Spacepower in the 21st Century

By CHARLES D. LUTES

Air Force launches Wideband Global communications satellite

United Launch Alliance

It is appropriate that during the 50th anniversary year of the dawn of spacepower, the National Defense University completed its 18-month study investigating the phenomenon of spacepower and laying the foundations for an empirical theory of it. This article provides a glimpse of the emerging themes of spacepower theory as elucidated by this study, especially as they relate to issues of national security.

The Space Ages

Since the launch of Sputnik in 1957, the world has seen two identifiable space ages, each distinct in its significance and influence on human affairs. A much longer pre–space age saw technological advancements enable the fulfillment of once-fanciful visions of space travel and exploration. This rich history of space offers signposts that point to potential space ages of the future.

The First Space Age (1957–1991). The first space age is often associated with the shorthand term *space race*. Space activity became a microcosm of the ideologically fueled geostrategic competition that defined the era. The advancement of space technology and activities in space were driven largely by the imperatives of the Cold War. For both the Soviet Union and the United States, this played out as a geostrategic competition to showcase technological, economic, and military power—especially in the form of a civil scientific contest to explore near Earth space and ultimately the Moon—and less publicly as a military and intelligence quest for strategic advantage.

A primary product of the first space age was *prestige*. Both the Soviet Union and the United States viewed their space programs through the prism of geostrategic competition. The prestige associated with civil space programs generated a new type of moral power for both nations as they vied to establish the preeminence of their respective cultural, political, and economic systems.

The Second Space Age (1991 to Present). Just as the Cold War was the defining context for the first space age, the fall of the Soviet Union and an era of U.S. unipolarity have defined the second space age. The transition to this second age was exemplified by the 1991 Gulf War, sometimes referred to as the first space war. The characteristic features of the current space age are the rise of globalization, with greatly increased information flows enabled by satellite technology; a shift in the military sphere from gaining strategic advantage in space (for example, with intercontinental ballistic missiles) to using space-based assets for operational and tactical advantage in terrestrial operations; and a precipitous decline in the relative emphasis on scientific civil space.

The primary product of the second space age has been *information*. While new players entered the space arena to enhance their prestige, advanced spacefaring actors developed and used space to enable the transition into the information age. Today's emphasis on information in space has greatly enhanced the military, economic, and political power of those actors, with the United States as the dominant power in the space-enabled information area.

The Next Space Age. It is unclear what the dominant features of the next space age will be or when it will definitively begin. However, discernible trends in the geopolitical environment suggest that a significant transition will occur within the next 50 years. This includes a shift away from the unipolarity of today's international system to a multipolar environment with a much broader and more diverse set of actors. As power is diffused among these actors, the nature of power in space will begin to change. Possible features of the next space age might include

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great technological advancements that lower the economic barriers to entry for potential spacefaring actors and a renewed strategic competition in space.

The primary product of the next space age is likely to be *wealth*. The dominant paradigm in space could become an economic one, as activities in space shift from enabling wealth creation on Earth through spaceborne dissemination of information to that of actual wealth creation in space itself. The economic use of space is currently but a small fraction of its potential; unexplored wealth frontiers include tourism, energy, mining, and manufacturing. Beyond the impact that space has in supporting earthly economic enterprises, the next space age will be marked by a boom in the economic value of space itself.

Launch of Sputnik in 1957 defined beginning of first space age

NASA

Toward Theory

Thinking about the space ages provides a way of conceptualizing what has been and anticipating what might be. Theory is the tool to explain the relationships of the past to the current space age and anticipate the shift to a future space age. It suggests that spacepower is not static. Spacepower theory provides clues as to how to enable this shift favorably and, as importantly, what might impede it or influence it in undesirable ways.

Theory is often contrasted with practice as if the realm of theory were inherently impractical. In fact, it is by theorizing that we systematically define, categorize, explain, connect, and anticipate events in whatever environment we are working in. Theory informs practice, and may even imply the superiority of certain practical policies and strategies over others, but it is not itself policy or strategy. A classic example is Adam Smith's *The Wealth of Nations* (1776), which laid the theoretical groundwork upon which modern free-market economics are based. Alfred Thayer Mahan's *The Influence of Sea Power Upon History, 1660–1783*, laid a similar theoretical basis for understanding the relationship between maritime activity—or seapower—and national prosperity. Mahan addressed the essence of seapower primarily through a historical lens by looking at the nature of the maritime activity of great powers in history. Writing from the perspective of what could be considered a second-tier naval power at the time (the United States), he drew important lessons for creating American economic strength by drawing national attention to seapower.

the next space age might include great technological advancements that lower the economic barriers to entry for potential spacefaring actors and renewed strategic competition in space

A Mahanian theory for spacepower would consider the role of space activity in relation to the larger strategic and international environment. Mahan recognized the primacy of human behavior in developing his theory of seapower. "It must be remembered," he wrote, "that, among all changes, the nature of man remains much the same; the personal equation, though uncertain in quantity and quality in the particular instance, is sure always to be found."[1]

The Essence of Spacepower

One of the first tasks in developing a theory is to define the phenomenon under study. Spacepower is even more complex than the constituent terms *space* and *power*. Legal and bureaucratic debates over the definition of space have consistently hampered the development of international standards for space activity. As a practical matter, though, the minimum altitude at which an object can remain in a stable elliptical orbit provides a reasonable basis for defining the beginning of "space."

Defining power is even more elusive, even though it is probably the most important concept in the study of politics and international relations. Power is often associated with the specific instrument through which it is manifested, such as diplomatic, informational, military, or economic power. Considerable attention has been devoted to how power is created, increased, decreased, stored, communicated, used, and measured. A key consideration is whether power is fungible, or easily transferable, between dissimilar instruments such as diplomatic and military power. Most dimensions of politics and international relations revolve around how states and other actors use power.

This study builds from Joseph Nye's simple definition of *power* as "the ability to achieve one's purposes or goals."[2] Nye suggests that it is the ability to influence others that creates this power. That applies to spacepower as well, with the additional notion that space capabilities may also be able to influence natural events. *Spacepower*, then, might be defined as the ability to use space to influence other actors and the external environment to achieve one's objectives.

Spacepower both contributes to and is supported by other forms of power: diplomatic, informational, military, and economic, among others. Spacepower can be looked at through sociocultural, economic, and security lenses, each roughly equating to the civil-scientific, commercial, and military-intelligence sectors of space activity.

Any actor's space capability is shaped in a variety of ways. The physical nature of the domain both constrains and enables human ability to use space for specific applications. Technology is used to overcome these limitations but is itself constrained by costs and the state of scientific development. The political and cultural environments within and among nations also determine the level of interest and

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motivations for developing space programs. Governance issues, particularly with regard to international laws and regimes, play a role in determining the path of spacepower. Additionally, the space capability of any particular country is determined by its facilities, technology, industry, economy, populace, education, intellectual climate and tradition, geography, and exclusivity of capabilities and knowledge.[3]

The International System

Spacepower has had a marked influence on the current international system, and in turn has been shaped by the evolution of this system. Globalization, arguably the defining dynamic of the 21st century, is dependent on the space-enabled information networks that have transformed the nature of human and technological interaction. However, this transformation has been uneven, and political processes and relationships struggle to keep pace with technological change.

Soyuz TMA–11 spacecraft in transit to launch pad

NASA (Bill Ingalls)

With the Sputnik launch in 1957, fears arose that the Cold War competition was unbounded; indeed, it had literally spread to the heavens. The military-technical revolution spawned by the power of the atom was accelerated by the power of space. These disruptive technologies created new challenges for managing human affairs. As the two superpowers jockeyed for strategic advantage, each sought ways to define the competition and constrain the behavior of the opponent. The rest of the world sought ways to constrain both powers and looked for approaches to salvage the utopian hope for space as a venue for cooperation and peaceful activity.[4]

In this context, the 1967 Outer Space Treaty and associated legal regimes were developed to define the initial principles for space activity. These principles remain the norms that generally guide space activity today:[5]

- Space is the province of all mankind—a "global commons."
- Space is to be used for peaceful purposes.
- All states have an equal right to explore and use space.
- International cooperation and consultation are essential.

State parties to the treaty bear responsibility for national activities in space, whether such activities are carried out by governmental agencies or nongovernmental entities.

The context in which these norms for space activity originally developed has changed. The Soviet Union is gone; the United States enjoys unmatched power, but its ability to maintain this level of dominance is uncertain; and rising powers such as China and India offer both opportunities and challenges to the international system. There is a growing diversity in the type of actors with influence in the system, particularly those not defined by or bound within any single state, such as supranational organizations, multinational corporations, and even terrorist groups. New technologies, many of them space-enabled, are accelerating the pace of change, creating both new opportunities and new threats. Signs of progress—such as the increasing spread of democracy, flourishing free-market economies, and multilateral cooperation on a wide range of issues—coexist with signs of peril—such as the growing threat of radicalism, instability in the Middle East, and uncertainty about how some emerging powers will conduct themselves.

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The political environment of space has been merely an extension of Earth-bound politics. Those who at the dawn of the space age predicted that it would be otherwise have thus far been disappointed.[6] There are signs that this may yet change, however. The increasing variety of space actors, both state and nonstate, not only provides opportunities for unparalleled scientific cooperation and economic competition but also raises the specter of military conflict. Rapidly changing space technologies, some with potentially destructive capacity, further exacerbate this dynamic. The challenge for the international community is to develop a system of relationships in space that encourages beneficial or benign behavior while containing threats. Unfortunately, that challenge is no easier in space than it is on Earth.

National Security

Because globalization is dependent upon the use of space, all the benefits of globalization would be placed at risk in the event of any major conflict there. Since the major spacefaring states, all of whom benefit from globalization, share an interest in preserving their ability to use space, they also presumably share a corresponding interest in ensuring that the space-based assets vital to the global economic system are secure from interference or disruption. Given the exorbitant cost of space activity, taking on the responsibility to protect commercial infrastructure in space or sustaining unilateral military dominance or hegemony there is probably beyond the capacity of any single state, especially if that state

were to be confronted by a hostile coalition or array of challenges.

While it would be desirable for all space actors to work toward preserving stability, in reality nations and other actors tend to focus first on pursuing their own parochial interests. The concept of enduring stability is an ideal peacetime condition for the international system, but it is unlikely to be the primary driver for individual actors, and in fact is likely to be achieved only when the security needs of the most powerful actors are realized.

Any actor's strategic approach to space security will depend on the actor's perception of the strategic environment and its position relative to other space actors. Spacefaring nations will pursue space security strategies based on their degree of reliance on space capabilities, perceived vulnerabilities both in and through space, and the expected behavior of other actors. Additionally, we should expect that an actor's approach will tend to mirror its approach to other strategic issues. For instance, the Europeans' view of collective security in space directly reflects their approach to terrestrial security issues.

Eight basic strategic approaches toward space security are examined below. In each of them, different combinations of the elements of power tend to be emphasized while others are downplayed—either intentionally or as a byproduct of the approach. When choosing an approach, an actor should carefully consider the impact of such tradeoffs on its overall power position.

Strategic Space Dominance. An actor can be said to have achieved strategic space dominance if it has the ability to pursue the entire range of its interests and objectives both in and through space unimpeded by another actor, *and* if it enjoys freedom from threat in or through the space domain.

Critics of the space dominance approach in general, and of so-called space control more specifically, suggest that the pursuit of space dominance would be counterproductive. It could impair global commerce, produce long-lasting environmental debris in space, and harm relations both with allies on Earth and among the major space powers.[7] By maximizing hard power and crossing the space weaponization threshold, the first nations to pursue a space control strategy (that is, developing or maintaining space dominance by maximizing hard power) risk international condemnation and severely degrading their soft power, not only in space but also in other arenas of international relations. The perception by other actors that their own interests demand that they counter such a strategy would likely lead to a costly military space race. Alternatively, rather than competing directly, adversaries might develop asymmetric access denial approaches such as low-cost, low-tech countermeasures in the form of space mines and other antisatellite devices, thereby vastly increasing the cost to the would-be controlling power.

Regulating Space. A limited governance structure for space already exists, constructed primarily around the principles of the Outer Space Treaty, which establish a limited normative structure regarding use of the space environment but do *not* deal directly with security issues. To be sure, the regulations required to deconflict orbital slots, allocate the electromagnetic frequency spectrum, and deal with common issues of concern such as space debris all have security implications, but do not address security concerns directly. Despite the lack of security regulation to date, however, many space actors consider a more holistic regulatory approach to be a useful means of providing enduring stability to the space environment and, with it, security for all.

In general, regulation can be focused on processes and procedures; behaviors and norms; or capabilities. In the security area, regulation-based approaches have utilized all three, seeking to shape behaviors, norms, and capabilities through rules of the road, codes of conduct, treaties, agreements, and arms control. Successful multilateral engagement, increased transparency, confidence-building, and goodwill are all important prerequisites for the success of this process.

Inherent in any regulatory approach is the assumption that stability in the space environment guarantees security for most, if not all, actors. It also assumes that certain types of governance can influence the behavior and actions of state actors. However, there are several challenges to these assumptions and to this approach:

- In the future, security threats may not be limited to state actors.
- Arms control agreements tend to be ineffective when technology changes rapidly.
- Many space applications are inherently dual use, and it is difficult to distinguish between military and civilian purposes.

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Space shuttle *Endeavour* photo of Sun and Earth

NASA

■ Overregulation for security purposes could limit development of technology necessary for economic and scientific advancement.

■ Cheaters and spoilers are difficult to detect and punish.

Most countries, including potential adversaries of the United States as well as many of its friends and allies, support a ban on weapons in space. The number of countries supporting such a ban has only increased since the early 1990s as the extent of U.S. military superiority became increasingly assured. Some supporters recall the benefits of strategic weapons limitations treaties during the Cold War and hope to imitate that process to produce a peaceful result. China and Russia see a weapons ban as restraining the United States from developing a space-based missile defense system, which could also provide technologies for offensive space systems. Even if no agreement is reached, China and Russia have gained a lot of goodwill and credibility among those in the international community who are concerned about the weaponization of space, regardless of their actual motivations for seeking a weapons ban.

because of the large expense of space activity, cooperative activities may be the only way to sustain a presence in space for some lesser space actors

The United States has been reluctant to limit its freedom of action through arms control agreements in space for several reasons. As the dominant space power today, America might wish to maintain or even extend that dominance. As China has demonstrated a move toward counterspace weapons, the United States might want to keep open its options to adopt a more aggressive space control strategy. Fears that verification problems and the potential for cheating would allow other nations to develop capabilities in secret also motivate the U.S. position. Moreover, American decisionmakers tend to be skeptical about the enduring effectiveness of formal strategic arms control agreements. Such agreements are often effective only for a limited time; the Washington Naval Conference, for example, provided some measure of peace and stability in the Pacific during the 1920s and 1930s, but ultimately could not prevent the growth of Japanese naval power that led to Pearl Harbor in 1941.[8]

Cooperative Interdependence. The importance of space activity as a contributor to globalization suggests to some that any type of conflict in space would create global economic havoc. Those most dependent on space, such as the United States, would have the most to lose in a threatened environment. This argument suggests that only cooperation among the major space powers could provide the kind of stability required to maintain the current economic system. The information and economic interdependencies woven together by space capabilities indicate that all stand to lose if that medium becomes contested.

Proponents of this approach conclude that the development of such a tightly bound globalized society will tend to encourage peace and stability. Space activities, they assert, tend to be predominantly global if not universal endeavors. Much of that activity, particularly with regard to sociocultural and economic spacepower, is mutually beneficial across national lines. With space as a global commons, the argument goes, everyone gains from activity in space as the common heritage of man. Conversely, the theory would suggest, all of global society will suffer if space warfare is introduced.

To ensure the growth of such interdependence, advocates of this approach to spacepower argue for more cooperative ventures. They also tend to support a certain degree of regulation in space, not so much because regulation in itself guarantees stability but as

Missile Defense Agency

Test of Kinetic Energy Interceptor

a means to encourage the cooperation that would, in their view, lead to stability. Codes of conduct and rules of the road are likewise seen as useful tools in fostering this environment.

Cooperative ventures in space allow different nations to develop niche capabilities, such as launch or satellite servicing, which they can then leverage on the open market. Because of the expense of space activity, cooperative activities may be the only way to sustain a presence in space for some lesser space actors. At the same time, when an actor becomes dependent on space capabilities for strategic purposes, this dependence can become a strategic vulnerability. For this reason, there is danger in assuming that conflict can be avoided under conditions of interdependence. Interdependence assumes a positive-sum game in which everyone benefits to a degree. Unfortunately, some actors see interdependence as a zero-sum game in which every gain on the part of one participant necessarily comes at a price to one or more others. Seen through that lens, interdependence becomes an incentive to increasingly intense competition rather than cooperation.

Collective Security. Collective security in space is similar to concepts of terrestrial collective security. Space actors, particularly those without comprehensive spacepower, might agree to share military space capabilities or come together to jointly protect each other's space capabilities.

Not surprisingly, the European approach to security is a collective one. An outgrowth of successful European cooperative ventures, both in commercial and civil space activity and more broadly, European ideas about collective security in space are also beginning to emerge.[9] For example, desiring independence from U.S. military space activities, Europeans now share the use of French Helios reconnaissance satellites and soon will deploy the multinational Galileo satellite constellation for civilian and military positioning, navigation, and timing. Critics of collective security arrangements suggest that they may become unwieldy, sometimes spawning intransigent institutions and bureaucracy. They argue that the complexities of the space environment may make collective agreement difficult to obtain.

Protection. Space protection is an alternate strategy that might be employed by a space actor that is economically and technologically advanced and highly reliant on vulnerable space assets. The aim of a space protection approach is to guard the space actor's ability to continue benefiting from space activity despite attempts by hostile actors to interfere with its operations. Such a protection strategy would seek to maximize space situational awareness; provide effective passive or active means of defending satellites and other space assets; and maintain the capability to rapidly replace any losses resulting from hostile actions.

there is an expanding group of state and nonstate actors motivated to exploit the advantages of space without having to develop or field their own space assets

Developing a space protection strategy requires an understanding and prioritizing of what needs to be protected and why. A protection strategy would be designed to be as stabilizing as possible and would likely be pursued in conjunction with other strategic approaches. For instance, a country might seek protective capabilities in tandem with support for a system of agreements concerning offensive weapons. Alternately, it might be employed as a hedge, keeping open the possibility of shifting to a space control strategy.

Dissuasion and Deterrence. Technical challenges and the high cost of entry to develop military space capabilities provide an opportunity to employ a dissuasion strategy against an opponent. Very few nations can afford to engage in a technological space race. Those few who do have the resources to pursue game-changing capabilities have a strategic advantage.

Some have argued that the heavy U.S. investment in the Strategic Defense Initiative (SDI) in the 1980s is a case of a successful dissuasion strategy. Although the program failed to produce a viable space-based missile defense system, it has sometimes been credited for accelerating the demise of the Soviet Union. Some have suggested that the exorbitant costs of competing with the SDI program hastened the collapse of an already weakened Soviet economy.[10] Whether that is true, it is clear that the Soviets were concerned about keeping up with SDI.

Deterrence by denial means that the adversary will not have confidence that he can gain advantage through attacking. Pursuing a protection strategy coupled with investment in robust or rapidly replenishable space systems can effectively deny enemy incentives to develop an offensive strategy. Deterrence by punishment requires an adversary to believe a credible and effective response would result from any offensive action. Developing offensive space capabilities for deterrence purposes may have a negative effect internationally. However, deterrent responses need not be constructed to cross the threshold of warfare in space. For example, an effective deterrent response to an antisatellite (ASAT) attack would be a long-range strike on launch facilities or other ground-based support systems. For such a response to be effective, some type of declaratory policy would be required to make red lines and possible responses known to potential adversaries.

Asymmetric Approaches. There is a growing diversity of actors in space with a wide spectrum of capabilities. A lesser space actor, state or nonstate, that perceives itself at a strategic disadvantage may well seek vulnerabilities in more powerful actors that it can exploit at a relatively low cost. In other words, such an actor would seek to employ asymmetric methods, such as hacking into control systems, electronic jamming of communications, or sabotaging launch facilities, to take advantage of this vulnerability. These spoilers are most likely to arise in reaction to a power employing a space domination or protection strategy.

Emerging powers who see themselves at risk from the space-based systems employed by greater powers may seek to optimize discrete capabilities that have the potential to produce tactical or operational disruption of potential adversaries' operations. The most probable targets for disruption are capabilities that would enable terrestrial precision attack. Middling powers that see their own space capabilities at risk may see other states' counterspace systems, such as direct ascent ASAT or terrestrial jammers and lasers, as prime targets for asymmetric action.

Asymmetric attacks on space capabilities might be useful in attempts to secure local, operational, or regional goals, but they are less likely to achieve a fundamental shift in the international strategic balance, especially once the major powers respond and adapt. China's ASAT test in January 2007 is consistent with expectations of this type of behavior for a rising space power. It also is

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conceivable that second-tier powers might pursue a modern variant of *guerre de course* with raids against an adversary's commercial assets in space.

Free Riding. In addition to states with assets in space, there is an expanding group of state and nonstate actors motivated to exploit the advantages of space without having to develop or field their own space assets. This seems particularly the case in the information and communications arenas, which could have national security implications for states and their neighbors. For instance, television and radio broadcasts transmitted over a satellite pirated by the Liberation Tigers of Tamil Eelam were intended to have a destabilizing impact in Sri Lanka.[11]

Implications for the United States

Today, the United States is the dominant power in space and has developed a solid civil, commercial, and national security space foundation. Its most recent space policy recognizes that "those who effectively utilize space will enjoy added prosperity and security and will hold a substantial advantage over those who do not."[12] In action and words, the United States affirms its resolve to maintain space leadership and continue to enjoy the advantages of space. Yet clearly, the international context in which the United States employs its spacepower continues to evolve.

The economic vitality of the Nation, and of the larger global society, will grow more dependent on the critical yet fragile infrastructure of space-enabled information networks. Additionally, it is clear that military operations at all levels of conflict will continue to depend on crucial space capabilities. Protecting the space infrastructure is a daunting fiscal and technological challenge.

The United States is at a crossroads as it seeks to adapt to 21st-century challenges. Potential adversaries will see vulnerabilities and opportunities to gain asymmetric advantage by threatening the space infrastructure. But America must seek to balance its strategic approach to space with its need to address other strategic concerns. Other actors will weigh similar tradeoffs. The United States must find partners—public and private actors, international civil agencies, and foreign militaries—to help shape the global environment before conflict can occur. Understanding of the essence of spacepower, and the ways in which other actors will approach it, is an essential first step for policymakers as they seek to ensure the tranquility of the final frontier while maximizing space activity for national good. **JFQ**

NOTES

[1] Alfred T. Mahan, *The Influence of Sea Power Upon History, 1660–1783*, 14th ed. (Boston: Little, Brown and Company, 1898), 89.

[2] Joseph S. Nye, Jr., *Understanding International Conflicts: An Introduction to Theory and History* (New York: Pearson-Longman, 2005), 59.

[3] James E. Oberg, *Space Power Theory* (Washington, DC: U.S. Government Printing Office, March 1999).

[4] For a thorough treatise of the space age in its political contexts, see Walter A. McDougall, *The Heavens and the Earth: A Political History of the Space Age* (Baltimore: The Johns Hopkins University Press, 1985).

[5] See *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, Including the Moon and Other Celestial Bodies,* Bureau of Verification, Compliance, and Implementation. Signed at Washington, London, and Moscow, January 27, 1967, and entered into force October 10, 1967. 18 UST 2410; TIAS 6347; 610 UNTS 205.

[6] See Walter A. McDougall, *The Space Age That Never Arrived: A Meditation on the 50th Anniversary of Sputnik 1*, Foreign Policy Research Institute e-Notes, November 2007, available at <www.fpri/org/enotes/200711.mcdougall.sputnikanniversary.html>.

[7] For a critique of the space dominance approach, see Michael Krepon, *Space Assurance or Space Dominance? The Case Against Weaponizing Space* (Washington, DC: The Henry L. Stimson Center, 2003).

[8] Erik Goldstein. *The Washington Conference, 1921–22: Naval Rivalry, East Asian Stability and the Road to Pearl Harbor* (London: Frank Cass Publishers, 1994).

[9] See John M. Logsdon, James Clay Molz, and Emma S. Hinds, eds., *Collective Security in Space* (Washington, DC: Space Policy Institute, 2007).

[10] For a discussion of the grand strategic role of the Strategic Defense Initiative in ending the Cold War, see John Lewis Gaddis, "Strategies of Containment: Post–Cold War Reconsiderations," address to The George Washington University Elliot School of International Affairs, April 15, 2004, available at <www.gwu.edu/~elliott/news/transcripts/gaddis.html>.

[11] Peter B. de Selding, "Intelsat Vows to Stop Piracy by Sri Lanka Separatist Group," *Space News*, April 18, 2007, available at <www.space.com/spacenews/archive07/tamiljam_0416.html>.

[12] The White House, U.S. National Space Policy, August 31, 2006, available at <www.ostp.gov/html/US%20National%20Space%20Policy.pdf>.