

THE FUTURE OF WORLD PEACE AND OUTER SPACE

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I. INTRODUCTION.....	389
II. CATEGORY I MEASURES.....	390
III. CATEGORY II MEASURES.....	391
IV. OUTLOOK TO THE FUTURE	391
V. MAGNA CHARTA OF OUTER SPACE FOR ALL NATIONS.....	393

I. INTRODUCTION

Space debris is both natural and man made. The Space Shuttle several times changed course to avoid debris. In 1998 there has been a very large increase of about 912 United States satellites and payloads, for telecommunications, in low earth orbit. In geostationary orbit with more than 700 catalogued objects we are down to less than two degrees spacing. That is definitely "crowding," both for essential satellite controls and communications purposes. The United States Space Surveillance Network tracks 8,500 objects in low earth orbit. It is well aware of these 1998 United States 912 additions from Iridium of Motorola, from Globalstar of Loral Space and Communications, and from other Satellites. To these we must add the new satellites of the European Space Agency nations, the Japanese NASDA, the Chinese satellites, and, of course, the new Indian, African, and South American satellites. Despite the International Telecommunications Union Agreement and the World Administrative Radio conferences in 1999, and particularly in the year 2000, the satellite payload crowding, in both equatorial and polar LEO orbits, becomes serious. The linear geometric progression of increased space debris from satellites hitting on themselves, physically and communications' wise, has become a much more serious international problem than envisaged just a few years ago. To all this we add much increased natural meteor shower activity in 1998 and 1999, which is now confirmed. Thus, there is a space debris national security problem for all nations that will make news headlines in 1999 and the year 2000.

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It is important not to mix operational orbiting satellite payloads with non-operational space debris satellite payloads. Only when operational satellite and payloads become totally non-operational are they legally space debris. About five to ten percent of satellites and payloads tracked above 10 centimeters. are fully operational. Crippled satellites are not legally space debris. Explosions are one large source of space debris.

Many in government and in diplomacy point to the technical and legal voluntary compliance programs, laws, regulations, and decrees of nations, in their own self-interest, to control this rapid increased spread of space debris. The United States has promptly and voluntarily complied in United States Presidential Executive Orders, and in Department of Defense, Department of Transportation and Department of Commerce work to measure, model, reduce, control, and mitigate space debris. The subject is under continued national and international review.

In United Nations General Assembly document A/AC.105/C.1/L.217 of 12th January, 1998 states, "The (voluntary) control measures to be considered fall into two categories; (1) those requiring minimal impact on the design and operations, and (2) those requiring significant changes in hardware or operations." Neither category of measures require development of new technology. Measures of Category I should be applied immediately, while measures of Category II should be applied by all space operators from an agreed time point onwards.

II. CATEGORY I MEASURES

Category I comprises those measures that require no or limited changes to the design, and cost impacts are, in general, minimal. They may imply changes in hardware and operations. Some performance reduction may, however, result. These have first priority for implementation and should be implemented by all space operators immediately. Category I measures include the following: (1) no deliberate break-ups of spacecraft that produce debris in long-lived orbits; (2) minimization of mission-related debris. Often cost-effective engineering solutions are available with low cost for implementation. In several cases, however, the cost will no longer be minor as significant design changes will be needed (e.g. yo-yo devices and separated Apogee Boost Motors); (3) passivation (venting, burning to depletion, and battery safing) of upper stages and spacecraft in any Earth orbit at end of a mission; (4) for spacecraft and rocket upper stages below 2,000 kilometers with excess fuel, at the end of operations, lower the perigee altitude to minimize the orbital lifetime; (5) re-orbiting of geostationary satellites at end-of-life to a disposal orbit; (6) minimum altitude increase 300 kilometers (location of perigee above the geostationary orbit) above the geostationary orbit; (7) upper stages and spent Apogee Boost Motors used to move geostationary satellites from GTO to GEO should also be inserted into a disposal orbit at

least 300 kilometers above the geostationary orbit and freed of residual propellant.

III. CATEGORY II MEASURES

Category II comprises those options that require either significant changes in hardware or operational procedures. However, no new technology developments are needed. Category II options are aimed at removing used upper stages and defunct spacecraft from orbit within T_{max} years, thus eliminating a major debris source. The measures below provide candidate quantitative values. Agreement on T_{max} and the time after which these measures have to be applied should be achieved through discussion and deliberations in suitable international forums, such as the Inter-Agency Space Debris Coordination Committee or the Committee on the Peaceful Uses of Outer Space. There is some urgency for the application of measures of Category II in some orbital regions. An undue delay in their application will lead to a further degradation of the space environment. Removal of large or compact objects, which could partially survive entry heating, is accomplished with a de-orbiting maneuver to ensure atmospheric entry over oceanic areas during the next perigee pass. Objects which will completely burn up during atmospheric entry should be placed in orbits with limited lifetime, say twenty-five years, (T_{max}). Hence, in these cases natural perturbations will be exploited. Category II measures include the following: (1) removal after the end of a mission within T_{max} years of all rocket upper stages and defunct spacecraft in orbits with an apogee below 2,000 kilometers altitude; (2) removal after end of a mission within T_{max} years of all rocket upper stages and spacecraft in geostationary transfer orbits, transfer orbits to 12-h orbits or other eccentric orbits with a perigee altitude below 2,000 kilometers altitude; (3) re-orbiting of upper stages and satellites at end-of-life into a disposal orbit (as a temporary measure) for circulate orbits above 2,000 kilometers altitude. The debris control measures in Categories I and II can be carried out with existing technologies.

IV. OUTLOOK TO THE FUTURE

The search for new mitigation methods, technical feasibility, and cost-efficiency should be pursued further. Of great benefit for the space environment would be advanced propulsion capabilities and reusable launch systems, in particular, reusable upper stages. Advanced propulsion techniques could lower cost for de-orbiting or render feasible de-orbiting from high-energy orbits.

For example in 1997, 200 space debris experts from eighteen countries took part in the Second European Conference on space debris under European Space Agency and International Astronautical Federation. NASA, NASDA, CNES, and ESA are issuing behavior protocols to nations in order to avoid space debris. These are accepted by many

nations. Station keeping and operations satellite insurance is already substantially effected. Shielding, construction, monitoring, and final power boost to junk orbit or burn up orbit of satellites is in place. There is a serious problem, however, with regards to outer space terrorism and intentional use of space debris to destroy the eyes and ears of nations in outer space for purposes of national security. All nations are seeking to monitor their security on a full time basis in order to protect from possible space or ground war like action. The 1967 Outer Space Principles Treaty bans fractional orbital space weapons of mass destruction. The United States, ESA, and Russia maintain, both ground and space based, extensive technological monitoring of all objects in outer space over ten centimeters in size, and sometimes of even smaller space objects. There exists the United Nations Treaty that requires reporting of all satellite launches to the United Nations Secretary General Register. Unfortunately, the prompt timing of compliance reporting with it has been lacking. Amendment of that Treaty for prompt reporting would be a real contribution to world peace for the national security of all nations.

For some years the Space Committee of the International Law Association has drafted and completed a Space Debris Treaty, which has been extensively and repeatedly reviewed by international, scientific, and legal experts. Such a draft also has been informally discussed in Subcommittee meetings of the United Nations Committee on Peaceful Uses of Outer Space. It is not yet a full Committee United Nations agenda item. Dr. Nandasiri Jasentuliyana, Director of United Nations Outer Space Affairs Division, a brilliant international space lawyer and scientist, has reviewed it. Because of the advent of UNISPACE III in July, 1999 (and the importance of advancing the spread of outer space spin-off technologies, especially to the developing countries of the world), space debris is not a high priority in the United Nations yet. When it hits the front-page news it will be too late. Treaty action takes a couple of years for over 100 nations.

The writer has drafted ten principles for the advancement of a space debris treaty for the peaceful uses of outer space in the year 1999 or 2000. It is called the Magna Charta of Outer Space. It has been published in a number of languages, Its economic, political, and legal principles remain unchanged since October 15, 1963 when presented at the 34th International Astronautics Federation Congress in Budapest.

These were often considered in the pending space debris treaty drafts. These ten principles below are fully supported by the UNISPACE 1982 Resolutions, the I.T.U. Convention and the 1967 Outer Space Principles Treaty. A UNISPACE 1999 space debris workshop by the International Astronautical Academy at the 1999 UN-COPUOS-UNISPACE III Meeting in July 1999 is planned by the IAF and the United Nations. That is a good time for a world space debris treaty discussion. The extensive in depth 3-year United Nations space debris science and law study will soon be completed. The International Academy of Astronautics space debris

Position Paper will be ready in March 1999. Technology on space debris has been much advanced.

V. MAGNA CHARTA OF OUTER SPACE FOR ALL NATIONS

- A. Outer space is the key to world peace.
- B. Outer space requires long range, consistent policy planning to be successful, economically and scientifically.
- C. Outer space is inherently international by nature.
- D. Outer space holds an important solution to the global resources shortages, and needs of every nation.
- E. Outer space is a key factor for world information, world trade, national development and national security.
- F. Outer space progress will be advanced by the maximum number of nations participating in a space policy, agreement or project. Thus, the greater is the non-threat to any nation's national security, the greater the popular support, and the greater the contribution to world peace.
- G. Outer space is necessary for all nations for command, control, communications, intelligence, and national security. For all nations these common problems and their solutions are compounded by timing and scientific breakthroughs. The geostationary orbit is important for all nations.
- H. Outer space balance of power is necessary for the peace of all nations.
- I. Outer space economic demands on all nations compete with national economic demands of every nation.
- J. Outer space, manned or unmanned, space stations on the Moon, Mars, L-5, or elsewhere in outer space are the economic and scientific steps to the future of outer space for the true benefit of all nations and of all mankind.