

July 1997

# DEFENSE SATELLITE COMMUNICATIONS

## Alternative to DOD's Satellite Replacement Plan Would Be Less Costly



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National Security and  
International Affairs Division

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July 16, 1997

The Honorable William S. Cohen  
The Secretary of Defense

Dear Mr. Secretary:

We reviewed the Department of Defense's (DOD) plan to acquire a follow-on system to the Defense Satellite Communications System (DSCS). Our specific objectives were to assess DOD's long-range plan to replace DSCS in fiscal year 2006 and its interim plan to replenish the DSCS constellation with satellites in the inventory, relative to satellite communication requirements. This report discusses an alternative to DOD's long-range plan that could save the government about \$2.8 billion in future years if acquisition of the replacement system were accelerated to fiscal year 2003.

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## Background

DSCS is DOD's primary means of providing worldwide satellite communications in support of the National Command Authorities, intelligence users, and military forces. DSCS also provides communications services to non-DOD users, as approved by the Joint Chiefs of Staff and the Office of the Secretary of Defense.

According to a 1992 Joint Chiefs of Staff policy statement, the DSCS constellation is to consist of five fully capable satellites, plus any residual satellites in orbit that have partial capabilities. Currently, operational DSCS satellites are located over the East and West Atlantic, East and West Pacific, and Indian oceans. Each fully capable satellite has a communications throughput capacity of about 100 megabits per second (MBPS).<sup>1</sup> Additionally, DOD has five DSCS satellites that are scheduled to be launched during fiscal years 1997 through 2003 to replenish the existing constellation. DOD does not plan to acquire any more DSCS satellites of the current design.

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<sup>1</sup>The amount of information that can be passed through a satellite is measured in bits per second. A bit is the smallest unit of information, and a megabit is a million bits. Megabits per second and gigabits (one billion bits) per second are used as common units of measure for high-capacity satellite throughput.

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In 1996, the DOD Space Architect<sup>2</sup> assessed alternative ways of meeting emerging satellite communication requirements and established time frames for replacing existing satellite communication systems. Regarding DSCS, which is designed for high-capacity communications (defined as 1.544 MBPS and greater), the Architect recommended that DOD acquire a constellation of replacement satellites, based on commercial technology and using commercial acquisition practices, that would include a broadcast capability.<sup>3</sup> According to the Architect, this acquisition strategy would minimize technical risks, development costs, and delivery times. DOD expected that each satellite would have about 1 gigabit per second (GBPS) of capacity—10 times the amount of an existing 100 MBPS operational DSCS satellite. Because of expected funding constraints, the Architect recommended that the first replacement satellite be launched in fiscal year 2006. The Joint Space Management Board<sup>4</sup> agreed with the Architect's recommendation, and DOD authorized the effort last fall in a program decision memorandum.

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## Results in Brief

During the next decade, DOD anticipates that its requirements for high-capacity satellite communications will increase significantly because of the (1) shift in the national military strategy and (2) increasing availability of advanced satellite communication technologies and services and DOD's desire to take advantage of such technologies. DOD's Joint Requirements Oversight Council<sup>5</sup> plans to review these requirements later this year.

The Defense Satellite Communications System's replenishment satellites, most of which are to have twice the capacity of the existing operational satellites, are not expected to keep pace with the projected requirements. To the extent that these requirements are not satisfied by the System, the

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<sup>2</sup>The purpose of the Space Architect organization is to consolidate the responsibilities for DOD space missions and system architecture development into a single organization to achieve acquisition and future operational efficiencies. The Architect also performs this function with the intelligence community to support national security requirements.

<sup>3</sup>Satellite broadcast means data would be transmitted from terrestrial sources to the satellites, and then retransmitted from the satellites to multiple users, simultaneously, within focused or earth coverage listening areas.

<sup>4</sup>This Board was established by the Secretary of Defense and the Director of Central Intelligence to ensure that defense and intelligence needs for space systems, and their terrestrial components, are satisfied within available resources, using integrated architectures to the extent possible.

<sup>5</sup>This Council is DOD's authoritative forum for assessing requirements for defense acquisition programs. It is chaired by the Vice Chairman of the Joint Chiefs of Staff.

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users' alternative would be to lease satellite communications from commercial providers.

Funding for the replacement of the System in fiscal year 2006 is to be requested starting in fiscal year 2001. Meanwhile, the projected requirements are expected to continue increasing, which will force increases in the leasing of commercial satellite communication services to meet unsatisfied requirements. A DOD analysis indicates that commercial leasing is more costly than acquiring equivalent commercial-like capabilities.

According to military satellite communications program representatives and studies, the first launch of a replacement satellite would be technically feasible in fiscal year 2003. Our analysis of the effect on costs of this 2003 alternative, compared to DOD's 2006 plan, indicates that the government could save about \$2.8 billion in future years. The alternative, however, would require DOD to transfer about \$945 million in planned funding from fiscal years 2004-2006 to its fiscal years 1999-2003 future years defense program.

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## DOD Anticipates a Significant Increase in Satellite Communication Requirements

DOD anticipates that the requirements for satellite communications will increase significantly during the next decade. In the 1996 military satellite communications architecture study, the Space Architect predicted that the demand for high-capacity communications would increase from the current requirement of 1 GBPS to at least 3.6 GBPS by fiscal year 2006. Although quantifying requirements beyond fiscal year 2006 is more difficult, the U.S. Space Command and other DOD representatives project that the demand could be much higher by fiscal year 2010. The Joint Requirements Oversight Council has not validated the fiscal year 2006 requirements, but it is expected to review them later this year.

A 1995 DOD Satellite Communications Technical Advisory Group's final report and several previous and subsequent DOD documents that led to the 1996 architecture study stated that the expected increase in satellite communications is attributable, in part, to the shift in the national military strategy from deploying large numbers of forces overseas to stationing most forces in the United States. According to the documents, this shift creates a greater dependence on satellite communications because of the operational support required from centers in the United States when forces are to be deployed overseas for military operations.

In addition, the documents indicate that the requirements are expected to increase because of the increasing availability of advanced satellite communication technologies and services. DOD has indicated its desire to take advantage of such advanced technologies. Future satellite communications systems, for example, are expected to support increased military demands for video, imagery, and personal communication capabilities as well as alternate transmission methods such as direct broadcasting. These growing demands will require higher communication data rates, additional communications capacity, and better interoperability.

## DOD's DSCS Replenishment Plan Will Not Satisfy Emerging Requirements That Will Result in More Leasing

DOD plans to replenish the existing DSCS constellation during fiscal years 1997-2003 with the five satellites remaining in the inventory. DOD is modifying four of these satellites (1) to double each satellite's capacity from 100 MBPS to about 200 MBPS and (2) to replace potentially defective parts with improved electronic components. Although the increase in capacity is significant, it will not keep pace with the projected requirements. To the extent that valid high-capacity requirements are not satisfied by DSCS, the users' alternative would be to lease satellite communications from commercial providers.

In comparing the 1 GBPS requirement for 1997 with the existing DSCS constellation's capacity, 50 percent of the requirements either are satisfied by leasing commercial services or unsatisfied. Using a straight-line extrapolation to 3.6 GBPS, by fiscal year 2005—1 year before DOD plans to replace DSCS—about 75 percent of the requirements could be satisfied by leasing or using other satellites, or could be unsatisfied.

A preliminary DOD assessment indicates that DOD currently pays commercial providers, on average, about \$450,000 per year for 1 MBPS of satellite communication services. This average leasing cost was derived from costs under DOD's commercial satellite communications initiative<sup>6</sup> and defense business operations fund<sup>7</sup> rates. DOD representatives estimated that of the current 1 GBPS requirement, about 500 MBPS are satisfied by DSCS, about 300 MBPS are leased, and the remaining 200 MBPS

<sup>6</sup>In 1992, DOD established this initiative to explore greater uses of the advances in commercial satellite communications. The initiative is managed by the Defense Information Systems Agency and was intended to consolidate commercial satellite leases into a comprehensive program to take advantage of economies of scale.

<sup>7</sup>This is a revolving fund for providing goods and services on a reimbursable basis. For commercial satellite communications, the Defense Information Systems Agency develops specific billing rates for use by DOD components.

are unsatisfied. Thus, DOD's current annual leasing costs are estimated at \$135 million (\$450,000 times 300 MBPS). These leasing costs could be as high as \$225 million (\$450,000 times 500 MBPS) if all the requirements were to be satisfied. By fiscal year 2005, the difference between requirements and DSCS capacity could be about 2,500 MBPS. Assuming that the current average leasing cost remained the same, DOD's annual leasing cost would be over \$1 billion (\$450,000 times 2,500 MBPS) if all the projected requirements were to be satisfied.

## Replacing DSCS Earlier Than Planned Is a Less Costly Alternative

DOD's fiscal year 2006 replacement plan for DSCS will not satisfy the growth in satellite communications requirements, which will necessitate an increase in commercial leasing of high-capacity communications services. A less costly alternative would be to launch the follow-on system in fiscal year 2003. Our analysis indicates that this alternative would cost about \$2.8 billion less than DOD's 2006 plan. Table 1 illustrates the differences in the estimated acquisition and commercial leasing costs associated with (1) DOD's fiscal year 2006 plan and (2) the alternative of accelerating DOD's plan by 3 years to 2003.

**Table 1: Acquisition and Commercial Leasing Costs for DOD's Current Plan and an Alternative**

Dollars in millions

Costs by fiscal years	2006 plan <sup>a</sup>	2003 alternative	Increases and (decreases) from 2006 plan
<b>Acquisition cost</b>	<b>\$1,575</b>	<b>\$1,575</b>	<b>0</b>
1999-2003	630	1,575	\$945
2004-2006	945	0	(945)
<b>Commercial leasing cost</b>	<b>\$6,219</b>	<b>\$3,384</b>	<b>(\$2,835)</b>
1999-2003	3,125	2,810	(315)
2004-2006	3,094	574	(2,520)
<b>Total cost</b>	<b>\$7,794</b>	<b>\$4,959</b>	<b>(\$2,835)</b>
1999-2003	3,755	4,385	630
2004-2006	4,039	574	(3,465)

<sup>a</sup>Our funding assumptions are based on preliminary DOD satellite replacement cost data.

According to a DOD analysis, purchasing commercial-like, high-capacity communication capabilities is more cost-effective than leasing equivalent commercial services. Under DOD's 2006 plan, a constellation of five commercial-like DSCS follow-on satellites, which would include a broadcast

capability, would (1) have a total capacity of about 5 GBPS (1 GBPS per satellite) and (2) cost almost \$1.6 billion, including launch costs (\$315 million per satellite). Each satellite would be expected to provide communications over a 10-year life span. These costs convert to \$31,500 for 1 MBPS of capacity per year (\$315 million divided by 10 years divided by 1,000 MBPS), which is in contrast to the estimated average of \$450,000 for 1 MBPS of capacity that DOD currently pays for commercial leasing. Thus, if this leasing rate remained the same for 10 years, there would be a 14-to-1 cost advantage (\$450,000 to \$31,500) for DOD to acquire a commercial-like system rather than lease an equivalent amount of commercial services.

Under its plan, DOD could spend about \$6.2 billion in commercial leasing during the 8-year period from fiscal year 1999 through 2006 to satisfy all the requirements not satisfied by the existing DSCS and the replacement system. This estimate (1) assumes that the requirements for high-capacity satellite communications will increase on a straight-line basis, (2) includes the existing capacity of the operational DSCS satellites and the increased capacity of the replenishment satellites that are currently being modified, and (3) applies the \$450,000 annual average lease rate to the difference between (1) and (2).

Under the alternative, DOD could satisfy all the requirements not satisfied by DSCS and the replacement system through commercial leasing for about \$3.4 billion during fiscal years 1999-2006. However, all the planned funds to acquire the five DSCS replacement satellites would be needed earlier, requiring DOD to transfer about \$945 million from fiscal years 2004-2006 to fiscal years 1999-2003. The next opportunity for DOD to address a funding transfer is in its fiscal year 1999 future years defense program, which will be developed during the remainder of 1997. Such a funding change would create considerable savings in operations and maintenance funds that would otherwise be needed for commercial leasing to satisfy all the projected requirements. We estimated that during fiscal years 1999-2006, the alternative would save about \$2.8 billion (\$6.2 billion minus \$3.4 billion) compared to DOD's 2006 plan.

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## Recommendation

Considering the (1) anticipated increase in requirements for high-capacity satellite communications, (2) relative high cost of leasing commercial satellite communications and apparent cost-effectiveness of acquiring commercial-like satellites instead of leasing equivalent services from commercial providers, and (3) potential for significant long-term savings to the government, we recommend that the Secretary of Defense

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accelerate the introduction of a DSCS replacement system from fiscal year 2006 to 2003, or as soon as practicable, if the emerging requirements are deemed valid, the estimated acquisition and commercial leasing costs are considered credible, and the necessary acquisition funds can be made available.

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## Agency Comments

In commenting on a draft of this report, DOD agreed with our assessment of future shortfalls in military satellite communications. It stated that our recommendation regarding accelerating the introduction of the DSCS replacement system is one option that will be given full consideration pending completion of efforts by a DOD military satellite communication transition planning team. DOD indicated that in the fall of 1997, it will validate future needs, determine the level to which these needs will be satisfied, and establish dates for a replacement system. Until then, DOD does not believe it is in a position to consider departures from the baseline plan, such as accelerating the DSCS replacement system. Therefore, it partially concurs with our recommendation at this time.

DOD's comments are reprinted in appendix II.

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## Scope and Methodology

To develop information for the report, we examined (1) transition plans, launch schedules, and budget information related to DOD's replenishment plans for DSCS; (2) the military satellite communications architecture study, master plan, capstone requirements document, single integrated program plan, investment strategy, and contractor studies related to DOD's replacement plans for DSCS; and (3) internal memoranda and analyses related to satellite communication requirements and commercial leasing.

To perform our analysis, we used DOD's estimates for future high-capacity requirements, high-capacity satellite replacement and launch costs, and average commercial leasing rates. We developed a model to derive the total costs DOD could incur if the requirements that exceed DSCS capacity were to be satisfied through commercial leasing. Appendix I discusses our analysis of the high-capacity communications shortfalls in more detail, including information on DOD's emerging satellite communication requirements, DSCS constellation capacity, DOD's replacement plan, and an acquisition alternative.

We held discussions with representatives of the Office of the Deputy Under Secretary of Defense for Space; the Office of the DOD Space



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Architect; the Defense Information Systems Agency; the Joint Staff Directorate for Command, Control, Communication, and Computers; the Air Force's Office of the Assistant Secretary for Acquisition; and the Army's Directorate of Information Systems for Command, Control, Communication, and Computers in the Washington, D.C., area. We also held discussions with representatives of the Air Force's Space and Missile Systems Center and the Aerospace Corporation in El Segundo, California.

We performed our review from June 1996 through April 1997 in accordance with generally accepted government auditing standards.

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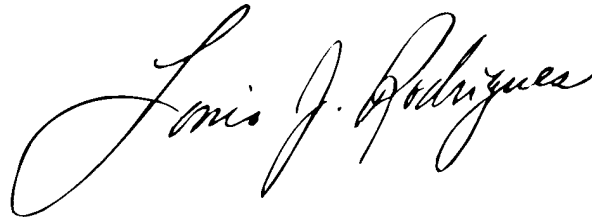
As you know, the head of a federal agency is required by 31 U.S.C. 720 to submit a written statement on action taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Reform and Oversight not later than 60 days after the date of this report. A written statement must also be submitted to the Senate and House Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of the report.

We are sending copies of this report to the Chairmen and Ranking Minority Members of the Senate Committee on Armed Services; Senate Committee on Appropriations, Subcommittee on Defense; House Committee on National Security; and House Committee on Appropriations, Subcommittee on National Security. We are also sending copies to the Secretaries of the Air Force, the Army, and the Navy and the Director, Office of Management and Budget. Copies will be made available to others upon request.

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This report was prepared under the direction of Thomas J. Brew, Associate Director, Defense Acquisitions Issues, who may be reached at (202) 512-4841 if you or your staff have any questions concerning this report. Major contributors to this report are listed in appendix III.

Sincerely yours,

A handwritten signature in cursive script that reads "Louis J. Rodrigues". The signature is written in black ink and is positioned below the text "Sincerely yours,".

Louis J. Rodrigues  
Director, Defense Acquisitions Issues

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# Contents

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Letter	1
Appendix I DOD's Projected Satellite Communication Requirements Compared With Existing and Planned DSCS Constellation Capacity	12
Appendix II Comments From the Department of Defense	16
Appendix III Major Contributors to This Report	19
Table	Table 1: Acquisition and Commercial Leasing Costs for DOD's Current Plan and an Alternative 5
Figures	Figure I.1: DOD's Projected High-Capacity Requirements Compared With DSCS Constellation Capacity and DOD's Fiscal Year 2006 Replacement Plan 12
	Figure I.2: DOD's Projected High-Capacity Requirements Compared With DSCS Constellation Capacity and the Fiscal Year 2003 Replacement Alternative 14

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## Abbreviations

DOD	Department of Defense
DSCS	Defense Satellite Communications System
GBPS	Gigabits Per Second
MBPS	Megabits Per Second

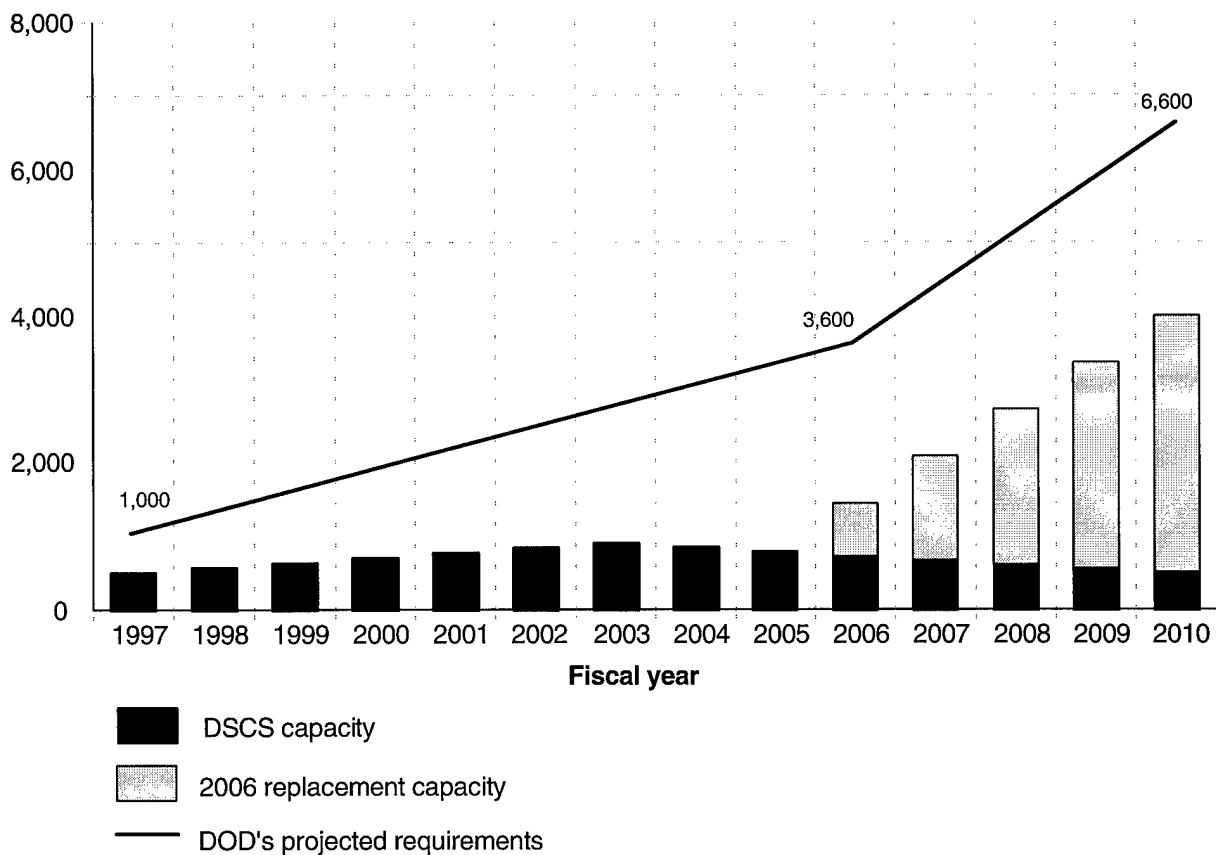


# DOD's Projected Satellite Communication Requirements Compared With Existing and Planned DSCS Constellation Capacity

Figure I.1 illustrates the Department of Defense's (DOD) projected high-capacity satellite communication requirements (solid line) from the validated 1 gigabit per second (GBPS) for fiscal year 1997 to the projected 3.6 GBPS in fiscal year 2006. The 6.6 GBPS in fiscal year 2010 is based on an interpolation of DOD's estimated high-capacity satellite communications requirements. We used a straight-line extrapolation to assess requirements data between these points.

**Figure I.1: DOD's Projected High-Capacity Requirements Compared With DSCS Constellation Capacity and DOD's Fiscal Year 2006 Replacement Plan**

Requirements and capacity (MBPS)



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**Appendix I  
DOD's Projected Satellite Communication  
Requirements Compared With Existing and  
Planned DSCS Constellation Capacity**

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Figure I.1 also illustrates the estimated Defense Satellite Communications System (DSCS) constellation capacity for fiscal years 1997-2010 (bold bars). Currently, the cumulative capacity of the existing constellation of five DSCS satellites is about 500 megabits per second (MBPS). Enhancements to four of the five satellites in the inventory, which are to replenish the existing constellation, would increase this capacity to about 900 MBPS in fiscal year 2003. Thereafter, the constellation capacity is expected to decrease to about 500 MBPS by 2010. This is because satellites gradually degrade before they reach the end of their useful lives. We used a straight-line extrapolation to assess capacity data between these points.

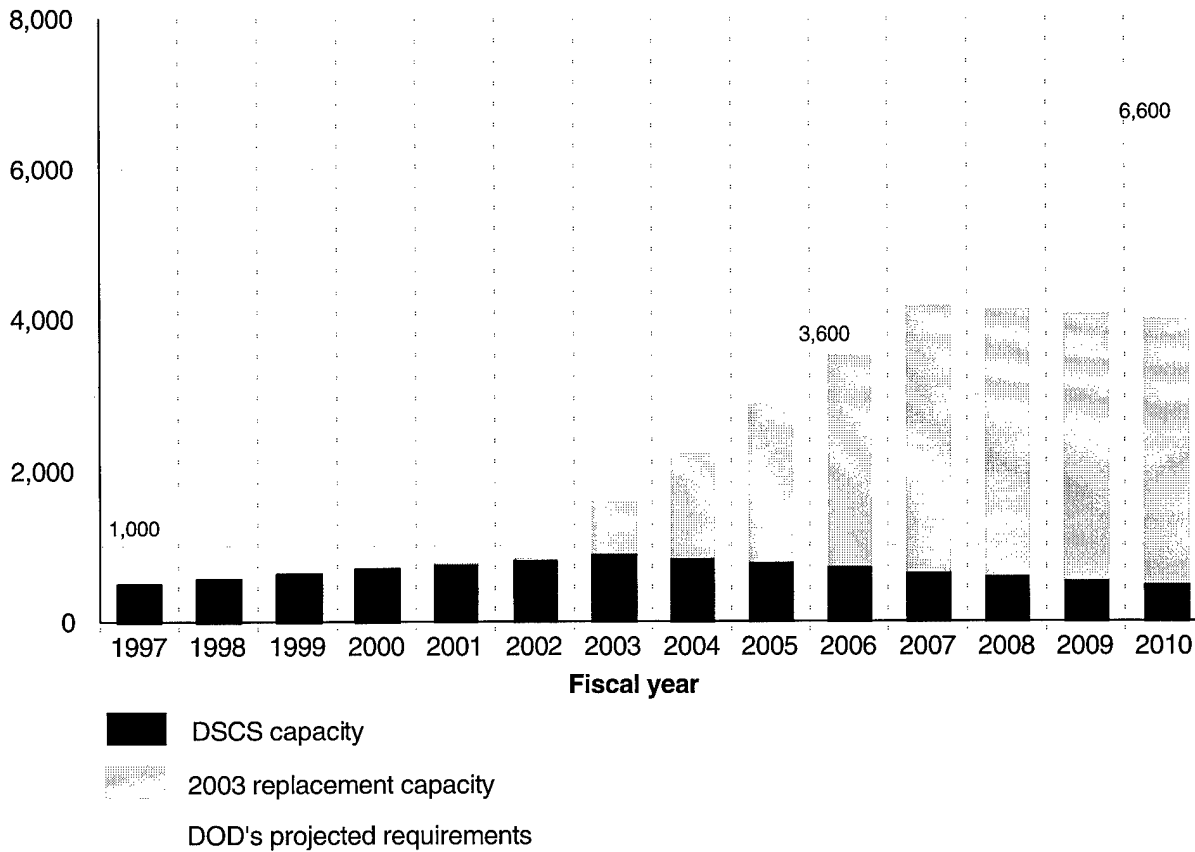
In addition, figure I.1 shows the cumulative capacity per year for the DSCS replacement satellites under DOD's 2006 plan (shaded bars) that would be added to the DSCS constellation. We assumed that DOD would launch one satellite per year. Each replacement satellite is estimated to have about 1 GBPS of capacity, consisting of about 700 MBPS for high-capacity communications and about 300 MBPS for a broadcast capability. For direct comparison purposes with the high-capacity requirements, the figure shows only 700 MBPS for each satellite.

The satellite capacity information presumes no launch vehicle or satellite failures or delays that would affect the schedule in future years. From fiscal year 1997 through 2006, the gap between projected requirements and the cumulative satellite capacity represents unsatisfied requirements that would have to be leased or satisfied with other satellite systems or would remain unsatisfied. DOD has not made a decision regarding capacity beyond its fiscal year 2006 plan, and would therefore need to evaluate the continuing gap between requirements and capacity.

Appendix I  
 DOD's Projected Satellite Communication  
 Requirements Compared With Existing and  
 Planned DSCS Constellation Capacity

Figure I.2: DOD's Projected High-Capacity Requirements Compared With DSCS Constellation Capacity and the Fiscal Year 2003 Replacement Alternative

Requirements and capacity (MBPS)



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**Appendix I  
DOD's Projected Satellite Communication  
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regarding capacity beyond its fiscal year 2006 plan, and would therefore need to evaluate the continuing gap between requirements and capacity.



