At the crossroads: the necessity for "rules of the road" for space

Alex Karl

In 1967, when the space age was still in its infancy, the Outer Space Treaty entered into force with the aim to protect the common interest of all societies while regulating the competition for military advantage that dominated the pioneering space programmes of the United States and the Soviet Union.[1] The treaty was amended four times in the following 12 years with the introduction of the Rescue Agreement, the Liability Convention, the Registration Convention and the Moon Agreement.[2]

Since 1967, the uses and utilization of space have greatly multiplied and evolved. Space-based applications such as weather forecasting, terrestrial navigation, remote sensing, and telecommunications are taken for granted by most of the world's population. Therefore space security is essential to ensure continued access to many applications that benefit life on Earth.

However, general public knowledge of space and space security is poor. Most people would associate space weapons with science fiction rather than consider them a real issue within the current global security debate. It is likely that the vast majority of the global population is unaware of the basic processes that influence space security. Access to and knowledge about the processes involved is limited to a privileged few, which makes space security quite an exclusive matter, even though it affects most if not every single human being on this planet.

Increased awareness is the first step toward creating a broad base of people, especially youth, who are interested and eventually get involved. Fresh ideas have always enriched discussions and progressed debates. Young people are interested and active when the opportunity arises. But to act responsibly one has to be educated. Educating young people about how space and security are connected as well as allowing them to learn from decisions taken in the past will enable future generations to make the right choices to maintain and protect space security.

Space, it seems, is a vast and limitless resource. No wonder that 44 states have built and launched satellites and other space hardware either independently or in cooperation with others. Numerous private sector space players are on the verge of changing that landscape even more.

However, space is not the limitless resource it appears to be—a fact that has been discussed increasingly among decision makers and space professionals over the last decade. In fact, space could become largely inaccessible to spacefaring nations within a few decades. With the world's societies and especially some nations' military capabilities so dependent on space applications this could result

Alex Karl is a space engineer and the Chairman of the Space Generation Advisory Council (SGAC), an international non-governmental organization based in Vienna, Austria, which represents the views of students and young professionals at the United Nations, and among Member States and space agencies. SGAC has observer status in the UN Committee on the Peaceful Uses of Outer Space. All opinions expressed in this article are the sole responsibility of the author and do not necessarily reflect the views or opinions of SGAC.

in a severe global crisis. The events leading to such a scenario are closely related to space security and can only be addressed in that context.

The space environment

The reason for this grim outlook is simple. Space exploration and travel is a dirty business—with every rocket launch and most manoeuvres made in space there are "leftovers" (commonly referred to as debris), such as spent rocket stages, dead satellites, ejected holding mechanisms, camera lenses, paint flakes, fuel droplets and other man-made objects (as opposed to naturally occurring objects such as micrometeoroids).

Due to the laws of physics that describe orbital mechanics, some orbits are more suitable for certain mission objectives and thus more frequently used. The same laws, however, dictate that the trash that is produced as a result of those missions will populate and distribute itself in the very same orbit among the satellites that provide humanity with essential services.

There are billions of debris objects in orbit—from thousands of large ones, such as dead satellites and spent rocket stages, to hundreds of millions of millimetre-sized objects, such as paint flakes. Travelling at an average speed of 8km/s (approximately 27,000km per hour), these pose a destructive potential for other space objects. While even a centimetre-sized particle can cripple a satellite, our current ground surveillance infrastructure can only track particles of about 10cm or greater, thus leaving enough uncertainty for discomfort—especially for manned missions. In addition, there is no international coordinated surveillance system in place and the ones that exist cannot track all the debris at all times.

Mitigation measures include satellite shielding for objects up to 2cm, at the cost of weight (leading usually to an increase in the cost of the satellite and a decrease in its functionality) and evasive manoeuvres to avoid collisions with large and trackable debris objects (greater than 10cm), at the cost of fuel (leading to shorter satellite lifetime). Objects in orbits at altitudes less than 600km at least get cleaned out by entering and burning up in Earth's atmosphere due to sun–atmosphere interactions within weeks, months or a few years depending on the orbit and size of the object concerned. However, all objects in orbit above 600km are there to stay for hundreds if not thousands of years.

In sum, there is no current technological or economical solution to clean the mess up once it is made. Frighteningly, the situation could get even worse. Once a critical debris density is reached in an orbit, the amount of debris continuously increases due to debris–debris collisions even if no new satellites are launched into those orbits—resulting of course also in the loss of existing space hardware due to hypervelocity impacts. Thus the most important orbits are also the ones in the gravest danger of being the first to be degraded and eventually to become useless.[3]

The space security outlook becomes even more urgent when you consider the growing number of emerging spacefaring nations.

The space security outlook becomes even more urgent when you consider the growing number of emerging spacefaring nations, the plans of various countries to put satellite constellations in orbit for global positioning systems, and the nascent space tourism market. Additionally, ageing satellites will need to be replaced if commercial, civilian and military assets are to continue to be served. We can also expect to see a rising demand for Earth observation platforms for climate change monitoring. In short, space traffic will most likely increase in the years to come, not only leading to the creation of more debris but also toward an ever more challenging space situational awareness environment, by having to coordinate satellite manoeuvres within highly populated orbits to reduce the risk of collisions.

Two recent events provided a basis for additional concern that had lain somewhat dormant since the 1980s. In early 2007 and early 2008 respectively, China and the United States demonstrated the threat of kinetic anti-satellite weapons (ASATs) by targeting their own space hardware—simply put, this comprised a rocket launched from Earth to destroy a satellite in space.[4] The results of these ASAT tests are twofold: they increase the debris environment dramatically and they destabilize space security as other nations can interpret such acts as threats to their own space assets. This perceived threat will most likely result in the spread of ASAT capabilities and space negation technology development by several spacefaring nations, thereby leading to further insecurity.

Events on Earth are also shaping the landscape of space security. Some perceive the current space policy of the United States as threatening to the assets of other states and their access to space.[5] This position has not helped to advance the discussion of legal issues concerning the utilization of space. The standstill has resulted, for instance, in deadlock within the Conference on Disarmament on discussions on the prevention of an arms race in outer space (PAROS) since 1994—almost 15 years in which not only the world but also the utilization of space have seen significant changes.

Safeguarding space

Action must be taken to safeguard space if it is to remain utilizable by our children and if we are to ensure the long-term viability to use space for peaceful purposes in accordance with the Outer Space Treaty. Four key areas must be addressed: space debris, space traffic management, preventing conflict or use of weapons in space, and space governance. The majority of the members of the Space Generation Advisory Council,[6] the only youth organization with observer status at the United Nations Committee on the Peaceful Uses of Outer Space (COPUOS),[7] are advocating the following actions to safeguard space for the benefit of future generations.[8]

Space debris

It is paramount that the creation of new debris in space is stopped. An important first step was taken by COPUOS in early 2007 when the Inter-Agency Space Debris Coordination Committee (IADC) Space Debris Mitigation Guidelines were adopted.[9] Of course, in order to tackle such a complex issue as the maintenance of secure and sustainable access to space, these non-legally binding recommendations need to be brought into a binding legal framework and enforced by international law to make them a globally accepted practice. How this could be done in detail is a task for the delegates and experts of the Legal Subcommittee of COPUOS and other bodies dealing with relevant international law. Recommendations for further action include:

- increase the resolution of surveillance capabilities of space debris observation infrastructure; and
- encourage international cooperation on coordinating observation strategy, ground systems utilization and data sharing.

Space traffic management

To tackle the problem of an increase in space traffic, several space traffic management (STM) systems have been proposed.[10] This idea is analogous to applying existing international air traffic control standards and coordination to space objects. Of course, due to fundamental differences the standards cannot simply be transferred for use in space. However, once standards have been agreed upon, all spacefaring entities would benefit. Space would be a safer place in which to operate satellites and it

could be done with greater accuracy, that is to say with less distance between satellites in crowded orbits, as the necessary unclassified space awareness data would be available to all civil operators. It would also facilitate international cooperation in space observation and other realms and conserve resources, such as satellite fuel and orbital slots. Although looked upon with suspicion by nations that rely strongly on their space assets for national security, STM will become a necessity in the near future. Spacefaring actors must understand that an STM system is vital and will contribute to space security for all. Currently, space agencies and experts are holding conferences and workshops to discuss this topic and to propose an STM system to protect their (manned) space assets in at least the short term. A full-scale STM system could be developed in an IADC Working Group and, once agreed, presented to COPUOS.

Space weapons

More attention must also be directed at keeping space free from weapons. This should not only be limited to the nuclear weapons and weapons of mass destruction explicitly mentioned in the Outer Space Treaty but needs to encompass any ground-based weapons that can be used against space objects as well as space-based weapons in general. Placing weapons in space would lead to an increase in the development of countermeasures by nations who feel threatened by such weapons. These countermeasures are much cheaper and technologically simpler to build and use than the sophisticated space weapons themselves (for example ground-to-space ASAT strikes), thus making space weapons a risky and economically questionable asset.

There are sufficient arguments against placing weapons in space, and there are even stronger ones not to use weapons in space. Not only would attacks lead to an increase of space debris, but space assets from all spacefaring countries could be affected. Keeping space weapons-free thus acts as a confidence-building measure and ensures security while saving and protecting valuable assets, such as orbits and the space hardware located within them.

Recommended actions include:

- prohibit weapons and aggressive acts from space via a treaty;
- negotiate such a treaty in the CD or COPUOS or append the Outer Space Treaty; and
- establish an International Space Surveillance Centre for verification.

Space governance issues

Lastly, issues such as property rights in outer space and lunar governance will need to be addressed in the near future. Commercial spaceflight activities are already beginning to enter legally uncharted—or at least unclear—territory. The Outer Space Treaty's last amendment was made around 30 years ago. In the fast-paced realm of space technology this, in essence, dates from another epoch. In the interest of the peaceful uses of outer space, clarifying guidelines and legal frameworks for the use and utilization of space and space objects need to be amended or developed before technical realities create situations that are even more challenging to resolve. Discussion in COPUOS on lunar governance, property rights and related issues should be initiated.

Conclusion

The situation is far from ideal but it is not hopeless. To safeguard space and ensure the secure and sustainable long-term access to, and use of, space for peaceful purposes for all humanity, a set of rules of the road for space—a code of conduct that addresses the above-mentioned issues—is needed. This

code of conduct could be understood as a vision, a roadmap toward legal measures that should be implemented into international law and become common practice.

My generation grew up with the notion that space travel is something normal rather than miraculous and dreamed to be able one day to go in to space themselves. More important, a quarter of the world's population is under 25 years old, and they expect at the very least to have the opportunity to utilize space the way it has been over the past 50 years. The support of all generations is needed in this endeavour. If protective action is not taken soon, access to space for peaceful purposes as we know it will end.

Notes

1. Nancy Gallagher and John D. Steinbrunner, 2008, *Reconsidering the Rules for Space Security,* Cambridge, MA, American Academy of Arts and Sciences.
2. In order of decreasing number of UN Member States who have ratified these treaties and agreements.
3. A. Karl, 2006, "Active Removal of Space Debris – Discussing Technical and Economical Issues", International Astronautical Congress, held in Valencia, Spain, October 2006, document IAC-06-B6.4.04.
4. See Space Security Index, <www.spacesecurity.org>, the only annual, comprehensive assessment of space security.
5. For example, the US National Space Policy charges the Secretary of Defense to "develop capabilities, plans, and options to ensure freedom of action in space, and, if directed, deny such freedom of action to adversaries". See US National Space Policy, 31 August 2006 (released 6 October 2006), available at <www.ostp.gov/cs/issues/space_aeronautics>.
6. For more details, go to <www.spacegeneration.org>.
7. COPUOS was established in 1959 by the UN General Assembly "to review the scope of international cooperation in peaceful uses of outer space, to devise programmes in this field to be undertaken under United Nations auspices, to encourage continued research and the dissemination of information on outer space matters, and to study legal problems arising from the exploration of outer space." See the United Nations Office for Outer Space Affairs web site, at <www.oosa.unvienna.org>.
8. These recommendations were presented by the author during the UNIDIR Conference "Security in Space: The Next Generation", held in Geneva, 31 March–1 April 2008.
9. The IADC is an international governmental forum for the coordination of activities related to the issues of man-made debris in space. See <www.iadc-online.org>.
10. For example, the International Space University, 2007, *Space Traffic Management: Final Report,* at <www.isunet.edu>, and Johanna Catena, "Introducing a New Framework for Space Traffic Management", presentation at the 51st session of COPUOS, 11–20 June 2008.