Preserving America's Strength in Satellite Technology

A Report of the CSIS Satellite Commission

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April 2002

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This one-meter resolution, color satellite image of the Lingshui military airfield on the southeastern coast of Hainan Island in China was collected at 10:32 a.m. local time on April 10, 2001, by Space Imaging's IKONOS satellite. A U.S. Navy plane made an emergency landing there after a mid-air collision with a Chinese fighter. The navy aircraft is clearly visible and parked on the taxiway adjacent to the north end of the runway (north is up). The image was available on the Internet shortly after collection.

Library of Congress Cataloging-in-Publication Data
CIP information available upon request.

ISBN 0-89206-402-1

The CSIS Press
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Executive Summary

America dominates military activities in space, but American preeminence cannot be taken for granted. Activity in space is now predominantly commercial, and the strategic environment is shaped by foreign competitors in satellites and space, the global spread of satellite technologies, the availability on the international market of militarily useful commercial satellite services, and the increasing importance of this global commercial market to the health of the U.S. satellite industry.

The dominance of global and commercial factors in shaping today's satellite industry poses a very different set of challenges for national security. The communications, navigation, and imagery services that were once available only to a few governments are now sold commercially in a global market. Other nations have crossed the threshold into space and operate satellites that provide commercial and militarily useful services. By 1999, revenues from the commercial satellite and satellite services market were roughly double those from the government and military market.[1] The rise of commercial services and of new competitors in the satellite industry increases the challenge to U.S. space policies.

This report looks at the new challenge faced by the United States in space. It assesses the nature and quality of commercial satellite services available on the global market in the militarily important areas of communication, navigation, and remote sensing. Second, it assesses the failure and costs of U.S. efforts to prevent potential opponents from gaining access to satellite service by restricting the participation of U.S. firms in the international market. Finally, it considers possible alternative approaches, while recognizing that the United States faces some hard choices concerning the satellite industry and its long-term viability.

Satellites and the Global Market

The goal of national space policy is to ensure that the United States continues to have capabilities in space that are superior to any potential opponent. Although U.S. spending on space and satellites dwarfs that of other nations, the domestic satellite industry needed for space power is being hollowed out. The reasons for this challenge lie in profound changes over the last decade. The United States no longer has a peer-competitor in space. One effect of this has been to focus Russian and U.S. space industries onto the commercial market. Second, the global spread of technological capabilities means that more nations are capable of building and using satellites for imagery, communications, and navigation without U.S. technology or support. Governments in Europe, Japan, China, and India have decided to make

1. Satellite Industry Association, 1999 survey.

the growth of national satellite capabilities a priority. These governments, and others, will continue to invest in space programs to enhance national pride and avoid a U.S. monopoly in space and satellites. The result is subsidized indigenous satellite industries that compete with U.S. firms. In the face of these new competitors, U.S. satellite manufacturers and service providers must rely more on a global market for customers and suppliers if they are to remain financially and technologically viable.

This global market reflects the increased demand for satellite services. As information and services have grown more economically important in the international economy, demand has increased for information technologies, including satellites. This demand was reinforced by the "lessons" of the war in the Persian Gulf, which showed militaries around the world that space capabilities are an essential component of military effectiveness and that military power is not measured by size or mass but mobility and swiftness. These two factors have increased global demand for satellites, and if the United States does not meet this demand, the global diffusion of technology means that others can and will.

The popular view that the United States and Russia, the two countries with manned space capabilities, are the only two nations with space programs markedly underestimates global space and satellite capabilities. More than a dozen countries have robust space programs, many of which have been in existence for decades. These countries have built and orbited satellites, often using their own launch facilities. They can produce imagery, communications, and experimental satellites that, while not always equivalent to top-of-the-line U.S. products, are capable of meeting many military needs.

Other nations have gained enough experience in building and operating satellites, communications equipment, and sensors. Russia and other parts of the former Soviet Union have commercialized their space technologies. The result is that many countries now have the technical skills to manufacture satellites and their components and to have independent national programs. These programs are often quasicommercial—owned or operated by governments and providing services to them, but also offering services on the commercial market. This is an attractive way to let foreign spending help subsidize government programs and is the model for remote sensing outside of the United States.

In 1998, congressional concerns over alleged leaks of space technology to China led to legislation that transferred the export-licensing jurisdiction for communications satellites to the Department of State. A review of changes in U.S. satellite revenues and share of the commercial communications satellite market shows that there has been significant damage. Budget cuts in the early 1990s gravely harmed the industrial base for military space programs; the export control changes of the 1990s are completing the damage by eroding the commercial industrial base through loss of sales.

Four years after these legislative changes, one leading space analyst told reporters: "The biggest problem we're facing is that of export controls. It has become increasingly difficult for American companies to export satellites and satellite-related components, software and technology over the past couple years. As it has become more difficult for American companies, our foreign competitors have gotten better and better at this stuff."[2]

When Congress weighed new satellite restrictions in 1998, it underestimated their cost to the U.S. industrial base. It did so because the 1998 debate overstated the "uniqueness" (and thus the risk to national security) of U.S. satellite and launch technology. The impetus the 1998 changes gave to foreign satellite manufacturers may result in a permanently larger share of the satellite market for these firms, much in the way that Airbus has permanently established itself as a leading manufacturer. In an era of fierce competition and overcapacity in satellite manufacturing, supportive government policies and a positive regulatory environment will be a key determinant for a healthy space industry.

Data on imports and exports show the change in startling detail. In 1998, the year before the new regulations went into effect, the United States imported only 19 percent of spacecraft, satellites, and satellite parts used in this country. In every year after the new regulations, U.S. imports rose to more than 40 percent, with imports in 2001 reaching more than 46 percent. This suggests that the United States could find itself being a net importer of satellite technology in the near future if this trend is not reversed.[3]

The 1998 restrictions on commercial communications satellites were not the only factor responsible for a decline in U.S. satellite market share (exchange rates, new suppliers, and European industrial policy also played a role), but they were the only factor that resulted from U.S. government intervention. The new rules came at a time when U.S. manufacturers were already under substantial pressure, and they reinforced trends outside the United States that worked against the health of U.S. satellite industry.

Technology restriction was effective when the United States had a near monopoly on advanced satellite technology (and when the Cold War limited technology exports). The United States still has some unique satellite technologies where restriction remains appropriate, but as technological capabilities have spread around the world, this has become a very small set of items. The United States, which controls all satellite technology as a munition, has not been able to distinguish between those technologies where there is still a U.S. advantage and that should be protected and those satellite technologies that are routine, commercial, and available from foreign sources.

For example, delays in securing a State Department license to bid to sell electronic modules worth $50 million for European commercial satellites led the European builder to purchase instead from European and Japanese suppliers. Another U.S. company waited for almost a year before a ground station was licensed so it could be shipped to a NATO ally. More recently, a major Canadian satellite operator has told U.S. satellite manufacturers that it will no longer purchase satellites from them because of onerous export requirements.

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2. Elliot Pulham, president and CEO of the Colorado Springs–based Space Foundation, in Lyn Berry-Helmlinger, "Why Has Colorado Taken the Lead in the Space Industry?" *Denver Business Journal*, January 18, 2001.

3. The figures for 1999 and 2000 are 49 percent and 71.4 percent respectively; see series 31, "Exports of U.S. Aerospace Products," and series 32, "U.S. Imports of Aerospace Products," http://aia-aerospace.org/stats/aero_stats/aero_stats.cfm, accessed March 24, 2002.

These broad U.S. technology transfer restrictions are counterproductive, as they reduce the commercial sales that are the key to sustaining the U.S. satellite industrial base. Military and government demand will not be enough in the coming decade, when the United States will need fewer satellites for national requirements and longer gaps will occur between government satellite acquisitions. The effect of denying U.S. satellites, components, and technology to the global market has been to encourage other nations to develop non-U.S. sources of supply. For some key space technologies, such as traveling wave tubes, European firms have taken the lead since 1998.

Commercial Satellite Services

The best measure of the changed satellite environment is the expanding number of foreign satellite programs (private and governmental) that provide communications, navigation, and imagery services. These have increased dramatically in number and capability over the last 10 years and continue to expand. A review of the services available show that most are sufficient for military needs and some are equivalent to what is available to the United States.

Foreign communications satellites and services provide services equivalent to much of what is available to U.S. forces. Mobile satellite communications services and VSAT (very small aperture terminals) provide a level of service that lets companies or government build high volume, geographically dispersed communications networks for commercial or governmental purposes. The same is true of navigation services. Although GPS (global positioning services) and GLONASS (global navigation satellite system) satellites remain the only sources of navigation signals (Europe and Japan are developing their own navigational satellite systems), the receivers for these signals are easily built and widely available on the commercial market. The commercial market offers equipment equal to what is available to the military and dwarfs the military market in value. Degrading GPS signals in a conflict would damage the ability of opponents from using satellite navigation, but the risk that the United States could block or degrade GPS signals helps motivate others to build and launch their own systems.

Commercial satellite imagery serves a smaller market than do communications or navigation, and governments remain a major source of demand. However, the promise of the commercial market has led several nations to cross the threshold of having access to high-quality (one-meter) imagery for military and intelligence use. Many other nations have considered purchasing or developing their own satellite reconnaissance systems, but only a few (France, Japan, Israel, India, Russia, and China) have the resources to pursue these programs.

Technological capabilities for building remote sensing satellites are unevenly spread among spacefaring nations. The United States retains unique technical capabilities that even Russia cannot match. The technologies that provide these capabilities should remain restricted. However, the United States, despite its efforts, cannot prevent other nations from obtaining satellite imagery. Commercially available imagery has limitations—it is not as detailed or as timely as the imagery provided by U.S reconnaissance satellites. This reduces its value for military and intelligence purposes such as early warning. However, for other military purposes, such as planning and targeting, it is more than sufficient.

Surviving the Global Market

The U.S. satellite manufacturing industry has been engaged in contracting since 1990, when luxurious defense budgets for space and satellite acquisitions came to an end. Overcapacity, intensifying foreign competition, and damaging export regulations, when combined with low returns on equity compared with other tech industries, have led many firms to quit the business. Changes in export regulations since 1998 accelerated this demise by increasing uncertainty and reducing profitability. At the same time, the United States has not been able to prevent other nations from acquiring space capabilities, and it must look for other ways to manage the risks posed by the growth of commercial satellite services.

A study by Booz-Allen & Hamilton sponsored by the National Reconnaissance Office and the Office of the Secretary of Defense found that the "deteriorating financial health" of satellite companies poses a threat to the defense industrial base. It summarized the satellite industry as one with overcapacity in production, increased business risk without adequate returns and increased debt, making the sector "unattractive" for the investment community.

The United States can manage the risks of commercial space activity by taking steps to help the U.S. satellite manufacturing base remain strong and to maximize the role of U.S. companies as the suppliers of services and goods in commercial space.

For example, space remote sensing poses the greatest risk to U.S. forces, as imagery provides potential opponents with potentially great strategic advantages. If U.S. firms have a larger share of the global market for imagery, commercial incentives for foreign governments and firms to build imagery satellites will decline (since many hope to use commercial imagery sales to subsidize their programs). A larger U.S. market share would also reduce the supply of services from non-U.S. sources and increase the effectiveness of shutter control in time of crisis. U.S. companies can be influenced in ways that foreign companies cannot.

Numerous studies and commissions have urged the United States to gain advantage by using commercial satellite services for military and intelligence purposes. Purchasing services from commercial imagery providers would be like the early programs when the United States paid commercial airlines to deliver the mail—thus obtaining a service it needed at lower cost and promoting the growth of an important domestic industry.

Both policy and legislation have encouraged government purchases of commercial imagery from U.S. suppliers, but these have not been sufficient to sustain a robust domestic industry. Although the United States should continue to rely principally on organic satellite capabilities to supply core services to its military and national security communities, it should extend purchases of commercial services to include imagery and an expanded array and quantity of communications services. Using commercial services provides an economical alternative (and potentially reduces vulnerabilities) to the current U.S. approach, which uses small numbers of large, expensive systems to provide service to the military and national security community.

Policies that shift market share away from the United States weaken national security. A policy that emphasized participation and leadership of the global space market would put the United States in the best position to capture the benefits of satellite innovation and advances in satellite research and development. If U.S. firms supply the satellite and component market, it will increase their financial health and allow them to benefit from technological developments. Greater U.S. participation in the global satellite market also enhances transparency, as the United States will be more knowledgeable about foreign satellite programs and their capabilities.

For the United States, removing regulatory obstacles may be a key determinant for keeping America strong in space, but other measures are needed as well. A new national strategy must recognize both the realities of the marketplace and the attendant risks to national security. Like it or not, America's armed forces now live in an era of commercially available satellite communications and reconnaissance products. Managing the risks involved requires an emphasis on keeping intact U.S. leadership in satellites and space.

Recommendations

U.S. national security strategy emphasizes information dominance as the basis of future military superiority. Satellites for remote sensing, intelligence, and communication satellites and navigation are key to information dominance. To exercise information dominance, the United States continues to have capabilities in space that are superior to any potential opponent.

However, in seeking superior space capability, the United States has not paid enough attention to its commercial industrial base or to the commercial satellite market, which is where most of the nations of the world concentrate their satellite activities. The unexplored aspect of "space control" is how it applies to the world commercial market for satellite services. Commercial satellites will play a larger role in sustaining the U.S. satellite industrial base in the coming decade as national requirements are met with fewer satellites that have longer lives and as there are longer gaps between defense and intelligence satellite programs.

There is no simple remedy for preserving the health of the U.S. satellite industry in a competitive, global commercial space environment. A 1960s-style defense-industrial policy would be costly and inefficient. Direct subsidies would be politically difficult to defend and difficult to manage. The best option will be to ensure that U.S. firms benefit from the larger forces shaping the global market. These forces are the increasing international demand for satellite services in communication, navigation, and remote sensing, the emerging global market for commercial satellite services. A successful policy will take advantage of these trends.

To repair this situation, we offer the following conclusions and recommendations.

1. **Adjust U.S policies and plans to recognize the progress other countries have made in the commercial satellite market, both as satellite builders and as satellite service consumers.**

America now confronts a very different environment in space for national security. The growth of commercial space activities, where private entities or governments operate satellites and sell satellite services on a global commercial market, has changed the nature of the challenge to national security. From a national security perspective, foreign commercial satellite services are the most significant activity in space. However, forecasts of foreign space activities that alternate between alarmist and dismissive do a disservice to serious policymakers and operators. A growing number of countries can build and operate satellites, and all countries have access to satellite services. This is not an arms race, and competitors will be commercial more than military.

Managing any risk posed by commercial satellite services requires a dedicated effort to track what is available on the global commercial market. This should not be industrial policy or a new regulatory system for commercial satellites, but the assignment of responsibility within an agency (perhaps the Department of Defense or in the intelligence community) to work with U.S. companies and to use budgets and information to help the United States shape the global market in ways that are conducive to national security. This should be an integral part of any reorganization of U.S. government space functions.

2. **Streamline irrelevant technology transfer restrictions. Most restrictions now applied to commercial satellites fall into this category.**

Restrictions on satellite technology transfers have backfired in the new global economic and security environment. These restrictions now do more damage to the U.S. satellite industry than to foreign space programs. State, the current regulator, has overbroad restrictions that damage U.S. national security. The efforts of the Defense export control agency are disconnected from program requirements and the reality of international space activity. Although State could reduce licensing times, it will take hard work and courage to undo the damage. The State process has been streamlined in the last year, but fundamental requirements of its regulations for technology and reexports make them harmful to the satellite manufacturing base.

If there were time, a "fix" to the satellite problem would be part of a broader reform of U.S. export controls, but continuing to treat communications satellites as munitions while we wait for some distant reform will lead to further shrinkage in America's satellite industry and expand the satellite industries of other nations. Legislation currently pending in Congress to return jurisdiction to Commerce for communications satellites, which includes extensive technology safeguards, would go far to repair damage. Passage of this or similar legislation is an important first step toward ensuring U.S. leadership in space.

To address concerns that have been raised about Commerce controls, any return to Commerce should include requirements for continued Defense Department monitoring, technology control plans, State Department licenses for launch failure investigations, and intelligence community review to verify end users. Commerce should also continue its former practice of referring all export license applications for communications satellites and related items to Defense and State for review.

This does not mean that the United States should simply end all restriction on satellite technology. In remote sensing, the United States retains unique capabilities that no other country can match, but the governmental process for identifying these unique technologies is broken. The regulatory bureaucracy at Commerce, State, and Defense lacks the expertise to determine which technologies require continued control. The solution is to use external expertise in satellites. Involving actual operators and builders will give any restrictions a sound footing. A neutral and technically proficient external body, like the National Research Council, supported by recognized outside experts and NRO, NASA, or other agencies with space expertise, should carry out this review to design effective regulations and lists by Commerce. This external effort would allow a clearer sense of where the world market for satellites and satellite technology stands to inform policymakers.

3. **Develop measures that will prepare U.S. forces for conflict with opponents who take advantage of commercial satellite services, but recognize that the denial of satellite services is potentially a double-edged sword and may pose knotty problems for military planners.**

America now confronts a very different environment in space for national security. The growth of commercial space activities, where private entities or governments operate satellites and sell satellite services on a global commercial market, has changed the nature of the challenge to national security. Maximizing the national advantage in this different environment requires a different strategy, which emphasizes active participation in the global market and finding ways to make U.S. firms into strong competitors. The more of the market space U.S. companies occupy, the less space there will be for foreign governments to use commercial programs to subsidize their military and intelligence use of satellites. For satellite services, the United States has a better idea of capabilities and more leverage in crisis over U.S.-made or U.S.-operated satellites than it does over foreign-made or foreign-operated satellites.

The military conflict in Afghanistan showed some of the measures that can protect U.S. forces, including the exclusionary purchase of imagery from commercial sources and the leasing of all available communications satellites transponders. In addition, cooperation with friendly remote sensing service providers can ensure temporary blackouts of areas of tension or conflict.

However, in a more extensive conflict or against a country with access to its own commercial communications and remote sensing assets (India, China, and Russia are such states), this may not be sufficient. The question of whether to actively deny such assets is a difficult one, as it could legitimize attacks on U.S. space assets, where we have more at risk. There is also the dilemma of an opponent using neutral thirdparty assets, such as (hypothetically) China using a privately owned Russian communications satellite. It could be very difficult to neutralize such space assets.

4. **Develop new ways to reinforce the commercial space sector, including supportive regulatory structures and the further "outsourcing" of communications and remote sensing requirements to U.S. companies.**

Countries that are best able to exploit commercial development for military purposes will be stronger than opponents who are less adept at this. Policies that emphasize participation and leadership of the global commercial space market will put the United States in the best position to capture the benefits of economies of scale in satellite production and advances in satellite research and development. Commercial remote sensing is the area of greatest challenge for the United States. PDD-23 has outlived its usefulness. Its ambivalence about U.S. participation in the commercial remote sensing market has worked against U.S. interests. It has not stemmed the "proliferation" of remote sensing satellites outside the United States, it has not seen any turnkey systems exported (chiefly because they are too costly for most countries to operate), and the state of U.S. commercial imaging companies remains parlous. The regulation of U.S. satellite service providers, remote sensing technology, and remote sensing satellites remain essential ingredients for policy. The key issues for renewing PDD-23 are to move away from "remote sensing satellite proliferation" and to emphasize sales of U.S. systems and services as the best way to reduce risks to national security.

Having U.S. firms in the market and able to supply better-quality imagery than foreign competitors will provide the most effective means of shaping the international commercial imagery market. The United States needs to allow American imagery providers to take advantage of the qualitative superiority of U.S. imaging satellite technologies by offering higher quality imagery than is available from non-U.S. sources. Holding U.S. companies to a level of imagery quality equal to what is available on the world market gives the initiative in imagery to foreign firm and reduces both sales by U.S. firms and leverage for the U.S. government.

For the long term, the United States will need to consider if the national interest is best served by the sort of consolidation among satellite manufacturers as has already occurred among defense firms. There is global overcapacity in satellite production, and a real possibility that the United States will not be able to sustain (especially if current technology restrictions continue) the number of prime contractors and subcontractors it has now. Pruning a few, although painful, may be better than starving all. The key policy objective should be to ensure that a downsized global industry rests on an American base.

5. **Create a coherent organization for government involvement in space activities.**

Managing risk in an era of commercial space services will not be easy, and the United States will see other nations' capabilities in space increase relative to its own. This does not mean, however, that the United States needs to surrender preeminence. New policies can help the United States reduce the potential risks of commercial satellite services, but the current, fragmented approach to space in the

United States may prevent us from developing and implementing effective new approaches. Program managers, research agencies, and export control bureaucracies have little overlap and less coordination, with a resulting loss of impetus. Whether this new, guiding organization is the Presidential Space Advisory Group called for by the Commission to Assess United States National Security Space Management and Organization or a recreation of the White House Space Council that existed until 1993, the current civil, commercial, military, and regulatory "stovepipes" must be replaced with a coherent structure that can integrate commercial, military, and intelligence requirements.