercial space industry," the departments and agencies are directed to undertake a remarkably specific array of tasks. They are to:

- Purchase and use commercial space capabilities and services to the maximum practical extent when such capa-

bilities and services are available in the marketplace and meet USG requirements;
- Modify commercial space capabilities and services to meet government requirements when existing commercial capabilities and services do not fully meet these requirements …
- Actively explore the use of inventive, non-traditional arrangements for acquiring commercial space goods and services to meet USG requirements, including measures such as public-private partnerships, hosting government capabilities on commercial spacecraft, and purchasing scientific or operational data products from commercial satellite operators in support of government missions;
- Develop governmental space systems only when it is in the national interest and there is no suitable, cost-effective US commercial or, as appropriate, foreign commercial service or system that is or will be available;
- Refrain from conducting USG space activities that preclude, discourage, or compete with US commercial space activities …
- Pursue potential opportunities for transferring routine, operational space functions to the commercial space sector where beneficial and cost-effective …
- Cultivate increased technological innovation and entrepreneurship in the commercial space sector through the use of incentives such as prizes and competitions;
- Ensure that USG space technology and infrastructure are made available for commercial use …
- Minimize, as much as possible, the regulatory burden for commercial space activities …

Although this section is the most extensive and specific, it is the area where—at least from the perspective of the commercial satellite industry—the least progress has been made.

Notwithstanding the space policy's guidance, within the DoD, the question of whether it is more prudent to buy military satellites or to lease commercial capacity is still an ongoing subject of discussion and debate. This debate continues even though some of the communications satellites that DoD procures are nearly identical to the commercial satellites currently providing the vast majority of DoD satellite communication (SATCOM) traffic in Afghanistan and Iraq. As was mentioned above, the USG is also actively marketing participation in its military WGS system to interested allies.[12] The WGS system, though certainly capable, does not include any of the exotic protections, such as anti-jam or nuclear hardening, which typically characterize a protected military communication satellite. So, in a sense, the USG's marketing activities are in direct competition with the commercial industry.

On first review, it is difficult to square current SATCOM acquisition practices with the rather emphatic terms of the commercial space policy. The simplest explanation is that the policy contains conflicting goals. The policy does encourage the use of commercial systems, but it also encourages the pursuit of "appropriate cost- and risk-sharing among participating nations in international partnerships." The space policy does not provide guidance on how to resolve this dispute, so the challenge will be to develop an implementation plan that balances these conflicting objectives.

One good place to start would be to clarify the role that commercial operators will play in future military satellite architectures and to appropriately fund that role. To this day, with the partial exception of the Navy, the US military services—even though they rely on commercial SATCOM for critical operations—do not routinely budget for these services but prefer, instead, to buy them with supplemental funds supplied by Congress for the war effort. Similarly, commercial satellite operators do not have a specific mission designated in DoD's communication architecture. This lack of a mission means that commercial operators are, for the most part, selling generic satellite capacity developed for the commercial marketplace to military users whose satellite needs are growing more and more specific.

Figure 3. Intelsat 14 is a communications satellite owned by Intelsat located at 45° West longitude, serving the Americas, Europe, and African markets.

Nowhere is this truer than in the role that the commercial satellite industry has played in supporting the dramatic increase in use of unmanned aerial vehicles (UAV). The success of early UAVs drove the demand for more UAV flights and more and better onboard sensors suites, which, in turn, drove the need for more satellite capacity. Once the data is collected, it must be dispersed for action. The quickest way to do this in theater is via satellite. This raises a fundamental question for the future: should the DoD create an enduring

role for commercial industry in meeting long-term UAV requirements, or should it mount a multi-billion dollar campaign to replace existing commercial terminals and satellite capacity with new military satellites and antennas?

In many ways, this debate echoes the now more than a decade-long debate regarding the role of the commercial remote sensing industry in meeting the basic mapping mission of the USG. For years, the imagery community debated whether the commercial sector could be granted an enduring role in collection of certain types of imagery data. After much anguish, several presidential policies, innumerable Pentagon and intelligence community reviews and numerous Congressional directives, the answer on remote sensing has finally been determined to be "yes." It now seems clear that commercial remote sensing will play a distinct role in the government's acquisition of medium resolution data.

There is much in the commercial space policy that is creative and forward looking. One in particular is the policy's guidance to explore the "use of inventive, nontraditional arrangements for acquiring commercial space goods and services to meet USG requirements, including measures such as public-private partnerships, hosting government capabilities on commercial spacecraft, and purchasing scientific or operational data products from commercial satellite operators." However, a simple and practical starting point would be to declare, as a matter of policy, that the commercial sector will be the primary means to meet some specific portion of the UAV satellite requirement and then to fund this commitment appropriately. The private sector is prepared to invest heavily in satellites that can respond to DoD's changing SATCOM needs if the government is prepared to build a partnership for the future.

Conclusion

Success in both commercial and government space programs throughout the world has meant that new demands are being placed on the space environment. This has resulted in orbital crowding, an increase in space debris, greater demand for limited frequency resources, and the proliferation of sometimes conflicting military and commercial activities. The successful management of these issues will require a strong partnership between government and industry, new procedures for data sharing, and the careful, experienced-based expansion of international law and diplomacy.

As DoD's satellite communication needs continue to change and grow, new partnerships and commitments must be developed that harness the creativity and resources of the private sector and the international partners of the US. A good first step in the implementation of this goal would be to define the appropriate role that each of the major partners will play in a preferred future satellite communication architecture and then to fund that architecture consistent with available resources.

Notes:

[1] President Barack Obama administration, *National Space Policy of the United States of America*, White House, 28 June 2010, http://www.whitehouse.gov/sites/default/files/national_space_policy_6-28-10.pdf.

[2] Statement of Frank A. Rose, deputy assistant secretary, Bureau of Verification, Compliance, and Implementation, US Department of State, to the *Conference on Disarmament Geneva*, Switzerland, 13 July 2010.

[3] Council of the European Union, *Council Conclusions and Draft Code of Conduct for Outer Space Activities*, Brussels, 17 December 2008, http://register.consilium.europa.eu/pdf/en/08/st17/st17175.en08.pdf.

[4] Statement of Robert V. Davis, deputy under secretary of defense (space), US Department of Defense to the *Second Annual Space Strategy And Architecture Symposium Internationalization Of Space: Increasing Cooperation With Our Allies*, 11-12 February 1997.

[5] National Research Council, *Assessment of Impediments to Interagency Collaboration on Space and Earth Science Missions*, (Washington, DC: The National Acadamies Press, 2010), http://www.nap.edu/catalog.php?record_id=13042#description.

[6] Andy Pazstor, "New Space Policy Call for Global Cooperation," *Wall Street Journal*, 28 June 2010.

[7] Turner Brinton, "US Talks with Allies About Buying into WGS," *Space News*, 10 September 2010.

[8] Peter B. de Selding, "Australian, US Forces To Share UHF Satellite Capacity: Agreement Involves US Mobile User Objective System and Narrowband Payload on Intelsat Craft," *Space News*, 29 April 2010.

[9] CFE was a pilot replacement for the NASA program sharing orbital data with non-USG users from 1960s-2003. The Air Force Space Command executed the CFE Pilot Program under the authority granted by Congress in November 2003 (FY04 NDAA) and extended (in FY07 and FY09) to 30 September 2010. Since 2003, the CFE program has provided registered users (documented by an on-line registration agreement) access to basic orbital data via an online web site (www.space-track.org). Further, CFE offered additional limited collision avoidance support using specific request procedures for a limited set of users pursuant to bilateral agreements.

[10] Statement of Major Duane Bird, USAF, US Strategic Command to *AMOS Conference*, September 2010.

[11] See: www.space-data.org.

[12] Brinton, "US Talks with Allies About Buying into WGS."

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