1995 IISL/IASL Symposium - Technical and Policy Issues Related to the Use of the Space Environment

United Nations Office for Outer Space Affairs

Space Environment: Policy Issues

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Thank you for inviting me to speak to you about policy issues regarding the space environment. My comments today will focus on the growing concern about orbital debris prompted most recently by the impending launch and operation of several low-earth orbiting global telecommunications satellite constellations, commonly known as "Big LEO" systems. The development of the new international space station, known as "Freedom," which should come to life around the turn of the century, also has sparked increased concern about orbital debris.

First, I will talk about why there is an increasing need for debris mitigation. Second, I will discuss options for establishing debris mitigation standards. Third, I will review the steps commercial, governmental and non-governmental organizations are taking to arrive at feasible solutions for orbital debris.

I. The Increasing Need for Debris Mitigation Standards

New global telecommunications systems promise to revolutionize wireless communications by providing a variety of high quality voice and data communications services to subscribers in every corner of the globe. To deliver on

this promise each system is designed to operate through the use of a constellation of satellites.

In the United States, five systems or constellations competed for frequency licenses. On January 31, 1995, the U.S. Federal Communications Commission licensed three Big LEO systems, which, added together, feature 126 first generation satellites. These three systems are: Iridium, Inc. (developed by Motorola) which totals 66 satellites; Globalstar (a joint venture between Loral Corp. and Qualcomm), which features 48 satellites; and TRW's Odyssey, which totals 12 satellites. Add spare satellites for each of these systems and the orbit becomes more crowded. Of course, if additional international systems, such as the ambitious Teledesic system, the number of new spacecraft and the amount of potential debris grows even higher.

Although these constellations and the launch vehicles used to deliver them to low-earth orbit will be both potential sources and victims of debris, a debris mitigation plan was not a requirement of the licensing process. However, now that these systems are licensed and are capable of being launched and operational in the near future, the space policy community has taken seriously the threat of unfettered debris proliferation.

Another new spacecraft destined for low-earth orbit--assuming it survives budget cuts in the U.S. Congress--is the international Space Station Freedom, which is scheduled to be launched and operational around the turn of the century. The Space Station will join the Russian space station Mir, which is also in low-earth orbit. Space Station Freedom is being designed not only as an orbiting laboratory, but also as the foundation for future international manned space expeditions. The notion that the Space Station also could be the source and victim of debris has been another catalyst for increased interest in the dangers of orbital debris.

Numerous studies have shown that the impact of a piece of debris, as small as a few millimeters in size, can cause serious damage to any spacecraft, unmanned or manned.

Damage to or loss of an unmanned spacecraft caused by debris would be very costly in a financial sense. Moreover, the cost of such damage or loss would be borne by a variety of entities including: (1) the satellite operator; (2) those who depend upon the services the satellite provides; and (3) the insurers. If damage or loss caused by debris becomes a frequent event, complex global satellite systems may become too costly to operate. Users will argue that the risk of service interruption caused by debris renders the system unreliable. Insurers will say that the risks caused by debris make the systems uninsurable--or they will set premiums so high that it will be commercially impracticable to insure the systems. In the end, the losers will be the

satellite manufacturers and operators, launch services providers and users, just to name a few.

The cost of a damaged or lost manned spacecraft is measured not only in dollars, but also in the value of human life. In the United States, the 1986 Challenger disaster demonstrated that the public is not willing to accept loss of life even in high risk activities such as space exploration, especially if such risk reasonably could have been lowered. The ripple effect of a catastrophic loss of a manned spacecraft caused by debris could be devastating. Once the public determines that the risk of loss caused by debris is unacceptable, the U.S. Congress is much less likely to fund manned missions. By extension, other space-faring nations also would be less likely to fund manned missions. Can we afford to be deprived of the benefits of manned exploration of space because orbital debris has made the journey unsafe?

Admittedly, the two scenarios I have posited are extreme; but hopefully they highlight the potential risks of unfettered debris proliferation and help bring to the fore the debate of what to do about debris before it gets out of hand.

II. Options for Establishing Debris Mitigation Standards

Orbital debris is very difficult to detect. The U.S. Space Command of the Department of Defense tracks more than 7,000 man-made objects in space. However, in order to be "trackable" the object must be at least ten centimeters in diameter. Therefore, the amount of tracked debris represents only a fraction of the man-made particles floating in space.

Because debris is so hard to track and the consequences of damage to or loss of a spacecraft caused by debris are far-reaching, spacecraft manufacturers and launch services providers should endeavor to mitigate debris whenever technically and financially feasible. The question then arises of what type of debris mitigation standards should be instituted and who should implement them.

Six years ago, then Senator, now Vice President, Al Gore stated at a speech delivered at the Conference of the International Astronautical Federation and the International Institute of Space Law in Malaga, Spain that "[o]rbital debris is already a problem of considerable importance; consequently, laws to control further proliferation will be needed."[1/] However, in the six years since Gore made these

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1. A few months after the conference, Gore's speech was converted into an article for the University of Tennessee Law Review. Albert Gore, Jr., *Outer Space the Global Environment, and International Law: Into the Next Century*, 57 Tenn. L. Rev. 329, 333 (Winter 1990).

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statements no such laws have been passed, no regulations implemented, no industry standards adopted.

Existing legal frameworks, such as the Outer Space Treaty and the Liability Convention, cannot adequately resolve the orbital debris problem. Orbital debris is a problem that can be managed only if space-faring entities--public sector and private sector--institute and adhere to debris mitigation policies. These policies can be instituted and enforced voluntarily by industry in the form of accepted industry standards or can be imposed through domestic and/or international laws and regulations. Either way, any standards that are established must be clear, enforceable and technically and financially practicable.

Industry probably would prefer to set its own standards because it is in the best position to know what is commercially feasible, but it may be impossible for affected entities to reach consensus and to provide efficient and effective enforcement. However, if governments decide to mandate debris mitigation, standards should be established with the full participation of industry. It would be ill-advised to jeopardize the feasibility--and by extension the benefits--of commercial space systems with unreasonable and unrealistic debris mitigation standards. In other words, we should not make the solution bigger than the problem.

Lastly, whatever reasonable standards are adopted should extend to civil and military spacecraft, as well as commercial systems, unless such measures cannot be employed for national security and related reasons.

The Legal Subcommittee is an ideal forum to consider space environment issues, once this subject is considered an acceptable agenda item. I would strongly encourage you, however, to consult and work closely with industry in the development of space environment standards. I think you will find a willing and interested community anxious to assist.

III. Efforts to Develop Debris Mitigation Standards

Various entities and organizations are examining orbital debris issues. For example, a couple of weeks ago the four member National Interagency Space Debris Coordination Committee met in Houston and, for the first time, included the Chinese Space Agency. The four agencies on the panel are the European Space Agency, the National Aeronautics and Space Administration, the National Space Development Agency of Japan and the Russian Space Agency. I understand the Committee meets every nine months to devise strategies for measuring and controlling space debris. I will focus this section of my talk, however, on those efforts underway in the United States. I should add, though, that for any effort to be successful--to

achieve the goal of minimizing orbital debris--it must be a coordinated *international* activity.

In the United States, commercial, governmental and non-governmental organizations are considering and implementing options for developing and employing debris mitigation standards.

Satellite manufacturers and operators are recognizing that debris presents a risk not only to other systems but also to their own systems. With these concerns in mind, at least one of the recently licensed Big LEO systems voluntarily has incorporated debris mitigation techniques into its satellite system design.

In a paper titled "Iridium Debris Mitigation Practices" given during the First European Conference on Space Debris in Germany in April 1993, Robert Penny of Motorola Satcom outlined the philosophy as to orbital debris mitigation of one of the leading participants in mobile communications.

He stated:

> "To implement a cost and technically effective debris mitigation plan space operators must commit to debris mitigation in the very first phases of a space program. Debris mitigation must be a part of the Operations Concept that accompanies the basic statement of need or program initiating document. Debris mitigation must be clearly stated policy in the concept definition phase. It must have unambiguous requirements evolve in the requirements generation phase, and it must maintain prominence in the Systems Engineering and Trade-off Analysis phase. Most importantly, it must be a matter of resolve in the operational phase."

The commitment of Motorola to this very important issue is impressive. Also significant is the effect of space debris hazards on the operation of this system. For example, small adjustments were made to orbital inclination and latitude to create miss distances of greater than 100 kilometers at the poles. When the system was first planned, higher orbits were eliminated from consideration because of the higher debris density in the 800 to 1200 kilometer band. Evaluations of explosion hazards regarding the use of nickel-hydrogen batteries led Motorola to consult with the leading scientist knowledgeable about this field, who happens to be Russian.

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Motorola required of its launch services providers that they minimize the risk of debris by requiring that the launch vehicle upper stage perform a de-orbit maneuver placing the upper stage in a decay orbit. Also, each satellite launched is required to contain sufficient fuel to de-orbit and thereby avoid becoming an orbital hazard.

With the prospect of one satellite in its system being lost every five years due to orbital debris impact, Motorola has appreciated the importance of debris mitigation. It certainly is at the leading edge of this issue.

Do debris mitigation requirements cost money? Yes. They are an expense for the satellite manufacturer and the launch services provider. But many companies have come to the conclusion—on a corporate policy level--that such measures are worth the cost. In fact, in the long run, the use of debris mitigation techniques may save money. For example, insurance companies do not currently require debris mitigation of their insureds. However, if insurance companies can be convinced that such measures demonstrably reduce the satellite's risk of damage or loss by debris, the cost of insurance for projects employing such techniques should be reduced. As an aside, launch and in-orbit insurance currently covers any loss or damage caused to a satellite even if caused by orbital debris. This has never been a significant risk for the large majority of insured satellites, which are in geostationary orbit. However, this attitude may change with the greater risks involved with LEO systems.

As mentioned earlier, if the satellite and launch services industry do not impose upon themselves debris mitigation standards, their regulating agencies most likely will. To explore orbital debris issues and debris mitigation options, the U.S. government has established an Interagency Working Group on Orbital Debris, led by the Department of State. Among the Executive branch agencies represented in this Working Group are the Departments of Transportation, Commerce, Energy and Defense, NASA and the Office of the U.S. Trade Representative.

In April of this year, the National Research Council is scheduled to release a major report on orbital debris issues. Shortly after release of this report, the Interagency Working Group may also release a report (however, this deadline is likely to be extended).

Professional societies, such as the American Institute of Aeronautics and Astronautics (AIAA), have established committees to address the issues of voluntary and mandatory debris mitigation standards. It has identified four categories of debris mitigation measures as promising candidates for standards: (1) venting of residual fuel and pressurants from discarded upper stages; (2) boosting of geostationary satellites into disposal orbits; (3) de-orbiting spent equipment; and (4) reducing

operational debris. The AIAA Orbital Debris Committee, Subcommittee on Legal and Institutional Aspects, currently is assessing which U.S. federal agency or agencies would have the jurisdiction to establish, apply and enforce disposal requirements and other debris mitigation measures specifically for LEO satellites and spent rocket upper stages. The issue of orbital debris mitigation surely will be a topic of discussion and debate at the AIAA Global Meeting to be held in May in Washington, D.C.

Forums such as the AIAA Global Meeting--as well, of course, as this meeting--are essential for getting representatives of industry, government and non-governmental organizations to collectively explore mutually agreeable solutions to the orbital debris problem.

This is an initiative in which the United Nations Office for Outer Space Affairs can play an important leadership role. I believe the world aerospace industry and the insurance community are ready and willing to cooperate.

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