Focusing the Space Law Games: Overcoming Operational and Legal Barriers to Space Situational Awareness

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Over the last decade, there has been a significant increase in the orbital population. The licensing of a number of large constellations means that this is set to increase dramatically. A significant number of technical advances have facilitated this and, this has been matched by an increased policy focus on the need for increased space surveillance and tracking, culminating in 2018 for the USA, in Space Presidential Directive 3. The rise of mega-constellations and other innovations, such as active debris removal or on-orbit servicing procedures means ever more data of space is going to be needed to keep track of the increasing burden placed on the orbital environment. The provision of corroborated information which removes as much ambiguity as possible about the position of objects in orbit is crucial to both safe and sustainable satellite operations. Yet, despite this pressing need, there are considerable barriers that exist to obtaining a more complete picture of this information.

This paper will outline these problems in detail. It will be proposed that what is required is both codification of the norms for safe sustainable satellite operations and clarity on protocols for evidence gathering in cases where a collision has resulted in damage to a space asset and fault may be an issue. This discussion will identify that a way in which this could be achieved is by the use of "space law games", which will utilize established military wargaming methodology whereby complex fictional scenarios could highlight some of the key operational and legal issues that might need to be dealt with. Perla (1990: p.23) suggests the integration of realism and playability in a delicate balancing act designed to achieve a well-understood and well-chosen objective is a key. The paper will outline some of the ways in which the space law games might work and pose questions as to what data and other considerations will be needed to make such simulations meaningful. By identifying the data gaps in the fictional 'law game' scenario will help locate possible areas of enhancement in space surveillance and tracking capacity to support future SSA.

Such capacity will be crucial if on-orbit collisions result in economic loss and the raising of security concerns. Despite the aforementioned advances in operational technology, an area that has not seen development is in respect of the way in which satellite operators can prepare for litigation and gather evidential quality data that is probative of fault. The Outer Space Treaty 1967[1] places a tripartite layer of responsibility upon national governments; a launching state (not a private company) that is responsible for licensing and on-going supervision, has continued jurisdiction over the space object and is liable for any damage caused by a space object[2]. Under the Liability Convention 1972, this is broken down into two components. In respect of liability for any damage caused by a space object to any person or property on Earth, or an aircraft in flight, the launching state will be absolute, and courts will not look at responsibility. Of greater importance for satellite operators, where damage is caused by the space object of one nation state anywhere other than the surface of the Earth, any damage caused to the space object of another nation will be assessed on the basis of fault. The rise of LEO constellations coupled with the experimental nature of rendezvous and proximity operations (RPOs) means that

[1] The Treaty on Principles Governing the Activities of States in the Exploration Use of Outer Space, including the Moon and Other Celestial Bodies (known colloquially as the Outer Space Treaty 1967) was adopted by the General Assembly of the UN on 19 December 1966 by virtue of Resolution 2222 (XXI). It was opened for signature on 27 January 1967 and entered into force on 10 October 1967. It can be found here:
http://www.oosa.unvienna.org/pdf/publications/ST_SPACE_061Rev01E.pdf

[2] Article VI, Article VII and Article VIII respectively.

the chances of damage increases, and companies will increasingly resort to legal mechanisms to recover any potential loss incurred by damage. Article III of the Liability Convention means that any action in contemplation of legal proceedings will look at both norms of behaviour, deviation from which will point towards fault and the types and standard of evidence that will be required to prove that spacecraft A had, in fact, *caused* the damage to spacecraft B.

Given that the OST imposes responsibility upon states, it is to the States and the space active nations that we must look for the *lex specialis* in respect of their operating framework for space activities. Each nation with a space program will have, in some way, incorporated their responsibilities under the OST within their national law. These national laws, however, will provide only the first port of call when trying to establish fault. Obviously, a breach of national legislation or a failure to adhere to the terms of a licence issued by the launching state could leave an operator culpable. If no such obvious transgression is available, the following questions arise; (1) In the absence of any codes of conduct, best practice or industry standards for RPO, what rules should exist to minimize the risks of collision and what are the core roles and responsibilities of all space operators in avoiding such outcomes? (2) When a collision caused by an RPO cannot be avoided, what evidence is required to properly assign fault and (3) What information will be needed by the litigation team in order to successfully either prove or disprove fault.?

Whilst it might be possible to construct these rules and answer the questions in abstract, it is argued that a much better way to develop the rules is to see events develop by means of a simulation, role-play or war game. According to DCDC (2017) games are an integral part of all human cultures and are essential to learning. The use of wargaming methodology to simulate complex and contested events leading to uncertain outcomes is well established and the success of the wargame relies on the ability to challenge (DCDC, p19). Indeed, Paikowsky and Tzezana (2018), have suggested that such an approach can be used to simulate the response of nations to a successful space mining operation in the future. As they rightly identify;

> "*Roleplaying games are also of particular use when trying to forecast the impact and consequences of large changes. Experts have an advantage in understanding the results of small changes in their field of expertise, but they lose this benefit when confronted with major and disruptive changes that span many fields.*" (Paikowsky and Tzezana, 2018, p.13)

There are, however, a considerable number of different variables that need to be tested and little in the opportunity to experience this for real. Simulations will be central to the development of the space law games; at least for the generation of the incident that influences the 'desire for litigation'. Allen (1987, p.276) highlighted how the increased use of simulation hardware was spurred the interest in just how humans both acted and reacted to the strange world where "the unreal imitates the real". But in the situation of an event in space there are a number of different and often separate 'angles' to consider. There are the actions of the space operators both before, during and after an RPO-led collision. There is the collection of data by those on the ground, both connected to the operators and those responsible for the acquisition of data regarding the orbital population and developing space situational awareness. There is, essentially a requirement both for estimation of the amount of data that would be received, what gaps exist in that data and then a requirement to interpret that data for the purposes of any legal proceedings. It is apparent, therefore that in order to effectively role play a collision and the litigation arising from that, there would need to be two simulations; one regarding the event and furnishing the data, another litigating the matter based upon the data gathered and analyzed from the first simulation. These role plays will be independent but interconnected and will be conducted under the banner of the Space Law Games.

These 'Space Law Games' will not only draw upon the experience of the US military in predicting and role-playing critical conflicts in space but wider experiences across the international space community. Historically, wargames have had a "concrete effect on the military operations" (Prados, 1987, p.4) and the US Air Force Space Command Schriever War Games[3] have an established methodology that can be imported directly into the study. Usually, the scenario for the games involves the use of global scenarios which re-create conflict in the space

[3] See https://www.afspc.af.mil/News/Article-Display/Article/1349906/schriever-wargame-concludes/ for further details.

domain. The scenario cuts across military and civilian challenges and seeks to use existing capabilities to predict the actions of other actors within the space environment (AFSPC, 2017). As Paikowsky and Tzezana (2018) have identified, war-gaming has been used for centuries in trying to forecast the way in which complex events might unfold. Given that the template for such a simulation exists in the form of the Schriever War Games, it would seem a natural model for the simulation of an RPO event which could provide information on the type of data that might be available and the type of data that would be missing from a failed RPO mission.

Johnson-Freese (2017) identifies, the key lesson learned from successive Schriever war games is the danger of rapid escalation. It will therefore be of peripheral, yet significant benefit that a civilian focused war game may be able to project the information given from a non-hostile (i.e. non-wilful) but flawed RPO event and feed into military calculations about whether a collision in orbit is hostile or not; central to the establishment of SSA. Yet the data that could be gleaned from the simulation poses a crucial question about the location of the simulation. The nature of the RPO mission is likely be contingent upon the altitude of the spacecraft that are docking with each other. As Blount (2019) identifies, RPO missions in LEO are likely to be centred around the removal of debris from congested orbits, while GEO missions are likely to focus on extending the life of expensive space assets. Not only are these two missions, whilst falling under the umbrella of RPOs, very different in both execution and outcome but also there is considerable difference in the effects of the operating environment; not to mention the availability of object and environmental data from the ground systems. In all likelihood, to gain sufficient richness of data, it will be necessary to conduct two separate, independent simulations of RPO missions; an ADR mission in LEO and on-orbit servicing simulation in GEO. Additionally, considering the complexities of the RPO missions and likely outcomes of an incident on orbit, it is likely that a number of simulations will be needed over subsequent years.

Identifying the wargaming methodology for the first simulation, and the need for at least two distinct ‘games’ in different orbits is crucial as these will provide the data for the legal phase of the ‘Space Law Games’. Just as war-gaming is a well-established method of gathering data about decision-making in theatres of armed conflict, so law has its own tradition of role-playing. The legal moot is used extensively within law training; therefore, this seems a natural way to simulate the litigation needed for the second half of these games. The Moot is a role play which involves the posing of certain legal questions that need addressing. The role-play itself, however, is open-ended and such a simulation may produce conclusions which will surprise both the student and the adjudicator (Phillips, 2012). Given the total absence of litigation in this respect, the moot seems an ideal way in which to test the contours of fault within a courtroom setting using the data produced by the space war game. The rules for both the creation of the skeleton argument and the subsequent oral presentation are well defined and clearly understood by lawyers (Baskind, 2016).

This paper has outlined the legal vacuum that exists in respect of defining fault in space collisions. The discussion has identified that for all RPO missions, the lack of accepted operator practice means that in many circumstances it could be extremely difficult to establish fault. Whilst clear negligence or malpractice may be easy to identify, in the early years of on-orbit servicing, ADR and the operation of a very large constellation, the experimental nature of the ventures will make it extremely high risk and consequently difficult to establish clear identifiable operational duties which have been breached. There will undoubtedly be guidance issued for operators, through forums such as CONFERS and this may form the basis of establishing duties and roles but until such time as RPO missions become ubiquitous, the legal uncertainty surrounding the appropriate duties incumbent on both RPO operators and customers will mean that establishing fault in litigation will be extremely challenging.

The proposed Space Law Game will attempt to ameliorate some of that uncertainty by combining two recognised forms of open-ended simulations designed to be led by the data that emerges. It is hoped this will complement the discussions underway within the space industry and appropriate government agencies in respect of identifying best practice. However, the outcomes are only as good as the participants. DCDC (2017, p.25) highlight that “an uninformed, unqualified or overconfident wargame team is unlikely to add value and may be detrimental to the project”. The authors aim to involve as many of the international space community as feasibly possible to ensure every angle is explored. Each phase of the Space Law Game will yield valuable data and go some way towards

answering the key questions posed by this paper. The first 'on-orbit' phase will highlight the data that could and should be available to both operators and observers, possibly highlighting the gaps and illustrating what additional tracking capacity is needed that is not already available. The legal moot phase will take that data and identify the duties owed at each stage of satellite operations. This will highlight the kinds of evidence that will be admitted, the scrutiny and weight that can be placed on that evidence. It will also be used to draw together the contours of liability to give operators *some* indication of how a collision in LEO or GEO will proceed should the case go to court. The Space Law Games represent an ambitious attempt to use a variety of simulations and methodologies to close one of the biggest gaps in extant space law and governance.

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