

Controlling Orbital Debris: The Role of the U.S. Congress

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Abstract

Although the dangers from orbital debris are becoming more widely known, and orbital debris experts generally agree on the need for concerted international attention to the issue, Members of Congress need to be better informed about orbital debris concerns and how the United States might best resolve them. This paper examines the role that the U.S. Congress could play in the U.S. approach to reducing orbital debris. It also discusses the challenge posed by crafting an international solution and how Congress could assist in that important task.

Introduction

Most knowledgeable parties agree on the need to reduce or eliminate the production of orbital debris in order to preserve the ability to operate spacecraft safely in low Earth orbits (LEO) and geosynchronous orbits (GSO). They even agree substantially on the most important technical methods to use, and the importance of involving the entire international spacefaring community. They disagree, however, on the precise characterization of the nature and extent of the danger to space operations in particular orbits. In addition, there is substantial uncertainty about the spatial distribution and total mass of small objects (less than 1 centimeter in diameter), and the threat they may pose, which, in turn, contributes to uncertainty regarding the costs of mitigating the effects of debris.

Nations have been reluctant to commit to mitigation measures that might limit their range of economic or operational options because changes in launch procedures and satellite design intended to reduce the generation of orbital debris generally exact an economic or

operational penalty. The international response to debris generation is thus typical of responses to other pollution problems involving several parties with diverse economic and political interests. Although the major spacefaring nations have begun to address the debris problem both on an individual and a multilateral basis, legal, economic, political, and institutional barriers inhibit formal international cooperative action to limit debris.

Nevertheless, the continued production of orbital debris by the United States and other countries threatens U.S. national security, the pursuit of science from space, human safety, and the economic viability of commercial satellites. Even with today's relatively low launch rate, the debris problem is worsening steadily. As many experts have noted,¹ in the absence of controls, the development of new space activities would certainly exacerbate the existing situation. In the United States, occasional debris impacts on the space shuttle and concern over the potential threat to the international Earth-orbiting space station have helped to focus public attention on the problem of orbital debris. Such attention has led to a growing consensus that policy initiatives may be needed to address the orbital debris issue.

So far the U.S. Congress has played only a limited role in the debate over the prevention and mitigation of orbital debris. Of course, Members of Congress who serve on the authorization and appropriations committees overseeing U.S. space efforts are generally aware of the problems orbital debris can cause. Nevertheless, there is a strong need to inform Congress, both about the overall problem and about some of its

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international consequences. Most important, Members of Congress need to have a clear idea of the range of uncertainties in scientists' estimates of the debris problem, and what such uncertainties mean for the development of mitigation or adaptation strategies that would reduce the risk to space operations.

Historically, the United States and Russia have generated most of the orbital debris, but as other launching countries increase their space activities, they too, will begin to add substantial quantities of orbital debris. Hence, because all of the spacefaring nations contribute to the orbital debris problem, all of them will eventually have to be involved in the solution.

Informing Congress

Why should Congress be brought into the orbital debris discussion? We can answer this question in part by noting that Congressional decisions may inadvertently contribute to the problem. During every legislative session Congress makes numerous large and small decisions that affect both public and private investments in space activities. Proponents of increased space activities have long argued for the economic benefits that would flow from frequent, inexpensive access to space. They envision large numbers of commercial LEO communications satellites, commercial LEO remote sensing satellites, and even regular flights of human crews for scientific research and tourism. Congress has been extremely supportive of the continued expansion of commercial space activities, and generally views such proposals with favor. Hence, because Congressional decisions affect the use of outer space, Congress should be aware of the threat orbital debris poses to space activities, as well as of the risks of generating additional debris inherent in programs they support. Because orbital debris presents an extremely small, but real, threat to human safety, members of Congress should be especially aware of the risks that shuttle crews or possible future space station crews might face, lest they be taken by surprise in the event of serious injury to members of a human crew.

For example, the reports of debris impacts with the U.S. space shuttle, impacts which resulted in damage to the window of the orbiter *Challenger*,² stimulated Congressional interest in the potential threat of orbital debris to U.S. activities in space. In addition, analyses suggesting that projected growth in the orbital debris population could eventually result in significant hazards to unmanned and human spaceflight activities raised additional Congressional concern and led the Subcommittee on Space Science and Applications of the House Committee on Science, Space, and Technology to hold a public hearing on the problem of orbital debris in July 1988.³ That hearing explored a range of technical and policy issues.

Congress, primarily through the efforts of the House Committee on Science, Space, and Technology, has further educated itself about orbital debris by requesting:

- o a 1990 General Accounting Office report,⁴
- o a 1990 Office of Technology Assessment report,⁵ and
- o a 1992 General Accounting Office report.⁶

The work of technical and legal experts from the United States and other countries has served as the basis of these three reports. In addition, several domestic and international professional associations have conducted assessments of the risks from orbital debris and how to reduce them. These organizations have made their findings known to Members of Congress and their staffs.

Two factors suggest the need to update Congress about the risks caused by orbital debris: 1) Since the 1988 hearing was held and the first two congressional studies published, the scientific community has learned a great deal more about the orbital debris problem. 2) The turnover in Congress was especially high in 1992.

In one sense, the control of the generation of orbital debris has a technical solution, but most of the barriers to action are political and economic, rather than technical. In addition to becoming more aware of the risks of orbital debris, Congress can assist in reducing those barriers.

What Can the U.S. Congress do to Assist in Promoting Orbital Debris Controls?

Although the U.S. Congress finds it difficult to initiate action, particularly in an arena where technical experts disagree over the need for action or the modes actions should take, it nevertheless routinely responds to Administration requests for legislation on topics of importance to the United States. Congressional committees also conduct oversight hearings and investigations in an attempt to see that relevant agencies such as the National Aeronautics and Space Administration (NASA), the Department of Defense (DOD), the Department of State, and the Department of Transportation carry out their responsibilities appropriately. As noted, they also request the Congressional support agencies to provide technical and policy options in areas of interest to Congress.

One of the recurring themes during questioning by Members in the 1988 hearing was the viability of a "zero growth" policy for dealing with the problem of orbital debris. That is, Members were interested in whether it would be realistic, in concert with other nations, to stipulate design, launch, and operational criteria that would result in a zero net increase in the amount of space debris left in orbit (that would not be removed through orbital decay over the course of the solar cycle—approximately 11 years).

In general, the federal agencies and a segment of the technical community have responded to this proposed policy by noting that although a zero-growth policy for orbital debris might be a worthwhile objective, it is not likely to be achieved. For example, when the witnesses were asked to give their comments on such a policy, the NASA representative responded:

Without being disrespectful, I think that's the kind of a statement ... where the admiral on a carrier says, 'There will be no wheels-up landings on my carrier.'

We can't control it on that way. I think that we have no control over the collisions of the existing material

that is there. I think that an admirable goal and a reliable goal would be to drive it towards zero, but ever getting to zero, the cost would be—you just couldn't control it from that standpoint.⁷

The Department of Defense representative had a similar response:

Sir, I think, of course, we do need a policy on this and an international policy, and there are very positive things that can be done. I think the goal should not be towards some absolute level of debris but towards reaching agreement on those positive measures we can take that will significantly reduce the problem.⁸

Finally, the State Department representative stated:

Mr. Chairman, while we don't have an adopted policy on this point yet, I'd like to suggest that one possible starting point for an international agreement would be to get other nations and operators to observe the same principle that we've enunciated in our space policy, which is basically to minimize the creation of space debris; try not to make the problem any worse unless you have to. I'm not sure it's realistic to go to a zero growth policy because it might be a major inhibition on space operations, some of which are essential.⁹

Despite resistance by the agencies to considering a zero growth policy, interest in the concept has recurred in the years since the hearing. Indeed, Public Law 101-611 (the "National Aeronautics and Space Administration Authorization Act, Fiscal Year 1991) included a section on space debris:

SECTION 118. SPACE DEBRIS.

(a) FINDINGS.--The Congress finds that--

(1) if space users fail to act soon to reduce their contribution to debris in space, orbital debris could severely restrict the use of some orbits within a decade;

(2) the lack of adequate data on the orbital distribution and size of debris will continue to hamper efforts to reduce the threat that debris poses to spacecraft; and (3) existing international treaties and agreements are inadequate for minimizing the generation of orbital debris or controlling its effects.

(b) SENSE OF CONGRESS--It is the sense of Congress that the goal of United States policy should be that--

(1) the space related activities of the United States should be conducted in a manner that does not increase the amount of orbital space debris; and

(2) the United States should engage other spacefaring Nations to develop an agreement on the conduct of space activities that ensures that the amount of orbital space debris is not increased.

Section 118 was not binding on the Administration since it reflected the "sense of Congress" rather than a mandate for a zero-growth policy. Nevertheless, such a statement reflects congressional interest in a strong debris control policy.

Another perspective that has frequently surfaced in discussions of options for dealing with the threat of orbital debris is the point of view that we do not yet know enough to impose across-the-board technical or regulatory solutions. Thus the State Department

representative testified at the 1988 hearing:

A number of proposals have already been made for technical and regulatory approaches to the space debris problem. We will be looking at such proposals in the interagency study.¹⁰ In the meantime, we would urge that no legislation be enacted that would pre-empt the results of that study by imposing specific technical or regulatory requirements. As we have noted in international fora, as well, premature actions that do not take into account all the interests involved could do more harm than good.¹¹

Congress has been sensitive to those considerations, which is one of the reasons there has been no substantive legislative activity related to the prevention and mitigation of orbital debris growth in the five years since the above-mentioned testimony.

Clearly, one of the most politically and economically sensitive considerations is the extent to which regulations levied on U.S. spacecraft and launch vehicle and launch service providers would place the U.S. satellite and launch industry at a disadvantage relative to its international competitors. Although this issue has been raised both in Congressional testimony and in studies such as the recent American Institute of Aeronautics and Astronautics assessment,¹² U.S. agencies do not appear to have made a thorough evaluation of the technical or economic costs of proposed regulatory measures. Yet actions contemplated by the United States to modify its current space launch and/or spacecraft design procedures could significantly affect the competitiveness of U.S. launch service providers and satellite vendors. Hence those potential actions must be evaluated in the context of the international competitive environment. Lack of knowledge about the potential additional costs of regulations intended to reduce the orbital debris threat has further slowed the movement toward any legislative involvement in the orbital debris issue. Yet it is

clear that inaction may impose its own set of costs at some future point – in terms of damaged spacecraft, unusable orbits, or even loss of life.

The U.S. House of Representatives signalled its concern over both the necessity for international standards to control the production of orbital debris and the importance of including the U.S. private sector in drafting U.S. standards when it passed the 1993 authorizing legislation for the National Aeronautics and Space Administration, H.R.2200, which contains the following provision:

The Office of Science and Technology Policy, in coordination with the National Aeronautics and Space Administration, the Department of Defense, the Department of State, and other agencies as appropriate, shall submit a plan to Congress within one year after the date of enactment of this Act for the control of orbital debris. The plan shall include proposed launch vehicle and spacecraft design standards and operational procedures to minimize the creation of new debris. The plan shall propose a schedule for the incorporation of the standards into all United States civil, military, and commercial activities. Finally, the plan shall include a schedule for the development of an international agreement on the control of orbital debris.¹³

The committee report accompanying the bill further stated:

The Committee believes that it is critical for the commercial sector to be involved in commenting on any proposed standards. In general, the Committee expects that OSTP will provide an appropriate mechanism for involving the satellite and launch vehicle industries in the development of the plan.¹⁴

Meanwhile, launch services companies and some satellite operators have begun to include debris mitigation measures in their design and operational procedures. For example, Arianespace and CNES have redesigned the launch operations for Ariane 4 to reduce its contribution to orbital debris and have included such considerations in the design of Ariane 5.¹⁵ and Motorola is including the capability to deorbit its Iridium satellites after the end of their useful life. The Iridium system, which will consist of a constellation of 66 satellites, will circle Earth 780 km altitude in various near-polar orbits.¹⁶

The development and impending deployment of numerous small LEO satellite systems for mobile communications and Earth observations, poses a particular challenge for the international community because they will operate from altitudes where the natural lifetime of objects in orbit is of the order of a 1000 years. Current plans call for the launch of up to 200 small satellites over the next decade. Even if not all these plans come to fruition, increasing the density of satellites in these orbits will eventually lead to a condition where collisions with orbital debris would be common and even bring on a "chain reaction" of collisions,¹⁷ thus severely reducing the utility of LEO orbits to government and commercial operators alike. Although Motorola has integrated debris reduction procedures in its plans, many other firms have not, which could give the latter a competitive advantage. International operational standards for these orbits could level the playing field.

What Does Congress Need to Know About Orbital Debris?

The threat posed by orbital debris to the nation's space activities is likely to remain somewhat abstract to Members of Congress and to the American public until debris destroys a well known spacecraft or imperils human lives. Space is vast, and the United States and the former Soviet Union have undertaken activities in space for more than 35 years without such a lethal encounter being reported.¹⁸ Thus it is difficult for the average Member of Congress to know how concerned he or she should be about the future threat posed by the accumulation of space debris, especially because Members find themselves constantly bombarded with issues

that are said to have reached the "crisis" stage.

If Congress is to play a constructive role in alleviating the orbital debris problem, Congress will need several types of information:

- o First, Members will need a clear understanding of the nature of the debris threat. The technical and legal communities can provide an important service in educating Members (and their staff) on orbital debris, but only if the communities can explain the essential issues in non-technical, relatively jargon-free terms. Such an effort may also have the healthy side-effect of helping to bridge the gap between those technical and legal experts, thereby allowing a more unified assault on the debris problem than has occurred in the past.
- o Second, Members need to know the risks inherent in each of the options for dealing with space debris, as well as the risks that accrue from doing nothing about the problem. Congress particularly needs to understand the economic risks (or costs and benefits) of any given mitigation approach -- both to the United States and to its international economic competitors. This understanding is critical, since inevitably some parties will assert that the government's actions in addressing the debris threat have imposed excessive costs on them.
- o Third, Members need to be aware of the areas of uncertainty in our understanding of the orbital debris problem. There is no question that the uncertainties are uncomfortably high, complicating the analysis of options for dealing with the debris threat. In many ways, the situation is analogous to that confronting Members as they attempt to evaluate the widely varying predictions being proffered in the global warming debate.
- o Finally, Members would benefit from hearing the views of orbital debris experts and policymakers from other spacefaring nations about their approach to orbital

debris.

The legislatures of other countries will need similar information in order to carry out their decisionmaking duties. Members of all legislative bodies are often faced with the necessity of making policy decisions in the face of uncertainty. Moreover, those policy decisions have to be made with the realization that a wrong decision could lead to very large economic and societal costs--whose magnitude might become apparent only in retrospect. If the U.S. Congress perceives a need for action at some point in the future, any remaining areas of uncertainty about the amount or distribution of orbital debris are not likely to be sufficient to prevent Congress from acting. Thus, in the interests of maximizing the efficacy of the resulting policy initiative, it is important to make a vigorous and sustained effort to reduce the remaining uncertainties associated with orbital debris

The International Community and Orbital Debris

Most observers believe that an international agreement must eventually be reached. To date, activities have centered on evaluating the technical aspects (among experts) and the legal aspects (among experts) of orbital debris, but with little focus on how to reach agreement internationally. In addition, they have given scant attention to educating non-experts, particularly politicians, about the problem and the range of available mitigation measures. Yet it will be politicians, both within the Congress and the Administration, who must ultimately pass judgement on any actions proposed by legal and technical experts. The technical experts need to analyze the nature and extent of the problem, and provide options to a broader community, but they cannot provide the political solution.

It is safe to say that the nature of the orbital debris threat is such that policy initiatives cannot be confined to U.S. activities in space. All of the world's spacefaring nations have a stake in successfully alleviating the orbital debris problem.

In an earlier paper,¹⁹ Williamson suggested a five step process to achieve binding

international action on orbital debris:

Step 1: Continue to share research information about the extent and threat of orbital debris with all potential players, and also with the general population. Information needs to be structured to reach the technical community, the political community, and the broader public. The sharing of information should especially include U.S. and foreign private launching firms, so they can generate input to the economic issues.

Step 2: Convene a multilateral Working Group as soon as possible, limited to the launching nations. The Working Group would attempt to reach consensus on a minimum set of mitigation strategies;

Step 3: The Working Group should develop a formal, nonbinding agreement that would include: a research agenda to reduce uncertainties about the distribution and extent of orbital debris; commitments from the launching states to institute the mitigation strategies agreed upon in Step 2; and a basic approach to solving the legal issues raised by the presence of orbital debris;

Step 4: The Working Group should invite into the membership of the Working Group other nations, such as Brazil, India, or Israel, which currently have a limited capability to reach orbit, but who are committed to developing their own launch systems. The expansion of membership should also include representatives from multistate organizations such as Intelsat, Inmarsat, Eumetsat, and Arabsat.

Step 5: Broaden the venue for discussion to include all countries who maintain active space science and/or applications programs and therefore have a vested interest in protecting their space investments. The wider group could then create, and propose to the United Nations, language for a flexible international agreement that would attempt to create debris control guidelines for all launching

nations, existing and future.

The organization of the Working Group suggested in this process is similar in concept to the Committee on Earth Observation Systems (CEOS), which was created in 1984 as a result of discussions begun in the International Economic Summit of Industrialized Nations. CEOS serves as the focal point for international coordination of space-related, Earth observation activities. Initial membership included only national and regional governmental agencies responsible for spacebased Earth observations programs.²⁰ It excluded the Soviet Union. Over the years, CEOS has gradually expanded its membership to include other countries and organizations having an interest in contributing the collection of Earth observations data.²¹

Historically, most international activities to share information regarding orbital debris and to develop international standards have taken the form of bilateral coordination. Recently, however, the United States, the European Space Agency, Japan, and Russia have met in a multilateral setting. They plan to develop a set of proposed principles and standards to take to the United Nations Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space. This approach, which is a variant of the above proposed sequence of steps, could be extremely fruitful in leading to a formal international agreement for limiting the production of orbital debris.

Eventually, an international agreement might set the terms for:

- o continued research on the nature and extent of orbital debris;
- o additional research on mitigation strategies;
- o a basic set of design and procedural standards for all countries to meet in launching and operating payloads;
- o mechanisms for adding new standards; and
- o the means of policing adherence to standards.

The development of orbital debris definitions²² would be particularly important, because as one analyst has recently noted,²³ the international legal community has invested a

great deal of labor in studying the legal aspects of orbital debris, including definitional issues, without reaching consensus.

Conclusions

The steady increase of orbital debris shares with many other pollution problems the characteristic that the broader public may well ignore it until a serious incident threatening human life, or creating considerable economic damage, makes action essential. If such an incident occurred, Congress would certainly hold hearings to understand why it happened and what could be done to prevent future occurrences. Many of the questions that have already been raised would be raised again, but in an atmosphere that might create pressure to craft legislative solutions without sufficient appreciation of the range of options available, or the costs of specific legislative remedies.

Although a series of interagency reviews and task forces have come into existence over the last five years to address the orbital debris problem, they have failed to reach agreement on the best approach to take--especially with respect to the most effective type of international agreements to seek. A new interagency working group was established under the auspices of the National Space Council during the last year of the Bush Administration. However, that interagency group did not develop definitive operational or policy guidelines to alleviate the orbital debris problem prior to the end of the Bush Administration. Thus, it appears that the interagency process will have to begin again under the auspices of the Clinton Administration, and there is no indication yet that such an effort is contemplated in the near future.²⁴

In summary, there has not been sustained attention given to the policy issues associated with orbital debris prevention or mitigation at a level that would allow a consensus to be achieved within the U.S. government. This is not to say that the extensive coordination among government agencies (notably DOD and NASA) at the working levels has not been useful, nor that the agencies' efforts to broaden the discussion in the international community have been ineffective. Indeed, scientists and

engineers within NASA and DOD have led the international debate over orbital debris. However, the lack to date of a policy consensus within the U.S. government has made it difficult to forge an international agreement to control the growth of orbital debris. This lack appears to be mirrored on the international scene, but the United States cannot safely assume that the future will be driven by U.S. actions. Other countries or groups of countries may well craft a draft agreement that could be embarrassing to the United States. Restrictions on production of orbital debris might well enter the negotiations over "rules of the road" for commercial launch systems, for example. These could, if adopted, result in de facto debris policy.

Ultimately, the U.S. interagency process may prove to be an ineffective mechanism for fully addressing the orbital debris issue. If so, Congress may decide to become more active in resolving the domestic policy impasse, and in providing guidelines for an international orbital debris agreement. It would be inappropriate at this point to speculate what policy approach Congress might follow to deal with the space debris problem. The various existing reports and papers contain a number of potential control and mitigation strategies. Suffice it to say, though, that any approach contemplated by the U.S. Congress and/or the Administration will have to take account of technical and economic implications that are not yet wholly understood. Gaining a realistic understanding of these implications will be an important next step in developing a workable space debris strategy.

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