Open-ended working group on reducing space threats through norms, rules and principles of responsible behaviours

Topic 2: Current and future earth-to-space threats by States to space systems

Geneva, Tuesday, September 13, 2022

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Excellencies, Permanent Representatives, Colleagues, Ladies and Gentlemen.

It is a great honour for me to address you. Thank you for your kind invitation. My name is Laetitia Cesari Zarkan, and I am a researcher in space security for UNIDIR, the United Nations Institute for Disarmament Research.

As such, I am responsible for addressing in this panel the current and future threats from Earth to space that States pose to space systems.

I will focus on non-kinetic threats, particularly electromagnetic, cyber and intentional non-kinetic physical interference.

First, I will discuss the impacts that intentional non-kinetic interference can have on the operations of space systems. Secondly, I will discuss the main challenges related to the attribution of these interferences. Finally, in the third part, I will outline some ideas on how these interferences can be mitigated.

Introduction

In order to put the topic of intentional non-kinetic interference into perspective within the framework of space security, I will start by asking the following question: what is harmful interference? It is the interference which damages its direct target, degrading its use. It is also one that potentially causes collateral damage to other objects or systems beyond its initial objective. Finally, it is that which is detrimental to the targeted operator and to all victims, whether or not the interference directly targeted them.

Harmful interference is not explicitly prohibited by the 1967 Outer Space Treaty, which only establishes, in Article IX, the obligation for States to engage in appropriate international consultations before undertaking any activity or experiment that may cause harmful interference with the activities of other States Parties to the Treaty. The other States may also request consultations if they have "reason to believe that an activity or experiment in outer space planned by another State would interfere with activities in the peaceful exploration and use of outer space," either before or during the execution of the space activity.

The Space Treaty does not define "harmful interference," but the International Telecommunication Union (ITU) defines it, both in No. 1.169 of the Radio Regulations and in No. 1003 of its Constitution, as "interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with Radio Regulations."

As reported in the UNIDIR working paper entitled “Threats to the security of space activities and systems” presented yesterday afternoon by my colleague Almudena Azcárate Ortega, “while the ITU definition of harmful interference centres around the disruption of radiofrequency signals, the OST’s reference to the same concept is often considered to be broader, and not limited to radiofrequency interference, but rather the creation of a situation where non-kinetic harm to space systems or the services they provide is caused. In this sense, "harmful interference" as established in the OST is closely related to the duty of States to have due regard for the space activities of others.” This notion of “due regard” was introduced by Professor Setsuko Aoki at the first session of this Open-Ended Working Group last May.

Some States, therefore, use the term “harmful interference” in this broad sense to highlight the threat posed by non-kinetic counter-space technologies.

Today, because of the importance of objects beyond our Earth's atmosphere, the disruption of a space system, especially when caused by intentional non-kinetic electromagnetic, cyber or non-kinetic physical interference, can have far-reaching consequences and dangerously compromise the vital civil, economic and military functions on which societies depend, particularly with regard to the humanitarian, financial and commercial sectors.

Why focus on this type of interference? Firstly, because the interconnection of space systems with terrestrial infrastructures is expected to grow rapidly and continuously. This has the potential to cause large-scale service interruptions with negative consequences extending far

beyond a country's territorial borders. Secondly, because of the speed with which new technologies are developed.

When misused, space operators need not only to have an adequate defence in place but also to identify the most vulnerable points in their systems to protect them and to deploy resilient systems that can be up and running again in the shortest possible time. Planning these security measures to reduce threats and cope with interference requires a significant investment by space operators.

Impact of intentional interference on space system operations

Here, three types of intentional interference against space system operations will be analysed: electromagnetic interference, cyber interference and non-kinetic physical interference.

The first is interference with radio communications caused by the creation of 'noise' in the same frequency band. This type of technology can target the electromagnetic spectrum used by space systems to transmit and receive data, and cause harmful interference. These technologies, also known as jamming, generate noise in the same radio frequency band as a space system in order to block or interfere with the signal travelling from Earth to a satellite (uplink) or from a satellite to Earth (downlink). Spoofing, on the other hand, is used to trick the system into believing a false signal has been generated by an attacker, allowing the attacker to surreptitiously introduce false information into the system, including, for example, false data or instructions sent to the controls that may disrupt its operation or cause one of the components of a space system to act in a manner different from that intended. Interference using these technologies is usually reversible but difficult to attribute.

It should be noted that navigation satellites have proven to be particularly vulnerable to interference. This type of navigation technology can be considered a prime target for interference as it is essential for certain military and economic activities, such as maritime, air or land transport, as well as for time synchronisation of certain equipment or infrastructure.

The second type of intentional interference has emerged due to the important role of computer systems and the inclusion of cyber technologies on board satellites and space networks. In addition, now that equipment on land, at sea and in the air is remotely connected to networks operated for military purposes, cyberspace has been conceptualised as a "domain of operations," giving it an underlying military nature.

These technologies can target the data itself and the systems that use, transmit and control the flow of that data. Cyber interference can target satellites as well as ground stations or even the network components that connect to the end user. While this type of interference is generally reversible, it can have a significant impact radius that has the potential to affect critical infrastructure. Interference that targets a satellite's command and control system could render it irreversibly inoperable, as the attacker could cause the satellite to stop manoeuvring permanently. Similarly, if the technologies or sensors on board the satellite are damaged, the entire space activity may be compromised. Generally, cyber interference does not require significant resources and is very difficult to predict, detect and attribute.

The particularity of the third type of intentional interference, non-kinetic physical interference, is that its effects on satellites are material and concrete without making direct contact. They include lasers, high-power microwaves (HPM) and electromagnetic pulses (EMP). These technologies can blind and dazzle sensors or damage a satellite's electrical circuits and processors. Non-kinetic physical interference operates at the speed of light and, in some cases, may be less visible to third-party observers and also more difficult to attribute.

In the context of space security, addressing this issue is important. For example, intentional interference that compromises the confidentiality, integrity and availability of data passing through a satellite, interferes with the telemetry, remote control and monitoring of space systems or damages its electronic components can be very problematic. Any malfunction of the services provided by the payloads on board a space object, or its manoeuvrability beyond our Earth's atmosphere, may jeopardise the operation and very *raison d'être* of the space system, without the certainty of being able to resolve the problem remotely. In this case, the space system may become inoperable and thus possibly prematurely enter the category of space debris.

If it is a single object, the resulting risk of collision is low. However, if the system is a constellation composed of a multitude of low-orbiting assets, the stakes are quite different and the sustainability of space activities may be affected.

Other difficulties related to non-kinetic interference are the identification and localisation of its sources in order to be able to attribute it.

Attribution challenges

Attribution is the process of identifying the source of an incident caused by intentional harmful interference to a system and involves determining its geographic origin and its instigator.

It poses two major challenges, which, although distinct, are closely related: a technical challenge and a legal challenge.

The first involves analysing the technical aspects of interference, which may include the location of the energy source used for jamming, malware signatures, the procedures employed and network traffic analysis.

The legal challenge refers to the international responsibility of a State based on its own activities or those of related non-governmental entities, which interfere with certain space activities or systems, regardless of who the stakeholders or operators are. Depending on the type of actor involved, discerning who is really behind the interference may be more or less obvious. While identifying State bodies seems less difficult, identifying non-State actors or entities that have been de facto 'elevated' to State agents or bodies may be considered arbitrary. The same applies to entities effectively controlled or directed by a State. Concerning harmful interference targeting space systems, jumping to conclusions about the source or origin of intentional interference poses many risks to inter-State relations.

Considerations for interference mitigation

Mitigating intentional interference and limiting its impact and scope when directed at space systems depends primarily on State initiatives.

At the national level, States can adopt laws and policies to control malicious behaviour and encourage private operators to put in place effective safety and security measures to prevent such harmful interference. National regulatory measures already exist in some States and in this respect, I invite you to consult certain tools made available by UNIDIR, such as the Cyber Policy Portal, as well as the future Space Security Portal, which will be operational very soon.

At the level of the international community, States could work together to improve the effectiveness of transparency and mutual trust measures, in particular by meeting at the regional level, as was the case this year in the context of the events organised by the Republic of Korea, whose report you will find on the UNIDIR website, and more recently by the Republic of Chile.

In addition, States can agree on common definitions. This type of undertaking could be facilitated by the Space Security Lexicon, which UNIDIR will be presenting in the near future.

In conclusion, I have outlined the main, in other words, the most worrying impacts that intentional electromagnetic, cyber and non-kinetic physical interference can have on the operations of satellites and space objects, and then I have outlined some of the challenges related to the attribution of these acts and finally, some avenues of reflection to mitigate the negative effects that such interference can cause.

On these points, Excellencies, Permanent Representatives, Colleagues, Ladies and Gentlemen, it is important that there be a more in-depth discussion in the future, as the success of this important endeavour of reducing space threats through norms, rules and principles of responsible behaviour depends on it.

The special nature of outer space means that States will increasingly have to seek to act together and cooperate for the safety and security of all, which will ultimately lead to the sustainability of space activities. In this context, you may rest assured, Excellencies, Ladies and Gentlemen, that you will find in UNIDIR the expertise, reliability and availability necessary for the smooth running of discussions, whenever you need it.

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