

## **Status of the IAA Study Group on „Traffic Management Rules for Space Operations“**

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### **Abstract**

The investigation of space traffic and its management has only recently become a point of wider discussion. In particular the series of workshops organized by the American Institute of Aeronautics and Astronautics (AIAA) and other international organizations on international cooperation highlighted the issue. It was discussed thoroughly at the workshops, which took place in 1999 and 2001 respectively. It was at the 2001 workshop, when the suggestion was made that an International Academy of Astronautics (IAA) Study on the subject of space traffic management should be prepared. This suggestion was taken up and a proposal was presented to the Board of Trustees of IAA, which, in late 2001, accepted this proposal.

Following this, an interdisciplinary study group of around twenty persons was composed. One early milestone in the process of work was the conduct of an International Institute of Space Law (IISL)/European Center of Space Law (ECSL) Symposium alongside the 2002 session of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) Legal Subcommittee. This symposium consisted of presentations of members of the IAA study group. Also, close coordination with other study projects of IAA, in particular with the one on space debris, is sought.

This paper presents the status of work of the study group, in particular the approach and the scope of the study as well as its preliminary findings. The study group intends to finalize its work in early 2004, in order to be able to put the study before IAA and launch its review

process before the 2004 International Astronautical Congress. Following this review, the study will be published and may be expected to make an impact in fora like the UNCOUOS.

The authors of this paper act as the coordinators/the rapporteur to this study. The paper will be presented in the IAA- as well as the IISL-session dealing with space traffic, by that bridging the two areas and seeking input from various sources.

### **1. Scope of the Study**

Space traffic already takes place. It seems, however, minuscule with regard to the dimension of near-Earth outer space. Around 10.000 man-made objects larger than 10 cm are currently tracked out of which only 650 are operational spacecraft. On the surface, it does not look, as if the management of space traffic was a pressing problem. Investigated further, this judgement has to be challenged. A high level or even growing number of launches from more and more launch sites and space ports, the entering of non-governmental entities, the positioning of satellite constellations, an increase in space debris and the advent of re-usable launch vehicles supports this judgement. Considering this scenario, conceptualizing space traffic management will turn out to become one of the most relevant tasks during the next two decades.

The dimension of this task can be assessed, when the following **definition of space traffic management** is taken into account:

Space traffic management comprises technical and regulatory provisions for guaranteeing safe interference-free access into outer space, operations in outer space and return from outer space to Earth.

Since an authoritative definition of space traffic management does not yet exist, this definition has been set up for the purpose of this study. Through this definition, the purpose of space traffic management becomes clear: it is to provide appropriate means so that space activities can be conducted without harmful interference. By that it supports the universal freedom to use outer space as laid down in the Outer Space Treaty of 1967. It should also be clear that for this purpose of achieving a common good, actors have to follow specific rules, which is also in their self-interest.

The investigation of space traffic and its management has only recently become a point of wider discussion. In particular the series of workshops organized by the American Institute of Aeronautics and Astronautics (AIAA) and other international organizations on international cooperation highlighted the issue. It was discussed at its 5th and its 6th workshop, which took place in 1999 and 2001 respectively. The results of these deliberations including recommendations have been laid down in the proceedings of these two events.<sup>1</sup> But so far, these activities have not advanced considerably more the subject than it had been analysed with startling far-sightedness by Lubos Perek already in the early 80s<sup>2</sup> – a pioneering work, which has not been followed-up for more than a decade.

It was, however, at the 2001 workshop of AIAA, when the suggestion was made that an **International Academy of Astronautics (IAA) Study** on the subject of space traffic management should be prepared. This suggestion was taken up and a proposal was presented to the Board of Trustees of IAA, which, in late 2001, accepted the proposal.

<sup>1</sup> AIAA Workshop Proceedings "International Space Cooperation: Solving Global Problems" 1999, p.35-39 and "International Space Cooperation: Addressing Challenges of the New Millennium," 2001, p.7-14.

<sup>2</sup> Perek, Lubos, Traffic Rules for Outer Space, 82-IISL-09.

Following this, the study group was composed, which prepared the present study. One early milestone in the process of work was the conduct of an International Institute of Space Law (IISL)/European Center of Space Law (ECSL) Symposium alongside the 2002 session of the United Nations Committee on the Peaceful Uses of Outer Space (UNCOPUOS) Legal Subcommittee. This symposium consisted of presentations of members of the IAA study group.<sup>3</sup> Also, close coordination with other study projects of IAA, in particular with the one on space debris, is sought. At the International Astronautical Congress in Bremen in 2003, this outline of the study will be presented to a dedicated session for discussion.<sup>4</sup> It will also be presented during the IISL Colloquium.<sup>5</sup>

The approach and scope of the present study are as follows. The **approach of the study** is characterized by interdisciplinarity. The study group consists of experts from the technical as well as from the legal/regulatory fields. It is composed of a core team, which prepares the text. While these members initially draft sections in their particular field of expertise, the work is further done on the text as a whole so that no reference is made on contributors of specific sections but the study as a whole is to be regarded as a joint product of this core team. In addition to that, an independent team of advisors will contribute ideas and suggestions to the first complete draft of the study as a whole. This team will also consist of experts with different backgrounds broadening the input even further.

The **scope of the study** reflects the understanding of space traffic management as given through the definition laid out above and the interdisciplinary set-up by the study team. The study encompasses detailed analyses of the technical background for space traffic management and the regulatory spectrum. It starts with a report of the current status. This comprises the status of space activities as well

<sup>3</sup> Proceedings of the IISL/ECSL Symposium on Prospects for Space Traffic Management, 2 April 2002, Vienna, UN Doc. A/AC.105/C.2/2002/CRP.7 of 4 April 2002.

<sup>4</sup> IAC-03-IAA.5.5.a. session on "Space Traffic Management" in the "Space Debris and Space Traffic Symposium".

<sup>5</sup> IAC-03-IISL.4. session on "Space Traffic Management and Navigation".

as the status of the legal and regulatory environment and also comparable traffic regimes. This will provide the basis for identifying the needs for traffic management provisions in the two spheres of technology and regulation. The main part of the study lays out elements for a space traffic management regime for the year 2010. Subdivided into the three phases of space traffic, the launch phase, the in-orbit operation phase and the re-entry phase, needs for technology development and application as well as regulatory provisions are investigated. The result is a set of recommendations, how traffic management rules should look like in around one decade.

Through investigating these issues, the study does not only apply an interdisciplinary approach inside the realm of space. It also has to take into account and touches various other fields as air traffic management and telecommunications regulation and the work conducted by the relevant institutions, in particular the International Civil Aviation Organization (ICAO) and the International Telecommunication Union (ITU). It has to do so, since in these two areas there have already been prepared elements for space traffic management, i.a. for the use of the geostationary orbit. The present study brings these developments together and merges them into a coherent, encompassing approach. The recommendations are prepared in order to take action in the various relevant organisations, in particular in UNCOPUOS.

## 2. Dimensions and Phases of Space Traffic as a concept used in the study

Space traffic encompasses almost all space activities from their start to their end. Only planetary probes leaving the near-Earth environment fall under it for a shorter part of their lifetime. For the purpose of this study, activities on the Moon and other celestial bodies (except transfer thereto and therefrom) are also excluded.

Space traffic touches **two dimensions**. These are the **scientific and technical area** and the **regulatory field**. In chapter 2, the status in these two dimensions will be analysed. The relevant technical data for the use of outer space will be presented together with prospects for various space activities including the

development of the space debris environment. On the other hand, the current legal and regulatory framework is analysed alongside the respective areas of space law, air law, telecommunications law as well as national space law, air law and licensing provisions. A comparison with comparable traffic regimes for air traffic and maritime traffic completes this chapter. So, this chapter will lay the groundwork for judging the prospects of space traffic, identify existing and lacking provisions for regulation and through this lead to the drafting of elements for a future space traffic regime.

In chapter 3, the two dimensions of space traffic will be applied to analysing the **three phases of space traffic**:

- the launch phase,
- the in-orbit operation phase,
- the re-entry phase.

They provide the structure for the in-depth analysis for elements of a space traffic regime for the year 2010. Each phase is subdivided into an analysis of the status and trends in technology developments on the one hand and the regulatory aspects on the other hand. A brief characterization of the three phases and the related problems could be summed up in the following way.

The **launch phase** does have to take into account expendable as well as re-usable launch vehicles, comprising operators from the governmental as well as the non-governmental field. Particular stress has to be put on aspects of debris mitigation. The regulatory aspects have to respond to a current lack of pre-launch notifications, a little harmonized system of national licensing provisions. In addition a close link has to be made with air law.

The **in-orbit operation phase** has to investigate the rules for the use of various orbits. Only the GSO so far can be seen as basically managed. Specifically movement of satellites on specific orbital plains or in altitude have to be covered by rules (who will have to give way?). This leads to the need of a comprehensive collision-warning system. It will turn out that the existence and access to on-time information about the status of space operations is essential for a functioning space traffic management system, as it is the case with the air traffic management. Another area of regulation in this context will be the

mitigation of space debris including the use of disposal orbits. Additionally the question does arise, whether certain space activities should have priority before others (e.g. manned before unmanned?, science before applications?, “useless” activities like funerals in orbit before “useful”?).

The **re-entry phase** is relevant for the operation of re-usable transportation systems as well as the intentional or un-intentional de-orbiting of other space objects including space debris. Again the link with air law provisions has to be drawn. New requirements for notification will be necessary in this context.

The division into these three phases seems useful with regard to their different technological characteristics and to the possibility to shape distinct blocks of regulatory provisions. In the following the three phases will be analysed in-depth and a synthesis of the findings and recommendations will be given as a model for space traffic management in the year 2010.

### 3. Preliminary findings

As pointed out, the study aims at an outline of a Comprehensive Space Traffic Management Regime. The preliminary findings can be summed up like this:

#### *Framework:*

- drafting of an international inter-governmental agreement building on and not replacing the existing treaties (includes provisions for liability and the basic principle that States are the primary actors but that provisions of the agreement are applicable for private activities as well through national licensing regimes; certain issues will be clarified in the agreement);
- comprises a legal text, which cannot be changed easily and technical annexes which can be adapted more easily
- three parts:

#### *1. Securing the information needs*

- definition of necessary data
- provision of the data (including financing)
- establishing a database and distribution mechanisms for data
- [- establishing new installations for surveillance if needed]

#### *2. Notification system*

- pre-launch notification with better parameters than Registration Convention as well as other provisions (e.g. ITU and proposed UNIDROIT Protocol)
- information on the end of active/operational lifetime of space objects
- pre-notification of orbital manoeuvres and active de-orbiting (communication rules and cooperation provisions)

#### *3. Traffic management*

- provides traffic management rules
  - clarification of "space objects"
  - for launch phase setting delimitation and clarifying the concept of the "launching State"
  - right of way rules for in-orbit phase
  - prioritisation with regard to manoeuvres
  - specific provisions for GSO in harmonization with ITU rules
  - specific rules for LEO satellite constellations
  - zoning
- clarifying "fault" in case of damage caused in outer space
- gives framework and main features for national licensing regimes, which implement the provisions of the agreement)
- provides overarching debris mitigation mechanisms
- sets out an enforcement mechanism (e.g. renouncement of access to information)
- clarifies institutionalized interlinks with ICAO and ITU

#### *4. Organisation*

- the provisions of the three agreements are in a first step monitored by UNCOPUOS and handled by the UN Office for Outer Space Affairs (UNOOSA)
- in a second step (post 2020), the new Agreement may be (together with the existing space treaties) replaced by a comprehensive Outer Space Convention; ICAO's mandate may be enlarged to cover both the aviation and space traffic management legal frameworks; UNCOPUOS as well as UNOOSA functions could be integrated into new ICAO; space activities by private actors will develop into the same legal status as in air traffic

It is planned that the study will also contain draft legal texts for these areas.