Report of the Symposium

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On the first day of the 54th Session of the Legal Subcommittee of the United Nations Committee on the Peaceful Uses of Outer Space (the ***Subcommittee***), the afternoon session was reserved for the joint Symposium organised by IISL and ECSL on Space Traffic Management (the ***Symposium***). Mr. **Kai-Uwe Schrogl** in his capacity as the Chair of the Subcommittee opened the Symposium noting that such symposia were not only for information, but were also a source of inspiration for the Subcommittee, before passing the floor to Ms. **Tanja Masson-Zwaan**, President of IISL. Ms. Masson-Zwaan referred to an earlier IISL/ECSL symposium on Space Traffic Management (or ***STM***), which was held during the 2002 session of the Subcommittee. She also noted that it was 40 years since the Convention on Registration of Objects Launched into Outer Space (***Registration Convention***) had entered into force. Ms. Masson-Zwaan further noted that the seminal International Academy of Astronautics (***IAA***) 2006 study on STM[1] was being updated, with results expected for 2016. STM was defined by the IAA in its 2006 study as being "[...] the set of technical and regulatory provisions for promoting safe access into outer space, operations in outer space and return from outer space to Earth free from physical or radio-frequency interference".

Eight speakers were invited to share their thoughts and perspectives of what STM meant to them and how it will develop in future years. Ms Masson-Zwaan then passed the floor to the first speaker, Mr. **Alexander Soucek**, Legal Counsel, European Space Agency (ESA), who spoke on behalf of Ms. Corinne Jorgenson, of Advancing Space. He set out his presentation entitled "From the 2006 to 2016 Space Traffic Management Studies of the International Academy of Astronautics". Mr. Soucek again reiterated the definition of STM as stipulated by the IAA and stated above. Mr. Soucek noted that the IAA does not only look at taking regulatory approaches but also focuses on the technical side. STM is structured by 3 elements: safe access to outer space

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* At the Symposium, the Rapporteurs were both candidates for the Advanced LLM in Air and Space Law offered by Leiden University's International Institute of Air and Space Law (***IIASL***). All references and links are current as at November 2015. The present report has been edited by Rafael Moro-Aguilar, Co-Editor of the IISL Proceedings.

1 "Cosmic Study on Space Traffic Management" edited by Corinne Contant-Jorgenson, Petr Lála, Kai-Uwe Schrogl (DLR) 2006 at page 10 (***2006 Study***).

(i.e. pre-launch and launch), operations in outer space, and return from outer space where "safe" means free from interference.

Mr. Soucek reviewed the background to the forthcoming STM Study 2016[2] and the research carried out since 2006.[3] The idea of studying STM dates back to Lubos Perek in the 1980s. Academic research has been extensive on the topic since then, there are public and private institutions working on the concept of STM. An example is the 2011 publication entitled "The need for an integrated regulatory regime for space traffic management: ICAO for space?"[4] Mr. Soucek also referred to further activities in this field, specifically ICAO's[5] aim to establish its role at the ICAO/UNOOSA[6] AeroSPACE Symposium held in March 2015 at its headquarters in Montreal entitled "Making Civil Space A Reality" as well as set up a learning group for civil space activities. Additionally, there have been regulatory initiatives such as ESA's Clean Space Initiative.[7]

As a result of all these academic and diplomatic initiatives, the IAA Cosmic Study on STM is now being updated, and the 2nd edition of the IAA study, entitled "*STM: Towards a Roadmap for Implementation*" (the ***2016 Study***), is due to be published in November 2016. Interestingly the Study includes comparative sections in relation to the law of the air, sea and Antarctica. This Study will be a multidisciplinary approach consisting of global participation through contributors and advisers, with 20 contributors from 8 countries.

Mr. Soucek took the opportunity to address the academic research that's occurred since the 2006 Study in relation to the rights and obligations in the international commons with respect to outer space. Mr. Soucek then hypothesized that the current legal regulation for international use of commons and outer space in particular is relatively well prepared, and legally we are on the way to effective STM. Mr. Soucek then reminded the Subcommittee that international commons refer to the commons that can be used and explored by all mankind. Each commons is subject to an international legal regime and while each regime may have similar characteristics they are not the same between commons. For any possible differentiation, it's crucial to determine whether all States, as with the Law of the Sea, or only a group of States, as with Antarctica, are considered to be guardians for international commons.

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2 See slide 3 of Mr. Soucek's presentation entitled "From the 2006 to the 2016 Space Traffic Management Studies of the International Academy of Astronautics" which is available here: www.unoosa.org/oosa/en/ourwork/copuos/lsc/2015/symposium.html.

3 See slide 4, *Ibid.*

4 Jakhu R.S, Sgobba T., Dempsey P.S "The Need for an Integrated Regulatory Regime for Space: ICAO for Space?" (Springer) 2011.

5 International Civil Aviation Organization.

6 United Nations Office for Outer Space Affairs.

7 See ESA's website for further details: www.esa.int/Our_Activities/Space_Engineering_Technology/Clean_Space.

Mr. Soucek then addressed how the international community has already made outer space into a commons as depicted in Art II[8] of the Outer Space Treaty (or ***OST***) and how resources may be appropriated even though territory cannot. In conclusion, Mr. Soucek stated that a new inter-disciplinary approach was the key to STM in the future and as such formed the goal of the 2016 Study.

The next speaker to take the floor was Mr. **Stephan Hobe** of the University of Cologne. Mr. Hobe's chosen topic was "*Rights and obligations in the International Commons: the case of Outer Space*". His first point was to refer to the holistic nature of the international commons[9] and stated that the "current legal regulation [...] is well prepared for STM, legally we are very much on the way" in that no further new legislation would be required to facilitate STM in the future. The international legal regime depends on the "space" under discussion and, according to Mr. Hobe, it is questionable as to whether States all have the same levels of rights and obligations.

Mr. Hobe also set out the common regulatory elements[10] as being (1) territorial, i.e. a flag is not necessarily recognition of territorial gain; (2) military, i.e. that there are different degrees of peaceful uses e.g. Antarctic, outer space; (3) exploration and use; and finally (4) the protection of the environment.

In relation to outer space, the legal regime has the following characteristics:[11]

(a) Freedom of exploration of use and scientific investigation (Article I OST) as the province of all mankind;
(b) Prohibition of national appropriation of territory (Article II OST);
(c) Peaceful uses (Article IV OST);
(d) Environmental regulations (Article IX OST; Articles 4 and 5 of the Moon Agreement;[12] NPS Principles[13] and Space Debris Mitigation Guidelines[14]);
(e) Telecommunications and the supervisory regime of ITU[15] in the allocation of orbital slots free of interference;

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8 Article II states "[O]uter space, including the Moon and other celestial bodies, is not subject to national appropriation by claim of sovereignty, by means of use or occupation, or by any other means."

9 See Slide 2 of Mr. Hobe's presentation in which he lists them as (a) High seas; (b) Deep seabed; (c) Antarctica; and (d) Outer space.

10 See Slide 4 of Hobe's presentation.

11 Extracted from Hobe's presentation, slide number 5.

12 Agreement Governing the Activities of States on the Moon and Other Celestial Bodies of 1979 (***Moon Agreement***).

13 Principles Relevant to the Use of Nuclear Power Sources, See www.unoosa.org/oosa/en/ourwork/topics/nps.html for further information.

14 Space Debris Mitigation Guidelines of the Subcommittee, See http://orbitaldebris.jsc.nasa.gov/library/Space%20Debris%20Mitigation%20Guidelines_COPUOS.pdf for a copy.

15 International Telecommunications Union.

(f) Transparency by way of a system of regulation in the Registration Convention[16] (Articles II, III, IV Registration Convention).

STM in relation to safety and security must be viewed as multifaceted and the main concerns were to ensure that it remains the province of all mankind, is used peacefully in an ecologically responsible way whilst managing liability, ensuring the application of the due regard principle (Art. IX OST), and establishing a regime, similar to that for Antarctica for non-living resources.
According to Mr. Hobe, the existing legislation "anticipates" STM and can serve as guidance for a future STM regulation. The UN has to play an active role in STM, in particular UNCOPUOS and the Subcommittee. Finally, Mr. Hobe also referred to the celebratory seminar to be held at Cologne University on 28 May to commemorate the 90 years since the birth of the Institut für Luft und Weltraumrecht[17] and invited participants to attend.
The next speaker was Ms. **Isabelle Rongier**, President of the International Association for the Advancement of Space Safety, who addressed the topic of "Space Safety and Space Traffic Management".
Ms. Rongier started her presentation with some basics stating that the total number of operating satellites in terrestrial orbits was 1,265, and we live in a time where the private sector has launched more satellites than governments. Ms. Rongier depicts examples of what she referred to as an upcoming satellite internet "Gold Rush". In 1-2 years she stated that there will be more than several thousands of satellites in space due to current plans of prospective constellations, such as SpaceX's plan to build a 4,000 satellite constellation or STEAM-1's plan to launch 4,257 satellites in KU-band. As a result, in a few months Ms. Rongier believes that the discussion regarding congestion of GEO orbit will switch to a one on LEO orbit.
Ms. Rongier referred to the 2009 collision of what Iridium-Cosmos and that STM requires international cooperation. She also referred to ICAO as a model of international cooperation in its sphere of competence: safety regulation for international aviation.
Ms. Rongier highlighted the fact STM consists of safe access into outer space, prevention of collisions in outer space, and the safe return/re-entry from outer space. Furthermore, she emphasized that STM is an important element of space safety because of the risk to public safety that occurs during launch and re-entry as well as the safety risk inherent in human spaceflight. In regards to space safety, the IAASS looks at 6 areas when addressing STM: (1) human

16 Convention on Registration of Objects Launched into Outer Space of 1975 (Registration Convention).

17 "Air Law – Space Law – Cyber Law: Looking at 100 years of Air Law and 60 years of Space Law – The Institute of Air and Space Law at Age 90 Years" on 28 May 2018 at the Institut für Luft und Weltraumrecht, Cologne University.

on-board safety; (2) public safety; (3) environmental protection; (4) ground personnel safety; (5) cosmic threats, and (6) STM.

Next, Ms. Rongier discussed space safety as a driver for the development of STM techniques with a brief history of collision avoidance manoeuvres. The arrival of the ISS[18] required the development of more precise methods to compute the collision probability, as there are uncertainties for both debris and satellite movements. After the 2009 collision between Iridium 33 and Russian Kosmos 2251, the space community had to take into account the great care needed for maximum predictability. As a result, the U.S. military JSpOC (Joint Space Operations Center) started sending notices of close approaches, called Conjunction Summary Messages (CSM), to satellite operators. CSM are not direct recommendations to perform an avoidance manoeuvre and therefore must be deeply analysed. Satellite operators receiving these CSM must assess the uncertainties and evaluate the risk level and compare it to their own data, among other procedures. This has resulted in the emergence of Middle-Man (MM) public services such as the Space Data Association (SDA) that brings together satellite operators to share more precise data for collision avoidance and prevention of RF interferences.

Ms. Rongier then discussed how at the IAASS'[19] last conference, part of the discussion focused on the Launch Collision Avoidance (COLA). A launch window is said to have a COLA blackout period when the vehicle trajectory is too close to another object already in space. In the US, a launch is not allowed if the rocket will pass within 200 km of the ISS. This procedure has been used in Europe for the last 4 years. Ms. Rongier then went to describe what is known as the 'COLA gap' which was triggered 56 hours after the launch of a GPS IIR-20 satellite which unexpectedly passed within 20 km of the ISS, when there was no data from the JSpOC. As a result, new probabilistic methods are used to compute the trajectory of two bodies so that no problem of collisions will occur during this gap.

It is important to note that the Chicago Convention[20] does not apply to State Aircraft compared to space objects as regulated by the U.N. Outer Space Treaties[21] which were – although now less so – all publicly owned and

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18 The International Space Station.

19 The International Association for the Advancement of Space Safety, See http://iaass.space-safety.org/ and http://iaassconference2014.space-safety.org/ for a programme overview from the 7th IAASS conference in 2014.

20 Convention on International Civil Aviation signed on 7 December 1944, referred to as Chicago Convention.

21 Specifically the five Space Treaties referred to are (1) The Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies adopted by the General Assembly in its resolution 2222(XXI) of 19 December 1966 (***the Outer Space Treaty*** or ***OST***); (2) The Agreement on the Rescue of Astronauts, the Return of Astronauts and the Return of Objects Launched into Outer Space adopted by the General Assembly in its

financed by governments. According to Ms. Rongier, a working group on STM was required.
Ms. Rongier concluded her presentation calling for an organized international cooperation on STM. She reinstated the importance of this because of the several thousands of satellites that might be launched in the upcoming years. Ms. Rongier believes that some of the first steps to extend responsibility internationally to organize STM could be defining borders and interfaces between military and civil/commercial STM, and launching an intergovernmental cooperation between space-faring countries for creating international voluntary STM rules. In addition, the IAASS suggests establishing a working group using ICAO as a model of international cooperation because of their use of technical specifications, called Standards and Recommended Practices (or SARPs), in order to achieve

> "the highest practicable degree of uniformity in regulations, standards, procedures and organization in relation to aircraft, personnel, airways and auxiliary services in all matters in which such uniformity will facilitate and improve air navigation."

Furthermore, the Chicago Convention does not generate any prerogative, right or obligation for individual nationals of the contracting States but they can also make recommendations for changes to national rules.
Following Ms. Rongier, Mr. **Yvon Henri** of the International Telecommunication Union (***ITU***) gave a very informative presentation on ITU as an organisation and its potential role in STM. Mr. Henri gave a short overview of the history of the ITU and the process for allocation of frequencies amongst applicants, recalling the ITU's mission to promote "rational equitable efficient and economical use [...]". Mr. Henri stated that there is always a trade-off. ITU regulations do not distinguish between civil or state use. Mr. Henri went on to discuss the importance of TTNC,[22] i.e. in order to provide a service from space you need these critical operation functions, which make possible the proper management of satellite platforms. Mr. Henri also gave some statistics: there are currently 410 satellites operating in GSO (36,000 km above the surface of the Earth); there are also 40,000 objects (i.e. debris) which con-

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resolution 2345 (XXII) of 19 December 1967 (***the Rescue Agreement***); (3) The Convention on International Liability for Damage Caused by Space Objects adopted by the General Assembly in its resolution 2777 (XXVI) of 29 November 1971 (***the Liability Convention***); (4) The Convention on the Registration of Objects Launched into Outer Space adopted by the General Assembly in its resolution 3235 (XXIX) of 12 November 1974 (***the Registration Convention***); (5) The Agreement on the Activities of States on the Moon and other Celestial Bodies adopted by the General Assembly in its resolution 34/68 of 5 December 1979 (***the Moon Agreement***). Also commonly known as *corpus juris spatialis internationalis*.

22 Tracking, timing and network communications.

tinue to grow. Also, we need to consider other orbits in addition to GSO. Several constellations in low earth orbit are coming, some of them involving hundreds of satellites. We need to be able to operate all of them safely, without intereference not only with space systems but also with ground-based telecommunications systems,

With respect to the new and/or upcoming satellite projects – more than 700 to 4,000 satellites which is challenging from several perspectives, manufacturing, launching, how to ensure that they work together and do not interfere with each other? In order to do this, the satellite industry needs to evolve. Smaller satellites (i.e. 150-250 kg which cost US$ 500k or less) are reducing cost and bringing benefit to whole industry although space debris mitigation measures still need to be considered. As far as Mr. Henri is concerned, any STM concept needs to ensure safe operation in GSO or on any orbit and in order to achieve that, the protection of the radio frequency spectrum is paramount.

The next speaker to take the floor was Mr. **Guoyu Wang**[23] of the Beijing Institute of Technology and Chatham House, whose topic focused on "Space Traffic Management and the governance of space activities". Mr. Wong stated that governance of space activities (or ***GSA***) depends on several factors, including the type of system, timelines, and whether an STM regime is necessary and feasible for the governance, including any national regulatory rules. He indicated that the current challenges were: increasing congestion of space, space tourism take-off, space debris removal, moon exploration, and asteroid mining, and that STM is possible at both national and international levels. Mr. Wang stated that STM is conducive to the academic research of GSA. As a result, he informed the Subcommittee that he will be taking a question driven approach which is in the spirit of the purpose of the Symposium.

The main questions that Mr. Wang explored were: (1) What is a STM regime? and (2) Whether a STM regime is necessary and feasible for the governance of space activities at this stage? Concerning the first question, Mr. Wang addressed it by presenting sub-questions regarding whether an STM regime should be considered soft law, composed of technical standards, regulatory guidelines, code of conduct or a combination; or would it be considered hard law composed of regulatory rules only or extending to technical standards? In addition, another sub question regarding the nature of a STM regime was whether the vision of a STM regime is one for near term (within 10 years), medium (10-20 years) or long term (20 years or more)? Concerning the second question, Mr. Wang also approached it by asking two subquestions: (1) What are the technical, regulatory, legal and political implications and requirements of STM? And (2) what's the relationship and interaction between a STM regime and the existing GSA regime?

23 Currently writing a PhD at Chatham House.

Mr. Wang then presented the challenges to GSA which included: the stagnant status of the 5 governing Space Treaties, the rapid development of space technology and non-traditional commercial space activities such as 3d printing in space and asteroid mining, and the insufficiency of national regulatory frameworks to deal with those advancements.
When addressing the dimensions of GSA, Mr. Wang posed the question regarding whether governance is more appropriate on a national or international level. Mr. Wang followed up that question by referring to the reciprocity principle which holds that the state who bears responsibility for GSA is the one that has the right to govern its activities, thus the state might be more appropriate.
For the international level of governance, Mr. Wang inquired whether there is a relation between a STM regime and the existing international rules and standards. Moreover, he considered whether there is a gap between the rules and standards. Mr. Wang indicated a belief that these questions are important and should be discussed on each level to keep consistency and efficiency. Furthermore, Mr. Wang believes that the technical standards of GSA should be harmonized under one platform and one regime. He highlighted that there is a major gap between the technical and regulatory rules.
On the political level, Mr. Wang asked whether an international STM treaty should be established. He continued his question oriented approach by asking to which extent could such a regime be recognized, acceptable and applicable for the majority of space faring states and between space faring states and non-space faring states? He admitted that this is a difficult task to accomplish because it is a political issue. Mr. Wang concluded his presentation by stating that at this stage, it is not necessary or practical to establish a treaty-basis STM regime, due to the technical, legal or regulatory and political concerns. However, referencing the movie *Interstellar,* Mr. Wang suggested that a possible way forward for GSA is to build up a quintic element space by the strongest will of human being, which is already sanctified in OST: The principle of free exploration and use of outer space and for the benefits and in the interests of all mankind.
Following Mr Wang, Ms. **Simonetta di Pippo** and Mr. **Niklas Hedman** gave an overview of UNOOSA activities in the realm of STM over the last year. The Joint Symposium between ICAO and UNOOSA held in Montreal in March 2015 had been a great success with over 350 participants. The challenges and opportunities – i.e. more actors in the space arena – will impact implementation of legal instruments in the near future. Ms. di Pippo stated that the objective of the Symposium was to create for the first time a platform for dialogue among stakeholders of both the aviation and the space communities. This goal was clearly met, and the March Symposium focused on commercial space transportation, both orbital and suborbital flights.

As a result, ICAO and UNOOSA decided to host a follow-up symposium in 2016 and a third event in 2017. Ms. di Pippo reviewed the list of issues as follows:

- Interrelationship between developed and developing nations – space agendas are becoming more complex;
- Rapid progress needs to be dealt with by the Subcommittee and/or UNOOSA, i.e. confidence building measures and long term sustainability of outer space activities;
- Pillars of Symposium – i.e. space tools which are fundamental to development of human society/resources.

Ms. di Pippo then passed the floor to her colleague Mr. Hedman who gave an overview of the discussions at the March Symposium, i.e. a review of air /space law and implementation, two themes, uniting community and regulatory perspectives and a concluding session to integrate the two cohesively. Given that the commercial space sector is rapidly growing, from a regulatory perspective, the general observations and requirements of any new regulatory system were reliability, predictability and consistency.

In conclusion, Ms. di Pippo stated that the overall benefit had been to create a platform for discussion which had allowed the creation of a Learning Group (jointly led by ICAO and UNOOSA), which is responsible for the preparation of the next meetings.

Ms. Masson-Zwaan then introduced Ms. **Diane Howard** of Embry Riddle Aeronautical University who spoke on the topic of STM and the Roadmap to the Stars, which had been a two-day conference in 2014 hosted by Embry Riddle. Ms. Howard confirmed that all the papers presented at the conference were available on the Embry Riddle website.[24]

Addressing the 2014 Conference, Ms. Howard said that Embry Riddle made a suitable host because of its campus facilities, which include Commercial Space Operations, Air Traffic Management Meteorology, Aerospace Safety, and Physical Sciences and Space faculties. Ms. Howard laid out the objectives of the conference which was to: bring the space traffic roadmap into focus, identify surfacing issues in STM, provide leadership in planning, and facilitate agreement on the next steps.

The conference was unique in which it prioritized initiatives, legal and policy, and space weather in the roadmap sessions along a spectrum of high, mid, and low. In addition, the conference was unique because it was not US centric. Moreover, the panels at the conference were as follows: Air & Space Traffic Integration: Operational Perspectives, Air & Space Traffic Integration: Initiatives, Air & Space Traffic Integration: Legal & Policy Issues, Weather (space and otherwise [...]), Space Situational Awareness. In concluding, Ms. Howard

24 See http://commons.erau.edu/stm/2014/ for further information.

went on to expand on future work which included that the papers are to be made into a digital e-book; further research will be carried out; a new electronic interactive version of the roadmap will be developed; and finally she hopes to increase international participation. Next conference would take place on 11-13 November 2015 at Embry Riddle in Daytona, Florida.
Following the presentations, delegates and participants were invited to provide questions and observations to the panel participants and a lively debate ensued.
The Chair of the Legal Subcommittee concluded the session by noting that one question had not been posed, namely: *why IISL and ECSL were bothering with the STM topic?* Mr. Schrogl stated that the debate had demonstrated that STM was not a visionary topic but something that was already relevant today. He further remarked that even those who understand the basics of STM benefit from such presentations which were extremely enlightening, interesting and stimulating. He concluded by stating that the Subcommittee is going to have to think forward and decide what role it wishes to play in the future.

End of session.

All presentations can be found on the website of UNOOSA.[25]

25 See www.unoosa.org/oosa/en/ourwork/copuos/lsc/2015/symposium.html.